ARYABHATTA KNOWLEDGE UNIVERSITY

Patna, Bihar

Bachelor of Technology (B.Tech.) Program

INCLUDES

- **Program**
- **Course Structure**
- **Detailed Syllabus**

CONTENTS

02 1x39	INDUSTRIAL ENGINEERING & MANAGEMENT	136
02 1x40	PROJECT	136

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

The Syllabus Of Electrical And Electronics Engineering Will Be Same As The Syllabus Of Electrical Engineering, But Electives May Be Chosen From Both Streams – Electrical Engineering And Electronics Engineering For Earning Required Credit For Obtaining The B.Tech Degree In ***Electrical & Electronics, And Communication Engineering.***

DEPARTMENT OF LEATHER TECHNOLOGY

07 1x01	THEORY & PRACTICES OF PRESERVATION AND PRE TANNING PROCESSES
07 1x02	INTRODUCTION TO LEATHER TECHNOLOGY
07 1x03	BIOCHEMISTRY OF PROTEIN
07 1x04	CHEMICAL ENGINEERING – I
07 1x05	CHEMICAL ENGINEERING – II
07 1x06	PRINCIPLES OF INORGANIC TANNAGE
07 1x07	PRINCIPLES OF ORGANIC TANNAGE
07 1x08	PRACTICES OF LEATHER MANUFACTURING – I
07 1x09	ANALYTICAL CHEMISTRY OF LEATHER
07 1x10	PRINCIPLES OF POST TANNING OPERATION
07 1x11	LEATHER BIO-TECHNOLOGY
07 1x12	LEATHER PRODUCT TECHNOLOGY- I
07 1x13	PRINCIPLES OF MATERIAL TESTING
07 1x14	CHEMICAL ENGINEERING –III
07 1x15	LEATHER FINISHING MATERIALS AND AUXILIARIES
07 1x16	ELECTIVES –I
07 1x17	PRACTICES OF LEATHER MANUFACTURING -II
07 1x18	THEORY OF LEATHER SUPPLEMENTS & SYNTHETICS
07 1x19	INSTRUMENTATION AND PROCESS CONTROL
07 1x20	LEATHER PRODUCT TECHNOLOGY-II
07 1x21	ELECTIVE –II
07 1x22	ELECTIVE –III
07 1x23	TANNERY WASTE MANAGEMENT
07 1x24	PRACTICES OF LEATHER MANUFACTURING –III
07 1x25	LEATHER PRODUCT TECHNOLOGY –III
07 1x26	PROJECT WORK

PRACTICALS

Eight experiments based on the theory papers in the relevant semesters.

ELECTIVE – I

07 1x16	ANIMAL AND TANNERY BY PRODUCT UTILIZATION. (LTE 1.1)
07 1x16	POLYMER SCIENCE & TECHNOLOGY. (LTE 1.2)
07 1x16	CO-ORDINATION CHEMISTRY. (LTE 1.3)
07 1x16	ORGANIC CHEMISTRY. (LTE 1.4)

ELECTIVE –II

07 1x21 FASHION STYLING AND COMPUTER ADDED DESIGN OF LEATHER PRODUCT. (LTE 2.5)

07 1x21 ADVANCE LEATHER PROCESS TECHNOLOGY. (LTE 2.6)

07 1x21 APPLIED STATISTICS & QUALITY CONTROL. (LTE 2.7)

07 1x21 SURFACE AND COLLOID CHEMISTRY (LTE 2.8)

ELECTIVE – III

07 1x22 COMPUTER APPLICATION IN LEATHER TECHNOLOGY. (LTE 3.9)
07 1x22 PROFESSIONAL ETHICS. (LTE 3.10)

07 1x22 ENTREPRENEURSHIP. (LTE 3.11)

07 1x22 TOTAL QUALITY MANAGEMENT. (LTE 3.12)

DEPARTMENT PHARMACEUTICAL SCIENCE

09 1101 PHARMACEUTICS - I (PHYSICAL PHARMACY)
09 1102 PHARMACEUTICAL ANALYSIS – I
09 1103 PHARMACEUTICAL CHEMISTRY – I (INORGANIC PHARMACEUTICAL CHEMISTRY)
09 1104 PHARMACOGNOSY - I
09 1105 COMMUNICATIVE ENGLISH
09 1106 REMEDIAL MATHEMATICS
09 1107 REMEDIAL BIOLOGY
09 1201 PHARMACEUTICS - II (UNIT OPERATIONS I, INCLUDING ENGG. DRAWING)
09 1202 PHARMACEUTICAL CHEMISTRY – II (PHYSICAL CHEMISTRY)
09 1203 PHARMACEUTICAL CHEMISTRY – III (ORGANIC CHEMISTRY)
09 1204 ANATOMY, PHYSIOLOGY & HEALTH EDUCATION (APHE) – I
09 1205 ADVANCED MATHEMATICS
09 1301 PHARMACEUTICS - III (UNIT OPERATIONS II)
09 1302 PHARMACEUTICAL CHEMISTRY – IV (ORGANIC CHEMISTRY - II)
09 1303 PHARMACOGNOSY – II
09 1304 PHARMACEUTICAL ANALYSIS – II
09 1305 ANATOMY, PHYSIOLOGY & HEALTH EDUCATION (APHE) – II
09 1401 PHARMACEUTICS - IV (DISPENSING AND COMMUNITY PHARMACY)
09 1402 PHARMACEUTICAL MICROBOLOGY
09 1403 PHARMACOGNOSY – III
09 1404 PATHOPHYSIOLOGY OF COMMON DISEASES
09 1405 BASIC ELECTRONICS AND COMPUTER APPLICATIONS
09 1406 PHARMACEUTICAL JURISPRUDENCE & ETHICS
09 1501 PHARMACEUTICS - V (PHARMACEUTICAL TECHNOLOGY - I)
09 1502 PHARMACEUTICAL CHEMISTRY – V (BIOCHEMISTRY)
09 1503 PHARMACOLOGY – I
09 1504 PHARMACOGNOSY – IV
09 1505 PHARMACEUTICS-VI (HOSPITAL PHARMACY)
09 1601 PHARMACEUTICS-VI (BIOPHARMACEUTICS & PHARMACOKINETICS)
09 1602 PHARMACEUTICAL CHEMISTRY – VI (MEDICINAL CHEMISTRY - I)
09 1603 PHARMACOGNOSY – V (CHEMISTRY OF NATURAL PRODUCTS)
09 1604 PHARMACOLOGY – II
09 1605 PHARMACEUTICAL ANALYSIS – III
09 1701 PHARMACEUTICS – VIII (PHARMACEUTICAL TECHNOLOGY II)
09 1702 PHARMACOLOGY – III
09 1703 PHARMACEUTICAL CHEMISTRY – VII (MEDICINAL CHEMISTRY - II)
09 1704 PHARMACEUTICAL BIOTECHNOLOGY
09 1705 PHARMACEUTICAL INDUSTRIAL MANAGEMENT
09 1706 ELECTIVE THEORY
09 1801 PHARMACEUTICS – IX (DOSAGE FORM DESIGN)
09 1802 PHARMACEUTICAL CHEMISTRY – VIII (MEDICINAL CHEMISTRY - III)
09 1803 PHARMACOGNOSY – VI
09 1804 PHARMACOLOGY – IV
09 1805 PROJECT WORK AND VIVA – VOCE

PRACTICALS

Eight experiments based on the theory papers in the relevant semesters.

ELECTIVES THEORY AND PRACTICAL

09 17E1	COSMETIC TECHNOLOGY
09 17E2	HERBAL DRUG TECHNOLOGY
09 17E3	BIOASSAYS
09 17E4	HOSPITAL PHARMACY ADMINISTRATION
09 17E5	ADVANCED PHARMACEUTICAL ANALYSIS

DEPARTMENT DAIRY TECHNOLOGY

COURSE CODE

All the courses offered are denoted by codes comprising of two letters except EEE and four digits. The department code will be followed by four digit number to represent course / subject being offered in a semester. The department subject code i.e., last two digits will be same for subject/course being offered in different semesters to different branch of students and have some course content for the subject.

The letter symbols of the departments are as follows:

CE	-	Civil Engineering
CH	-	Chemistry
CS	-	Computer Science & Engineering
DT	-	Dairy Technology
EC	-	Electronics and Communication Engineering
EE	-	Electrical Engineering
EEE	-	Electrical & Electronics Engineering
HS	-	Humanities and Social Sciences
IT	-	Information Technology
LT	-	Leather Technology
MA	-	Mathematics
ME	-	Mechanical Engineering
PH	-	Physics
PY	-	Pharmacy

<table>
<tr><td>1</td><td colspan="2">2</td><td>3</td></tr>
<tr><td>Program code:
UG Program:1
PG Program:2</td><td colspan="2">Semester code (If programs have more than nine semesters then 10th to 16th semesters will be coded in hexadecimal i.e., A to F)</td><td>Department Subject code:
From 00 to 99
A course offered by any department to other department/Branch Students in different semester with Same syllabus content will have a unique subject code only.</td></tr>
<tr><td></td><td>1st Sem
2nd Sem
3rd Sem
4th Sem
5th Sem
6th Sem
7th Sem
8th Sem
9th Sem
10th Sem</td><td>1
2
3
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5
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9
A</td><td></td></tr>
<tr><td colspan="4">Theory and Practical/ Sessional/ Project components have been separated & P is added in the end.</td></tr>
<tr><td><u>M. Tech Prog</u>1st Sem, 2nd Sem, 3rd Sem, 4th Sem</td><td colspan="3">(1,2,3,4)</td></tr>
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Note :

- Group A: Civil Engineering and Mechanical Engineering.
- Group B : Electronics and Communication Engineering, Electrical Engineering, Electrical & Electronics Engineering, Computer Science and Engineering, Leather Technology & Information Technology
- First and Second Semester subjects have been divided in two groups: Group A and Group B. If a Set of student of a branch is offered Group A in First Semester then this set of students will be offered Group B in Second Semester; likewise, if a set of students of another branch offered Group B in First Semester then they will be offered Group A in Second Semester.
- In course code Column 'X' represents semester code- to be substituted by the Department based on subject being offered either in First or Second Semester.
- In Bachelor of Pharmacy, and in Bachelor of Dairy Technology, the entire semester Course will be different and listed separately.

B. Tech. SEMESTER-I

Sr. No	Course Code	Subject	L-T-P	Credits
1	24 1x05	Communicative English (Group A)	3-1-0	4
	01 1x02	Environmental Science (Group B)	3-0-3	5
2	21 1x01	Mathematics-1	3-1-0	4
3	22 1x01	Physics (Group A)	3-0-3	5
	23 1x01	Engineering Chemistry (Group B)	3-0-3	5
4	03 1x01	Basic Electrical Engineering (Group A)	3-0-3	5
	01 1x01	Engineering Mechanics (Group B)	3-0-3	5
5	061x01	Fundamentals of information Technology(Group A)	3-0-2	4
	021x01	Elements of Mech. Engineering (Group B)	3-0-2	4
6	021x02	Engineering Graphics (Group A)	2-0-4	5
	021x03	Workshop (Group B)	0-0-6	4
7	GE 1x01	EAA-I-NSS		
		TOTAL :-	**16-2-16**	**27**

B. Tech. SEMESTER-II

Sr. No	Course Code	Subject	L-T-P	Credits
1	24 1x05	Communicative English (Group B)	3-0-0	3
	01 1x02	Environmental Science (group A)	3-0-3	5
2	21 1x01	Mathematics –II	3-1-0	4
3	22 1x01	Physics (Group B)	3-0-3	5
	23 1x01	Engineering Chemistry (Group A)	3-0-3	5
4	03 1x01	Basic Electrical engineering (Group B)	3-0-3	5
	01 1x01	Engineering Mechanics (Group A)	3-0-3	5
5	06 1x01	Fundamentals of information technology (group B)	3-0-2	4
	02 1x01	Elements of Mech. engineering (Group A)	3-0-2	4
6	02 1x02	Engineering graphics (Group B)	2-0-4	5
	02 1x03	workshop (Group A)	0-0-6	4
7	GE 1x01	EAA- II-NSS		
		TOTAL :-	**16-1-16**	**26**

COURSE STRUCTURE FOR B. TECH. PROGRAM
BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING

B.Tech.(Civil Engg.) SEMESTER-I								
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
CEUG	1	24 1x05	COMMUNICATIVE ENGLISH	3	1	0	4	
CEUG	1	22 1101	PHYSICS	3	0	3	5	
CEUG	1	21 1x01	MATHEMATICS- I	3	1	0	4	
CEUG	1	03 1x01	BASIC ELECTRICAL ENGINEERING	3	0	3	5	
CEUG	1	06 1x01	FUNDAMENTALS OF INFORMATION TECHNOLOGY	3	0	2	4	
CEUG	1	02 1x02	ENGINEERING GRAPHICS	2	0	4	5	
CEUG	1	GE 1x01	EAA-I-NSS					27
B.Tech.(Civil. Engg.) SEMESTER- II								
CEUG	2	01 1x02	ENVIRONMENTAL SCIENCE	3	0	3	5	
CEUG	2	23 1x01	ENGINEERING CHEMISTRY	3	0	3	5	
CEUG	2	21 1x02	MATHEMATICS II	3	1	0	4	
CEUG	2	01 1x01	ENGINEERING MECHANICS	3	0	3	5	
CEUG	2	02 1x01	ELEMENTS OF MECHANICAL ENGINEERING	3	0	2	4	
CEUG	2	02 1x03	WORKSHOP	0	0	6	4	
CEUG	2	GE 1x02	EAA-II-NSS					27
B. Tech (Civil Engg.) Semester – III								
CEUG	3	24 1x01	ORGANIZATIONAL BEHAVIOUR AND INDUSTRIAL PSYCHOLOGY	3	0	0	3	
CEUG	3	01 1x03	BUILDING SCIENCE	3	0	3	5	
CEUG	3	01 1x05	ENGINEERING GEOLOGY	3	0	2	4	
CEUG	3	01 1x07	FLUID MECHANICS	3	1	2	5	
CEUG	3	01 1x14	CIVIL ENGINEERING DRAWING	0	0	3	2	
CEUG	3	24 1x06	INDUSTRIAL ECONOMICS & ACCOUNTANCY	3	1	0	4	
CEUG	3	21 1x03	MATHEMATICS - III	3	1	0	4	
CEUG	3	GE 1x03	EAA III-NSS					27
B. Tech (Civil Engg.) Semester – IV								
CEUG	4	01 1x04	FIELD MEASUREMENT (SURVEYING)	3	0	3	5	
CEUG	4	01 1x06	MECHANICS OF SOLID – I	3	1	2	5	
CEUG	4	01 1x10	HYDRAULICS AND OPEN CHANNEL FLOW	3	0	0	3	
CEUG	4	05 1x01	OBJECT ORIENTED	3	0	3	5	

			PROGRAMMING					
CEUG	4	21 1x04	NUMERICAL METHODS AND COMPUTATIONAL TECHNIQUE	3	0	3	5	
CEUG	4	02 1x07	THERMODYNAMICS	3	1	0	4	
CEUG	4	GE 1x04	EAA -IV-NSS					27

B. Tech (Civil Engg.) Semester – V

Program	Semester	Course code	Course title	L	T	P	Credits	Total Credit/ Sem.
CEUG	5	01 1x08	ADVANCED SURVEYING	3	0	3	5	
CEUG	5	01 1x09	SOIL MECHANICS	3	0	3	5	
CEUG	5	01 1x11	STRUCTURAL ANALYSIS-I	3	1	0	4	
CEUG	5	01 1x12	ENGINEERING HYDROLOGY	3	0	2	4	
CEUG	5	01 1x13	MECHANICS OF SOLID –II	3	0	0	3	
CEUG	5	02 1x10	FLUID MACHINERY	3	0	3	5	26
B. Tech (Civil Engg.) Semester – VI								
CEUG	6	01 1x15	SOIL AND ROCK MECHANICS	3	0	3	5	
CEUG	6	01 1x16	STRUCTURAL ANALYSIS –II	3	0	0	3	
CEUG	6	01 1x17	DESIGN OF CONCRETE STRUCTURE-I	3	0	3	5	
CEUG	6	01 1x18	ENVIRONMENTAL ENGINEERING-I	3	0	3	5	
CEUG	6	01 1x19	TRANSPORTATION ENGINEERING-I	3	0	3	5	
CEUG	6	01 1x20	DESIGN OF STEEL STRUCTURES	2	0	3	4	27
B. Tech (Civil Engg.) Semester – VII								
CEUG	7	01 1x26	DESIGN OF CONCRETE STRUCTURE - II	3	0	3	5	
CEUG	7	01 1x25	DESIGN OF HYDRAULIC STRUCTURES	3	0	3	5	
CEUG	7	01 1xxx	ELECTIVE-I	3	0	0	3	
CEUG	7	01 1x23	ENVIRONMENTAL ENGINEERING -II	3	0	0	3	
CEUG	7	01 1x22	FOUNDATION ENGINEERING	3	0	0	3	
CEUG	7	01 1x24	TRANSPORTATION ENGINEERING-II	3	0	0	3	
CEUG	7	01 1x29	PROJECT-I	0	0	5	3	
CEUG	7	01 1x21	CIVIL ENGINEERING PROFESSION &PRACTICE OR VOCATIONAL TRAINING(DURING SUMMER FOR 4 WEEKS AFTER 6TH SEMESTER	0	0	3	2	27
B. Tech (Civil Engg.) Semester – VIII								
Program	**Semester**	**Course**	**Course title**	**L**	**T**	**P**	**Credits**	**TotalCredit/**

		code						Sem.	
CEUG	8	01 1x27	CONSTRUCTION PLANNING AND MANAGEMENT	3	0	0	3		
CEUG	8	01 1x28	CONTRACT, SPECIFICATION &ESTIMATION	0	0	3	2		
CEUG	8	01 1xxx	ELECTIVE – II	3	0	0	3		
CEUG	8	01 1xxx	ELECTIVE -III	3	0	0	3		
CEUG	8	01 1xxx	ELECTIVE - IV	3	0	0	3		
CEUG	8	01 1x52	IRRIGATION ENGINEERING	3	0	0	3		
CEUG	8	011x29	PROJECT-II(IN CONTINUATION OF 7TH SEM. PROJECT	0	0	15	10	27	
B.Tech.(civil engg.) Elective – I									
CEUG	EL 1	01 1x51	FINITE ELEMENT METHODS	3	0	0	3		
CEUG	EL 1	01 1x53	COMPUTER AIDED DESIGN	3	0	0	3		
CEUG	EL 1	01 1x54	WATER AND LAND MANAGEMENT	3	0	0	3		
CEUG	EL 1	01 1x55	AIR POLLUTION ENGINEERING	3	0	0	3		
CEUG	EL 1	01 1x56	DESIGN OF STEEL STRUCTURE -II	3	0	0	3		
CEUG	EL 1	01 1x60	SOLID WASTE MANAGEMENT	3	0	0	3		
CEUG	EL 1	01 1x61	TRAFFIC ENGINEERING	3	0	0	3		
CEUG	EL 1	01 1x62	INTRODUCTION TO EARTHQUAKE RESISTANT DESIGN METHODS	3	0	0	3		
CEUG	EL 1	01 1x87	ADVANCED SOIL MECHANICS	3	0	0	3		
CEUG	EL 1	01 1x88	ADVANCED STRUCTURAL ANALYSIS	3	0	0	3		
B. Tech (Civil Engg.) Elective – II									
CEUG	EL 2	01 1x59	STRUCTURAL DYNAMICS	3	0	0	3		
CEUG	EL 2	01 1x52	GEOGRAPHICAL INFORMATION SYSTEM AND REMOTE SENSING	3	0	0	3		
CEUG	EL 2	01 1x57	RIVER HYDRAULICS AND SEDIMENT TRANSPORT	3	0	0	3		
CEUG	EL 2	01 1x58	CIVIL ENGINEERING DRAWING USING AUTO CAD	3	0	0	3		
CEUG	EL 2	01 1x76	ADVANCED FOUNDATION ENGINEERING	3	0	0	3		
CEUG	EL 2	01 1x86	GROUND WATER ENGINEERING	3	0	0	3		
CEUG	EL 2	01 1x56	AIRPORT PLANNING	3	0	0	3		

			AND DESIGN					
B. Tech (Civil Engg.) Elective – III								
CEUG	EL 3	01 1x71	DESIGN OF WATER RETAINING, PLATE AND SHELL STRUCTURES	3	0	0	3	
CEUG	EL 3	01 1x72	INDUSTRIAL WASTE TREATMENT	3	0	0	3	
CEUG	EL 3	01 1x73	TRANSPORTATION SYSTEMS AND PLANNING	3	0	0	3	
CEUG	EL 3	01 1x74	WATER RESOURCES PLANNING AND MANAGEMENT	3	0	0	3	
CEUG	EL 3	01 1x75	SOIL DYNAMICS	3	0	0	3	
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
B. Tech (Civil Engg.) Elective – IV								
CEUG	EL 4	01 1x77	WATER POWER ENGINEERING	3	0	0	3	
CEUG	EL 4	01 1x78	BRIDGE ENGINEERING	3	0	0	3	
CEUG	EL 4	01 1x79	SYSTEM ENGINEERING	3	0	0	3	
CEUG	EL 4	01 1x80	ENVIRONMENTAL IMPACT ASSESSMENT	3	0	0	3	
CEUG	EL 4	01 1x81	PR-STRESSED CONCRETE DESIGN	3	0	0	3	
CEUG	EL 4	01 1x82	DESIGN OF DAMS	3	0	0	3	
CEUG	EL 4	01 1x85	FLOOD &DROUGHTS	3	0	0	3	
CEUG	EL 4	01 1x89	DISASTER MANAGEMENT AND MITIGATION	3	0	0	3	
BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING								
B.TECH. (Mech Engg.) SEMESTER-I								
MEUG	1	24 1x05	COMMUNICATIVE ENGLISH	3	1	0	4	
MEUG	1	22 1x01	PHYSICS	3	0	3	5	
MEUG	1	21 1x01	MATHEMATICS	3	1	0	4	
MEUG	1	03 1x01	BASIC ELECTRICAL ENGINEERING	3	0	3	5	
MEUG	1	06 1x01	FUNDAMENTAL OF INFORMATION TECHNOLOGY	3	0	2	4	
MEUG	1	02 1x02	ENGINEERING GRAPHICS	2	0	4	5	
MEUG	1	GE1x01	EAA- I- NSS					27
B.TECH. (Mech Engg.) SEMESTER-II								
MEUG	2	011x02	ENVIRONMENTAL SCIENCE	3	0	3	5	
MEUG	2	23 1x01	ENGINEERING CHEMISTRY	3	0	3	5	
MEUG	2	21 1x02	MATHEMATICS-II	3	1	0	4	
MEUG	2	01 1x01	ENGINEERING MECHANICS	3	0	3	5	
MEUG	2	02 1x01	ELEMENTS OF MECHANICAL ENGINEERING	3	0	2	4	

MEUG	2	02 1x03	WORKSHOP	0	0	6	4	
MEUG	2	GE 1x02	EAA- II- NSS					27
B.TECH. (Mech Engg.) SEMESTER-III								
MEUG	3	24 1x01	ORGANIZATIONAL BEHAVIOUR AND INDUSTRIAL PSYCHOLOGY	3	0	0	3	
MEUG	3	01 1x07	FLUID MECHANICS	3	1	2	5	
MEUG	3	02 1x05	MATERIAL SCIENCE	3	1	0	4	
MEUG	3	211x03	MATHEMATICS-III	3	1	0	4	
MEUG	3	02 1x06	STRENGTH OF MATERIAL	3	0	3	5	
MEUG	3	02 1x07	THERMODYNAMICS	3	1	0	4	
MEUG	3	GE 1x03	EAA-III-NSS					25
B.TECH. (Mech Engg.) SEMESTER-IV								
MEUG	4	04 1x01	BASIC ELECTRONIC	3	0	3	5	
MEUG	4	05 1x01	OBJECT ORIENTED PROGRAMMING	3	0	3	5	
MEUG	4	21 1x04	NUMERICAL METHODS AND COMPUTATIONAL TECHNIQUE	3	0	3	5	
MEUG	4	02 1x08	KINEMATICS OF MACHINERY	3	1	0	4	
MEUG	4	02 1x09	MANUFACTURING BY SHAPING AND JOINING	3	0	3	5	
MEUG	4	02 1x11	MACHINE DRAWING	1	0	3	3	
MEUG	4	GE 1x04	EAA-IV-NSS					27
B.TECH. (Mech Engg.) SEMESTER-V								
MEUG	5	24 1x02	PERSONAL MANAGEMENT AND INDUSTRIAL RELATION	3	0	0	3	
MEUG	5	06 1x05	INFORMATION SECURITY	3	0	0	3	
MEUG	5	02 1x10	FLUID MACHINERY	3	0	3	5	
MEUG	5	02 1x12	STEAM POWER SYSTEM	3	0	3	5	
MEUG	5	02 1x13	DYNAMICS OF MACHINERY	3	0	3	5	
MEUG	5	02 1x14	MACHINE TOOLS AND MACHINERY	3	1	0	4	25
B.TECH. (MECH ENGG.) SEMESTER-VI								
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
MEUG	6	02 1x16	HEAT AND MASS TRANSFER	3	0	3	5	
MEUG	6	02 1x17	NON CONVENTIONAL MANUFACTURING	3	1	0	4	
MEUG	6	02 1x18	COMPETITIVE MANUFACTURING STRATEGIES	3	1	0	4	
MEUG	6	02 1x19	INSTRUMENTATION AND MEASUREMENT	3	1	0	4	

MEUG	6	24 1x06	INDUSTRIAL ECONOMICS AND ACCOUNTANCY	3	1	0	4	
MEUG	6	02 1x15	DESIGN OF MACHINE ELEMENT	3	0	3	5	
MEUG	6	02 1x35	SEMINAR	0	0	2	1	27
B.TECH. (Mech Engg.) SEMESTER-VII								
MEUG	7	02 1xxx	ELECTIVE-L	3	1	0	4	
MEUG	7	02 1xxx	ELECTIVE-LL	3	1	0	4	
MEUG	7	02 1x20	REFRIGERATION AND AIR CONDITIONING	3	0	3	5	
MEUG	7	02 1x22	INTERNAL COMBUSTION ENGINE AND GAS TURBINE	3	0	3	5	
MEUG	7	02 1x30	COMPUTER AIDED DESIGN AND MANUFACTURING	3	0	3	5	
MEUG	7	02 1x36	MINOR PROJECT	0	0	5	3	
MEUG	7	02 1x37	INDUSTRIAL TRAINING				2	28
B.TECH. (Mech Engg.) SEMESTER-VIII								
MEUG	8	24 1x07	SUSTAINABLE DEVELOPMENT	3	1	0	4	
MEUG	8	06 1x22	MANAGEMENT INFORMATION SYSTEM	3	0	0	3	
MEUG	8	02 1x21	MECHANICAL SYSTEM DESIGN	3	0	3	5	
MEUG	8	02 1xxx	ELECTIVE-III	3	1	0	4	
MEUG	8	02 1x40	PROJECT	0	0	15	10	26
LIST OF ELECTIVE								
MEUG	EL 2	02 1x23	OPERATION RESEARCH	3	1	0	4	
MEUG	EL 1	02 1x24	AUTOMOTIVE MECHANICS	3	1	0	4	
MEUG	EL 1	02 1x25	EXPERIMENTAL STRESS ANALYSIS	3	1	0	4	
MEUG	EL 2	02 1x26	TOTAL PRODUCTIVITY MAINTENANCE AND VALUE ENGINEERING	3	1	0	4	
MEUG	EL 2	02 1x28	HEAT EXCHANGE DESIGN	3	1	0	4	
MEUG	EL 2	02 1x29	FINITE ELEMENT METHOD AND APPLICATIONS	3	1	0	4	
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
MEUG	EL 3	02 1x31	QUALITY ASSURANCE AND RELIABILITY	3	1	0	4	
MEUG	EL 3	02 1x27	INDUSTRIAL POLLUTION	3	1	0	4	
MEUG	EL 3	02 1x32	ROBOTIC AND ROBOT APPLICATION	3	1	0	4	
BACHELOR OF TECHNOLOGY IN ELECTRICAL ENGINEERING								
B.TECH. (EE) SEMESTER-I								

EEUG	1	24 1x05	COMMUNICATIVE ENGLISH	3	1	0	4	
EEUG	1	22 1x01	PHYSICS	3	0	3	5	
EEUG	1	21 1x01	MATHEMATICS	3	1	0	4	
EEUG	1	03 1x01	BASIC ELECTRICAL ENGINEERING	3	0	3	5	
EEUG	1	06 1x01	FUNDAMENTAL OF INFORMATION TECHNOLOGY	3	0	2	4	
EEUG	1	02 1x02	ENGINEERING GRAPHICS	2	0	4	5	
EEUG	1	GE 1101	EAA-I-NSS					27
B.TECH. (EE) SEMESTER-II								
EEUG	2	01 1x02	ENVIRONMENTAL SCIENCE	3	0	3	5	
EEUG	2	23 1x01	ENGINEERING CHEMISTRY	3	0	3	5	
EEUG	2	21 1x02	MATHEMATICS-II	3	1	0	4	
EEUG	2	01 1x01	ENGINEERING MECHANICS	3	0	3	5	
EEUG	2	02 1x01	ELEMENTS OF MECHANICAL ENGINEERING	3	0	2	4	
EEUG	2	02 1x03	WORKSHOP	0	0	6	4	
EEUG	2	GE 1202	EAA-II-NSS					27
B.TECH. (EE) SEMESTER-III								
EEUG	3	04 1x01	BASIC ELECTRONICS	3	1	2	5	
EEUG	3	03 1x42	ELECTRICAL MACHINE-I	3	0	3	5	
EEUG	3	21 1x03	MATHEMATICS-III	3	1	0	4	
EEUG	3	05 1x01	OBJECT ORIENTED PROGRAMMING	2	0	3	4	
EEUG	3	04 1x08	SOLID STATE PHYSICS AND DEVICES	3	0	3	5	
EEUG	3	02 1x07	THERMODYNAMICS	3	1	0	4	
EEUG	3	GE 1x03	EAA-III-NSS					27
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
B.TECH. (EE) SEMESTER-IV								
EEUG	4	04 1x01	DIGITAL ELECTRONICS	3	1	2	5	
EEUG	4	21 1x04	NUMERICAL METHOD AND COMPUTATIONAL TECHNIQUE	3	0	3	5	
EEUG	4	03 1x03	ELECTRICAL MACHINE-II	3	0	3	5	
EEUG	4	24 1x01	ORGANIZATIONAL BEHAVIOUR AND INDUSTRIAL PSYCHOLOGY	3	0	0	3	
EEUG	4	03 1x04	POWER SYSTEM -I	3	1	0	4	
EEUG	4	24 1x06	INDUSTRIAL ECONOMICS AND ACCOUNTANCY	3	1	0	4	
EEUG	4	GE 1x04	EAA-IV-NSS					26

B.TECH. (EE) SEMESTER-V								
EEUG	5	04 1x04	ANALOG ELECTRONICS	3	0	3	5	
EEUG	5	03 1x05	NETWORK THEORY	3	0	3	5	
EEUG	5	03 1x08	POWER SYSTEM -II	3	1	0	4	
EEUG	5	03 1x06	ELECTROMAGNETIC FIELD THEORY	3	1	0	4	
EEUG	5	03 1x10	SIGNALS AND SYSTEM	3	1	0	4	
EEUG	5	06 1x05	INFORMATION SECURITY	3	0	0	3	25
B.TECH. (EE) SEMESTER-VI								
EEUG	6	05 1x02	COMPUTER ARCHITECTURE	3	0	0	3	
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
EEUG	6	03 1x16	UTILIZATION OF ELECTRICAL POWER	3	1	0	4	
EEUG	6	04 1x03	INTRODUCTION TO COMMUNICATION SYSTEM	3	0	3	5	
EEUG	6	03 1x11	MICROPROCESSOR AND ITS APPLICATION	3	0	3	5	
EEUG	6	03 1x09	POWER ELECTRONICS	3	0	3	5	
EEUG	6	03 1x07	ELECTRICAL INSTRUMENT AND MEASUREMENT	3	0	1	5	27
B.TECH. (EE) SEMESTER-VII								
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
EEUG	7	03 1xxx	ELECTIVE-I	3	1	0	4	
EEUG	7	04 1x06	INTELLIGENT INSTRUMENT	3	0	3	5	
EEUG	7	03 1x38	INDUSTRIAL TRAINING				2	
EEUG	7	03 1x12	LINEAR CONTROL THEORY	3	0	3	5	
EEUG	7	03 1x13	PROTECTION OF POWER APPARATUS AND SYSTEM	3	0	3	5	
EEUG	7	03 1x39	PROJECT (MINOR)	0	0	6	4	25
B.TECH. (EE) SEMESTER-VIII								
EEUG	8	03 1xxx	ELECTIVE-II	3	1	0	4	
EEUG	8	03 1x15	MODERN CONTROL THEORY	3	1	0	4	
EEUG	8	24 1x02	PERSONAL MANAGEMENT AND INDUSTRIAL RELATION	3	0	0	3	
EEUG	8	03 1x41	PROJECT (MAJOR)	0	0	12	8	
EEUG	8	03 1x40	SEMINAR	0	0	3	2	
EEUG	8	03 1x14	POWER SYSTEM DESIGN	1	0	3	3	24
B.TECH. (EE) ELECTIVE*								
EEUG	EI	05 1x02	ADVANCED COMPUTER ARCHITECTURE	3	0	0	3	
EEUG	EI	05 1x09	DATA BASE SYSTEM	3	0	3	5	

EEUG	EI	05 1x13	COMPUTER NETWORK	3	0	0	3	
EEUG	EI	05 1x17	ARTIFICIAL INTELLIGENCE	3	0	3	5	
EEUG	EI	04 1x05	OPTICAL FIBER COMMUNICATION	3	1	0	4	
EEUG	EI	04 1x10	DIGITAL SIGNAL PROCESSING	3	0	3	5	
EEUG	EI	04 1x66	DIGITAL SYSTEM DESIGN	3	0	3	5	
EEUG	EI	04 1x67	DIGITAL IMAGE PROCESSING	3	0	3	5	
EEUG	EI	04 1x70	EMBEDDED SYSTEM DESIGN	3	1	0	4	
EEUG	EI	04 1x71	VLSI-DESIGN	3	1	0	4	
EEUG	EI	03 1x19	DIGITAL CONTROL SYSTEM	3	1	0	4	
EEUG	EI	03 1x21	COMPUTER AIDED POWER SYSTEM ANALYSIS	3	1	0	4	
EEUG	EI	03 1x22	ADVANCED ELECTRICAL MACHINES	3	1	0	4	
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
EEUG	EI	03 1x23	COMPUTER AIDED NETWORK ANALYSIS	3	1	0	4	
EEUG	EI	03 1x24	EHV POWER TRANSMISSION	3	1	0	4	
EEUG	EI	03 1x25	CONTROL SYSTEM DESIGN	3	1	0	4	
EEUG	EI	03 1x26	COMPUTER BASED PROCESS CONTROL	3	0	0	5	
EEUG	EI	03 1x27	COMPUTER AIDED MACHINE DESIGN	3	1	3	4	
EEUG	EI	03 1x28	DIRECT ENERGY CONVERSION	3	1	0	4	
EEUG	EI	03 1x29	MODERN POWER SYSTEM OPERATION AND CONTROL	3	1	0	4	
EEUG	EI	03 1x30	POWER SYSTEM DYNAMICS AND RELIABILITY	3	1	0	4	
EEUG	EI	03 1x31	FUZZY LOGIC CONTROL	3	1	0	4	
EEUG	EI	03 1x32	NEURAL NETWORK SYSTEM	3	1	0	4	
EEUG	EI	03 1x33	SWITCH MODE POWER CONVERTER	3	1	0	4	
EEUG	EI	03 1x34	ELECTRICAL MACHINE MODELING AND ANALYSIS	3	1	0	4	
EEUG	EI	03 1x37	INDUSTRIAL DRIVES AND CONTROL	3	1	0	4	
EEUG	EI	03 1x35	MICRO-CONTROLLER	3	0	3	5	

			AND ITS APPLICATION					
EEUG	EI	03 1x36	HIGH VOLTAGE ENGINEERING	3	0	3	5	
EEUG	EI	06 1x10	MULTIMEDIA TECHNOLOGY AND APPLICATION	3	0	0	3	
EEUG	EI	01 1x34	ROBOTICS AND ROBOT APPLICATION	3	1	0	4	
ELECTIVES FOR B.TECH. (EE) MAY ALSO BE CHOSEN FROM THE CORE OR ELECTIVES COURSES OF M.TECH. (EE)								
BACHELOR OF TECHNOLOGY IN ELECTRONICS & COMMUNICATION ENGINEERING								
B.TECH. (ECE) SEMESTER-I								
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
ECUG	1	01 1x01	ENGINEERING MECHANICS	3	0	3	5	
ECUG	1	23 1x01	ENGINEERING CHEMISTRY	3	0	3	5	
ECUG	1	011x02	ENVIRONMENTAL SCIENCE	3	0	3	5	
ECUG	1	21 1x01	MATHEMATICS-I	3	1	0	4	
ECUG	1	02 1x01	ELEMENTS OF MECHANICAL ENGINEERING	3	0	2	4	
ECUG	1	02 1x03	WORKSHOP	0	0	6	4	
ECUG	1	GE 1x01	EAA-I-NSS					27
B.TECH. (ECE) SEMESTER-II								
ECUG	2	03 1x01	BASIC ELECTRICAL ENGINEERING	3	0	3	5	
ECUG	2	24 1x05	COMMUNICATIVE ENGLISH	3	1	0	4	
ECUG	2	06 1x01	FUNDAMENTAL OF INFORMATION TECHNOLOGY	3	0	2	4	
ECUG	2	21 1x02	MATHEMATICS-II	3	1	0	4	
ECUG	2	02 1x02	ENGINEERING GRAPHICS	2	0	4	5	
ECUG	2	22 1x01	PHYSICS	3	0	3	5	
ECUG	2	GE 1x03	EAA-II-NSS					27
B.TECH. (ECE) SEMESTER-III								
ECUG	3	24 1x01	ORGANIZATIONAL BEHAVIOUR AND INDUSTRIAL PSYCHOLOGY	3	0	0	3	
ECUG	3	04 1x08	SOLID STATE PHYSICS AND DEVICES	3	0	3	5	
ECUG	3	04 1x01	BASIC ELECTRONICS	3	1	2	5	
ECUG	3	03 1x42	ELECTRICAL MACHINE-I	3	0	3	5	
ECUG	3	24 1x06	INDUSTRIAL ECONOMICS AND ACCOUNTANCY	3	1	0	4	
ECUG	3	21 1x03	MATHEMATICS -III	3	1	0	4	
ECUG	3	GE 1x03	EAA-III-NSS					26
B.TECH. (ECE) SEMESTER-IV								

ECUG	4	05 1x01	OBJECT ORIENTED PROGRAMMING	3	0	3	5	
ECUG	4	04 1x02	DIGITAL ELECTRONICS	3	1	2	5	
ECUG	4	04 1x12	ELECTRICAL & ELECTRONIC MATERIAL	3	0	3	5	
ECUG	4	24 1x02	PERSONAL MANAGEMENT & INDUSTRIAL RELATION	3	0	0	3	
ECUG	4	05 1x14	SOFTWARE ENGINEERING	3	0	3	5	
ECUG	4	21 1x04	NUMERICAL METHODS & COMPUTATIONAL TECHNIQUES	3	0	3	5	
ECUG	4	GE 1x04	EAA-IV-NSS					28
B.TECH. (ECE) SEMESTER-V								
ECUG	5	04 1x03	INTRODUCTION TO COMMUNICATION SYSTEMS	3	0	3	5	
ECUG	5	04 1x04	ANALOG ELECTRONICS	3	0	3	5	
ECUG	5	04 1xxx	ELECTIVE-I	3	0	0	3	
ECUG	5	03 1x07	ELECTRICAL INSTRUMENTS & MEASUREMENTS	3	0	3	5	
ECUG	5	03 1x11	MICROPROCESSOR AND ITS APPLICATIONS	3	0	3	5	
ECUG	5	06 1x02	WEB TECHNOLOGY	3	0	3	5	28
B.TECH. (ECE) SEMESTER-VI								
ECUG	6	04 1x05	OPTICAL FIBER COMMUNICATION	3	1	0	4	
ECUG	6	04 1x06	INTELLIGENT INSTRUMENTS	3	0	3	5	
ECUG	6	04 1xxx	ELECTIVE – II	3	1	0	4	
ECUG	6	03 1x05	NETWORK THEORY	3	0	3	5	
ECUG	6	03 1x06	ELECTROMAGNETIC FIELD THEORY	3	1	0	4	
ECUG	6	03 1x10	SIGNALS & SYSTEMS	3	1	0	4	26
B.TECH. (ECE) SEMESTER-VII								
ECUG	7	04 1x09	ADVANCED ELECTROMAGNETIC THEORY	3	1	0	4	
ECUG	7	04 1x10	DIGITAL SIGNAL PROCESSING	3	0	3	5	
ECUG	7	04 1x14	PROJECT – I	0	0	9	6	
ECUG	7	04 1xxx	ELECTIVE-III	3	1	0	4	
ECUG	7	03 1x09	POWER ELECTRONICS	3	0	3	5	
ECUG	7	04 1x15	INDUSTRIAL TRAINING				2	26
B.TECH. (ECE) SEMESTER-VIII								
ECUG	8	05 1x13	COMPUTER NETWORKS	3	0	0	3	
ECUG	8	04 1x11	MICROWAVE ENGINEERING	3	0	3	5	
ECUG	8	04 1xxx	ELECTIVE-IV	3	1	0	4	
ECUG	8	03 1x12	LINEAR CONTROL THEORY	3	0	3	5	

ECUG	8	06 1x05	INFORMATION SECURITY	3	0	0	3	
ECUG	8	05 1x24	PROJECT – II	0	0	9	6	26
B.TECH. (ECE) ELECTIVE*								
ECUG	EI – 1	04 1x61	MICROELECTRONICS – IC DESIGN & FABRICATION	3	1	0	4	
ECUG	EI – 1	04 1x63	BIO – MEDICAL SENSORS & TRANSDUCERS	3	1	0	4	
ECUG	EI – 1	04 1x64	TV ENGINEERING	3	1	0	4	
ECUG	EI – 1	04 1x65	MICROCONTROLLERS	3	1	0	4	
ECUG	EI – 1	04 1x81	CRYPTOGRAPHY & SPREAD SPECTRUM	3	1	0	4	
ECUG	EI – 2	04 1x66	DIGITAL SYSTEM DESIGN	3	0	3	5	
ECUG	EI – 2	04 1x67	DIGITAL IMAGE PROCESSING	3	0	3	5	
ECUG	EI – 2	04 1x68	BIOMEDICAL INSTRUMENTATION & IMAGING	3	1	0	4	
ECUG	EI – 2	04 1x69	RADIO ASTRONOMY	3	1	0	4	
ECUG	EI – 2	04 1x70	EMBEDDED SYSTEM DESIGN	3	1	0	4	
ECUG	EI – 2	06 1x61	NETWORK SECURITY	3	0	0	3	
ECUG	EI – 3	04 1x71	VLSI DESIGN	3	1	0	4	
ECUG	EI – 3	04 1x72	ALGORITHM DEVELOPMENT	3	1	0	4	
ECUG	EI – 3	04 1x73	BIOMEDICAL SYSTEM & ITS APPLICATIONS	3	1	0	4	
ECUG	EI – 3	04 1x77	DIGITAL COMMUNICATION &TELECOMMUNICATIO N MANAGEMENT	3	0	3	5	
ECUG	EI – 3	04 1x75	SOFT COMPUTING TECHNIQUES & ITS APPLICATIONS	3	1	0	4	
ECUG	EI – 3	06 1x33	BIOMETRIC SECURITY	3	1	0	4	
ECUG	EI – 4	05 1x42	SPEECH PROCESSING	3	0	0	3	
ECUG	EI – 4	04 1x76	IC ARCHITECTURE & FABRICATION	3	1	0	4	
ECUG	EI – 4	04 1x78	NANOTECHNOLOGY & ITS APPLICATIONS	3	1	0	4	
ECUG	EI – 4	04 1x79	FIBER OPTICS & NETWORKING TECHNOLOGY	3	1	0	4	
ECUG	EI – 4	04 1x80	EMBEDDED SYSTEM (REAL TIME SYSTEMS)	3	1	0	4	
ECUG	EI – 4	04 1x84	MOBILE COMPUTING	3	1	0	4	
ECUG	EI – 4	24 1x04	PERSONAL MANAGEMENT & INDUSTRIAL RELATION	3	0	0	3	

NOTE: TOTAL CREDITS IN SOME OF SEMESTER MAY VARY DUE TO ELECTIVE SUBJECTS HAVING VARIED COMBINATION OF L-T-P.

BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE & ENGINEERING								
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
B.TECH. (CSE) SEMESTER-I								
CSUG	1	01 1x02	ENVIRONMENTAL SCIENCE	3	0	3	5	
CSUG	1	21 1x01	MATHEMATICS – I	3	1	0	4	
CSUG	1	23 1x01	ENGINEERING CHEMISTRY	3	0	3	5	
CSUG	1	01 1x01	ENGINEERING MECHANICS	3	0	3	5	
CSUG	1	02 1x01	ELEMENTS OF MECHANICAL ENGINEERING	3	0	2	4	
CSUG	1	02 1x03	WORKSHOP	0	0	6	4	
CSUG	1	GE 1101	EAA-I-NSS					27.0
B.TECH. (CS**E) SEMESTER-II**								
CSUG	2	24 1x05	COMMUNICATIVE ENGLISH	3	1	0	4	
CSUG	2	21 1x02	MATHEMATICS-II	3	1	0	4	
CSUG	2	22 1x01	PHYSICS	3	0	3	5	
CSUG	2	03 1x01	BASIC ELECTRICAL ENGINEERING	3	0	3	5	
CSUG	2	06 1x01	FUNDAMENTAL OF INFORMATION TECHNOLOGY	3	0	2	4	
CSUG	2	01 1x02	ENGINEERING GRAPHICS	2	0	4	5	
CSUG	2	GE 1x02	EAA-II-NSS					27.0
B.TECH. (CSE) SEMESTER-III								
CSUG	3	21 1x03	MATHEMATICS-III	3	1	0	4	
CSUG	3	04 1x02	DIGITAL ELECTRONICS	3	1	2	5	
CSUG	3	05 1x01	OBJECT ORIENTED PROGRAMMING	3	0	3	5	
CSUG	3	21 1x04	NUMERICAL METHODS & COMPUTATIONAL TECHNIQUES	3	0	3	5	
CSUG	3	04 1x01	BASIC ELECTRONICS	3	1	2	5	
CSUG	3	GE 1x03	EAA-III-NSS					24.0
B.TECH. (CSE) SEMESTER-IV								
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
CSUG	4	21 1x05	DISCRETE MATHEMATICAL STRUCTURE & GRAPH THEORY	3	1	0	4	

CSUG	4	04 1x05	ANALOG ELECTRONICS	3	0	3	5	
CSUG	4	05 1x03	DATA STRUCTURES	3	0	3	5	
CSUG	4	05 1x02	COMPUTER ARCHITECTURE	3	0	0	3	
CSUG	4	05 1x05	SYSTEMS PROGRAMMING	3	0	3	5	
CSUG	4	24 1x01	ORGANIZATIONAL BEHAVIOUR AND INDUSTRIAL PSYCHOLOGY	3	0	0	3	
CSUG	4	GE 1x04	EAA-IV-NSS					25.0
B.TECH. (CSE) SEMESTER-V								
CSUG	5	03 1x11	MICROPROCESSOR AND ITS APPLICATIONS	3	0	3	5	
CSUG	5	05 1x06	DESIGN & ANALYSIS OF ALGORITHMS	3	0	0	3	
CSUG	5	05 1x29	INTRODUCTION TO JAVA PROGRAMMING LANGUAGE	3	0	3	5	
CSUG	5	05 1x09	DATABASE SYSTEMS	3	0	3	5	
CSUG	5	06 1x03	OPERATING SYSTEMS	3	0	3	5	
CSUG	5	05 1x13	COMPUTER NETWORKS	3	0	0	3	26.0
B.TECH. (CSE) SEMESTER-VI								
CSUG	6	05 1x04	OBJECT ORIENTED ANALYSIS & DESIGN	3	0	0	3	
CSUG	6	05 1x10	PRINCIPLES OF PROGRAMMING LANGUAGES	3	0	0	3	
CSUG	6	05 1x11	FORMAL LANGUAGES & AUTOMATA THEORY	3	0	0	3	
CSUG	6	24 1x06	INDUSTRIAL ECONOMICS & ACCOUNTANCY	3	1	0	4	
CSUG	6	05 1x14	SOFTWARE ENGINEERING	3	0	3	5	
CSUG	6	05 1x07	WEB APPLICATIONS DESIGN & DEVELOPMENT	3	0	3	5	
CSUG	6	05 1x16	COMPILER DESIGN	3	0	3	5	28.0
CSUG	7	05 1x15	DISTRIBUTED COMPUTING	3	0	3	5	
CSUG	7	05 1x17	ARTIFICIAL INTELLIGENCE	3	0	3	5	
CSUG	7	XX 17XX	ELECTIVE-I	3	0	0	3	
CSUG	7	XX 17XX	ELECTIVE-II	3	0	0	3	
CSUG	7	XX 17XX	ELECTIVE-III	3	0	0	3	

CSUG	7	05 1x20	PROJECT – I	0	0	6	4	
CSUG	7	05 1x21	INDUSTRIAL TRAINING				2	25.0
B.TECH. (CSE) SEMESTER-VIII								
CSUG	8	05 1x22	DATA MINING	3	0	3	5	
CSUG	8	24 1x04	PERSONAL MANAGEMENT & INDUSTRIAL RELATION	3	0	0	3	
CSUG	8	06 1x05	INFORMATION SECURITY	3	0	0	3	
CSUG	8	XX 18XX	ELECTIVE-IV	3	0	0	3	
CSUG	8	XX 18XX	ELECTIVE-V	3	0	0	3	
CSUG	8	XX 1xxx	ELECTIVE-VI	3	0	0	3	
CSUG	8	05 1x24	PROJECT – II	0	0	9	6	26.0
B.TECH. (CSE) ELECTIVE*								
CSUG	EI	05 1x02	FUNDAMENTALS OF DATA COMMUNICATION	3	0	0	3	
CSUG	EI	05 1x12	REAL TIME SYSTEMS	3	0	0	3	
CSUG	EI	05 1x18	CRYPTOGRAPHY	3	0	0	3	
CSUG	EI	05 1x19	MOBILE & WIRELESS COMPUTING	3	0	0	3	
CSUG	EI	05 1x22	DISTRIBUTED DATABASE	3	0	0	3	
CSUG	EI	05 1x23	PARALLEL COMPUTING	3	0	0	3	
CSUG	EI	05 1x25	ADVANCE COMPUTER ARCHITECTURE	3	0	0	3	
CSUG	EI	05 1x26	PERFORMANCE EVALUATION OF COMPUTER SYSTEMS	3	0	0	3	
CSUG	EI	05 1x27	OPTIMIZATION THEORY	3	0	0	3	
CSUG	EI	05 1x28	PATTERN RECOGNITION	3	0	0	3	
CSUG	EI	05 1x30	GENETIC ALGORITHM	3	0	0	3	
CSUG	EI	05 1x31	NATURAL LANGUAGE PROCESSING	3	0	0	3	
CSUG	EI	05 1x32	COMPUTATIONAL GEOMETRY	3	0	0	3	
CSUG	EI	05 1x35	COMPUTER GRAPHICS	3	0	0	3	
CSUG	EI	05 1x41	NEURAL	3	0	0	3	

			NETWORKS & ITS APPLICATIONS					
CSUG	EI	05 1x42	SPEECH PROCESSING	3	0	0	3	
CSUG	EI	01 1x23	OPERATIONS RESEARCH	3	1	0	4	
CSUG	EI	01 1x28	COMPUTER AIDED DESIGN & MANUFACTURING	3	0	3	5	
CSUG	EI	01 1x34	ROBOTICS AND ROBOT APPLICATIONS	3	1	0	4	
CSUG	EI	01 1x02	GEOGRAPHICAL INFORMATION SYSTEMS & REMOTE SENSING	3	0	0	3	
CSUG	EI	01 1x31	COMPUTER AIDED DESIGN	3	0	0	3	
CSUG	EI	04 1x03	INTRODUCTION TO COMMUNICATION SYSTEMS	3	0	3	5	
CSUG	EI	04 1x06	INTELLIGENT INSTRUMENTS	3	0	3	5	
CSUG	EI	04 1x10	DIGITAL SIGNAL PROCESSING	3	0	3	5	
CSUG	EI	04 1x65	MICROELECTRONICS – IC DESIGN & FABRICATION	3	1	0	4	
CSUG	EI	04 1x65	MICROCONTROLLERS	3	1	0	4	
CSUG	EI	04 1x67	DIGITAL IMAGE PROCESSING	3	0	3	5	
CSUG	EI	04 1x70	EMBEDDED SYSTEM DESIGN	3	1	0	4	
CSUG	EI	04 1x71	VLSI DESIGN	3	1	0	4	
CSUG	EI	04 1x74	DIGITAL COMMUNICATION & TELECOMMUNICATION MANAGEMENT	3	0	3	5	
CSUG	EL	04 1x75	NANOTECHNOLOGY & ITS APPLICATIONS	3	1	0	4	
CSUG	EL	04 1x76	FIBER OPTICS & NETWORKING TECHNOLOGY	3	1	0	4	
CSUG	EL	04 1x80	MOBILE COMPUTING	3	1	0	4	
CSUG	EL	06 1x04	VISUAL PROGRAMMING	3	0	3	5	
CSUG	EL	06 1x08	INTRUSION DETECTION	3	0	0	3	
CSUG	EL	06 1x09	XML WEB SERVICES	3	0	3	5	
CSUG	EL	06 1x10	MULTIMEDIA TECHNOLOGY & ITS APPLICATIONS	3	0	0	3	
CSUG	EL	06 1x13	NETWORK SECURITY	3	0	0	3	

CSUG	EL	06 1x17	INTERNET & INTRANET ENGINEERING	3	0	0	3	
CSUG	EL	06 1x18	E – COMMERCE & ERP	3	0	0	3	
CSUG	EL	06 1x19	IMAGE PROCESSING & GIS	3	0	0	3	
BACHELOR OF TECHNOLOGY IN INFORMATION TECHNOLOGY								
Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
B.TECH. (IT) SEMESTER-I								
ITUG	1	01 1x02	ENVIRONMENTAL SCIENCE	3	0	3	5	
ITUG	1	21 1x01	MATHEMATICS – I	3	1	0	4	
ITUG	1	23 1x01	ENGINEERING CHEMISTRY	3	0	3	5	
ITUG	1	01 1x01	ENGINEERING MECHANICS	3	0	3	5	
ITUG	1	02 1x01	ELEMENTS OF MECHANICAL ENGINEERING	3	0	2	4	
ITUG	1	02 1x03	WORKSHOP	0	0	6	4	
ITUG	1	GE 1x01	EAA-I-NSS					27.0
B.TECH. (IT**) SEMESTER-II**								
ITUG	2	24 1x05	COMMUNICATIVE ENGLISH	3	1	0	4	
ITUG	2	21 1x02	MATHEMATICS-II	3	1	0	4	
ITUG	2	22 1x01	PHYSICS	3	0	3	5	
ITUG	2	03 1x01	BASIC ELECTRICAL ENGINEERING	3	0	3	5	
ITUG	2	06 1x01	FUNDAMENTAL OF INFORMATION TECHNOLOGY	3	0	2	4	
ITUG	2	01 1x02	ENGINEERING GRAPHICS	2	0	4	5	
ITUG	2	GE 1x02	EAA-II-NSS					27.0
B.TECH. (IT) SEMESTER-III								
ITUG	3	24 1x01	ORGANIZATIONAL BEHAVIOUR AND INDUSTRIAL PSYCHOLOGY	3	0	0	3	
ITUG	3	05 1x01	OBJECT ORIENTED PROGRAMMING	3	0	3	5	
ITUG	3	04 1x01	BASIC ELECTRONICS	3	1	2	5	
ITUG	3	04 1x02	DIGITAL ELECTRONICS	3	1	2	5	
ITUG	3	24 1x06	Industrial Economics and Accountancy	3	1	0	4	
ITUG	3	21 1x03	MATHEMATICS-III	3	1	0	4	
ITUG	3	GE 1x03	EAA-III-NSS					26.0
B.TECH. (IT) SEMESTER-IV								
ITUG	4	21 1x05	DISCRETE MATHEMATICAL	3	1	0	4	

			STRUCTURE & GRAPH THEORY					
ITUG	4	03 1x11	MICROPROCESSOR AND IT S APPLICATIONS	3	0	3	5	
ITUG	4	05 1x09	DATABASE SYSTEMS	3	0	3	5	
ITUG	4	04 1x04	ANALOG ELECTRONICS	3	0	3	5	
ITUG	4	05 1x02	COMPUTER ARCHITECTURE	3	0	0	3	
ITUG	4	05 1x03	DATA STRUCTURES	3	0	3	5	
ITUG	4	GE 1x04	EAA-IV-NSS					27.0
B.TECH. (IT) SEMESTER-V								
ITUG	5	05 1x11	FORMAL LANGUAGES & AUTOMATA THEORY	3	0	0	3	
ITUG	5	04 1x03	INTRODUCTION TO COMMUNICATION SYSTEMS	3	0	3	5	
ITUG	5	05 1x16	COMPILER DESIGN	3	0	3	5	
ITUG	5	06 1x02	WEB TECHNOLOGY	3	0	3	5	
ITUG	5	05 1x13	COMPUTER NETWORKS	3	0	0	3	
ITUG	5	05 1x05	SYSTEMS PROGRAMMING	3	0	3	5	26.0
B.TECH. (IT) SEMESTER-VI								
ITUG	6	05 1x17	ARTIFICIAL INTELLIGENCE	3	0	3	5	
ITUG	6	06 1x04	VISUAL PROGRAMMING	3	0	3	5	
ITUG	6	05 1x14	SOFTWARE ENGINEERING	3	0	3	5	
ITUG	6	06 1x06	DATA MINING & WAREHOUSING	3	0	0	3	
ITUG	6	06 1x03	OPERATING SYSTEMS	3	0	3	5	
ITUG	6	05 1x06	DESIGN & ANALYSIS OF ALGORITHMS	3	0	0	3	26.0
B.Tech (IT) SEMESTER- VII								
ITUG	7	24 1x02	Personnel Management and Industrial Relation	3	0	0	3	
ITUG	7	06 1x07	Distributed Computing and its Application	3	0	3	5	
ITUG	7	06 1x11	Wireless and Mobile Communication	3	0	0	3	
ITUG	7	06 1x05	Information security	3	0	0	3	
ITUG	7	06 1xxx	Elective I	3	0	0	3	
ITUG	7	06 1xxx	Elective –II	3	0	0	3	
ITUG	7	06 1x24	Project- I	0	0	6	4	
ITUG	7	06 1x26	Industrial Training				2	26
B.Tech (IT) SEMESTER – VIII								
ITUG	8	06 1x09	XML Web Services	3	0	3	5	

ITUG	8	06 1x10	Multimedia Technology and Application	3	0	0	3	
ITUG	8	06 1x08	Intrusion Detection	3	0	0	3	
ITUG	8	06 1xxx	Elective III	3	0	0	3	
ITUG	8	06 1xxx	Elective IV	3	0	0	3	
ITUG	8	06 1x25	Project –II	0	0	9	6	23
B.Tech. (IT) ELECTIVE SUBJECTS:								
IT	EL	06 1x16	Bio- Informatics	3	0	0	3	
IT	EL	04 1x10	Digital signal processing	3	0	3	5	
IT	EL	06 1x15	Interactive Computer Graphics	3	0	0	3	
IT	EL	06 1x13	Network security	3	0	0	3	
IT	EL	05 1x04	Object Oriented Analysis and Design	3	0	0	3	
IT	EL	05 1x18	Cryptography	3	0	0	3	
IT	EL	06 1x18	E - Commerce and ERP	3	0	0	3	
IT	EL	05 1x30	Genetic Algorithm	3	0	0	3	
IT	EL	06 1x17	Internet and Intranet Engineering	3	0	0	3	
IT	EL	05 1x10	Principles of Programming Languages	3	0	0	3	
IT	EL	06 1x20	E-Customer Relationship Management	3	0	0	3	
IT	EL	04 1x70	Embedded Systems Design	3	1	0	4	
IT	EL	06 1x19	Image Processing and GIS	3	0	0	3	
IT	EL	05 1x23	Parallel Computing	3	0	0	3	
IT	EL	06 1x21	Web Programming	3	0	3	5	
IT	EL	05 1x22	Distributed Database	3	0	0	3	
IT	EL	06 1x22	Management Information System	3	0	0	3	
IT	EL	05 1x28	Pattern Recognition	3	0	0	3	
IT	EL	05 1x12	Real Time System	3	0	0	3	
IT	EL	05 1x10	Neural Networks and Applications	3	0	0	3	
B B. Tech. (Leather Technology) SEMESTER –III (For 2011 Batch and onwards)								
Program	**Semester**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**	**Total Credit/Sem**
MEUG	3	24 1x01	ORGANIZATIONAL BEHAVIOUR AND INDUSTRIAL PSYCHOLOGY	3	0	3	5	
LTUG	3	**07 1x01**	Theory & Practices of preservation and pre tanning processes	3	0	3	5	
MEUG	3	01 1x05	Material Science	3	1	0	4	
MEUG	3	21 1x03	Mathematics –III	3	1	0	4	
MEUG	3	02 1x06	Strength of material	3	0	3	5	
MEUG	3	02 1x07	Thermodynamics	3	1	0	4	
MEUG	3	GE 1x03	EAA-III- NSS					27
B B. Tech. (Leather Technology) SEMESTER –IV (For 2011 Batch and onwards)								

MEUG	4	04 1x01	Basic Electronics	3	0	3	5	
MEUG	4	05 1x01	Object Orientation Programming	3	0	0	3	
MEUG	4	21 1x04	Numerical methods and computational technique	3	0	3	5	
LTUG	4	**07 1x02**	Introduction to leather Technology	3	0	0	3	
LTUG	4	**07 1x03**	Biochemistry of protein	3	0	0	3	
LTUG	4	**07 1x04**	Chemical Engineering – I	3	0	3	5	
MEUG	4	GE 1x04	EAA-IV- NSS					24
B B. Tech. (Leather Technology) SEMESTER –V (For 2011 Batch and onwards)								
MEUG	5	24 1x02	Personnel management and Industrial relation	3	0	0	3	
LTUG	5	**07 1x05**	Chemical Engineering – II	3	0	3	5	
LTUG	5	**07 1x06**	Principles of Inorganic Tannage	3	0	3	5	
LTUG	5	**07 1x07**	Principles of Organic Tannage	3	0	0	3	
LTUG	5	**07 1x08**	Practices of Leather Manufacturing - I	3	0	3	5	
LTUG	5	**07 1x09**	Analytical Chemistry of Leather	3	0	3	5	26
B B. Tech. (Leather Technology) SEMESTER –VI (For 2011 Batch and onwards)								
MEUG	6	24 1x06	Industrial Economics& Accountancy	3	1	0	4	
LTUG	6	**07 1x10**	Principles of Post Tanning Operation	3	0	3	5	
LTUG	6	**07 1x11**	Leather Bio-Technology	3	0	0	3	
LTUG	6	**07 1x12**	Leather Product Technology- I	3	0	3	5	
LTUG	6	**07 1x13**	Principles of material testing	3	0	3	5	
LTUG	6	**07 1x14**	Chemical Engineering –III	3	0	0	3	25
B B. Tech. (Leather Technology) SEMESTER –VII (For 2011 Batch and onwards)								
LTUG	7	**07 1x15**	Leather finishing materials and Auxiliaries	3	0	0	3	
LTUG	7	**07 1x16**	Electives –I	3	0	0	3	
LTUG	7	**07 1x17**	Practices of Leather manufacturing -II	3	0	3	5	
LTUG	7	**07 1x18**	Theory of Leather supplements & Synthetics	3	0	0	3	
LTUG	7	**07 1x19**	Instrumentation and process control	3	0	3	5	
LTUG	7	**07 1x20**	Leather Product Technology-II	3	0	3	5	24
B **B. Tech. (Leather Technology) SEMESTER –VIII (For 2011 Batch and onwards)**								
LTUG	8	**07 1x21**	Elective –II	3	0	0	3	
LTUG	8	**07 1x22**	Elective –III	3	0	0	3	
LTUG	8	**07 1x23**	Tannery waste management	3	0	3	5	
LTUG	8	**07 1x24**	Practices of Leather manufacturing -III	3	0	3	5	
LTUG	8	**07 1x25**	Leather Product Technology –III	3	0	3	5	
LTUG	8	**07 1x26**	Project Work	0	1	6	5	26

Practicals :-
Eight experiments based on the theory papers in the relevant semesters.

Elective – I
07 1x16 Animal and tannery by product utilization. (LTE 1.1)
07 1x16 Polymer Science & Technology. (LTE 1.2)
07 1x16 Co-ordination Chemistry. (LTE 1.3)
07 1x16 Organic Chemistry. (LTE 1.4)

Elective –II
07 1x21 Fashion styling and Computer added design of leather product. (LTE 2.5)
07 1x21 Advance Leather process technology. (LTE 2.6)
07 1x21 Applied statistics & quality control. (LTE 2.7)
07 1x21 Surface and colloid chemistry (LTE 2.8)

Elective – III
07 1x22 Computer application in leather technology. (LTE 3.9)
07 1x22 Professional Ethics. (LTE 3.10)
07 1x22 Entrepreneurship. (LTE 3.11)
07 1x22 Total quality management. (LTE 3.12)

B.Pharm SEMESTER-I

Program	Semester	Course code	Course title	L	T	P	Credits	Total Credit/ Sem.
PSUG	1	24 1105	COMMUNICATIVE ENGLISH	3	1	0	3	
PSUG	1	09 1101	PHARMACEUTICS-I	3	0	4	5	
PSUG	1	09 1102	PHARMACEUTICAL ANALYSIS – I	3	0	4	5	
PSUG	1	09 1103	PHARMACEUTICAL CHEMISTRY – I	3	0	4	5	
PSUG	1	09 1104	PHARMACOGNOSY - I	3	0	4	5	
PSUG	1	09 1106	REMEDIAL MATHEMATICS	3	1	0	3	
PSUG	1	09 1107	REMEDIAL BIOLOGY	2	0	2	3	26

Candidates who did not pass Biology subject in entry qualification (+2 Sc. etc.) examination are required to take Remedial Biology (09 1107 & 09 1107P), and those who did not pass Mathematics subject are required to take Remedial Mathematics (09 1106). Candidates who passed both Biology and Mathematics subjects can take either Remedial Biology (T&P) or Remedial Mathematics.

B.Pharm SEMESTER-II

Program	Semester	Course code	Course title	L	T	P	Credits	Total Credit/ Sem.
PSUG	2	09 1105	ADVANCED MATHEMATICS	3	1	0	3	
PSUG	2	09 1201	PHARMACEUTICS-II	3	0	4	5	

PSUG	2	09 1202	PHARMACEUTICAL CHEMISTRY – II	3	0	4	5	
PSUG	2	09 1203	PHARMACEUTICAL CHEMISTRY – III	3	0	4	5	
PSUG	2	09 1204	APHE-I	3	0	4	5	23

B.Pharm SEMESTER-III

Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
PSUG	3	09 1301	PHARMACEUTICS-III	3	0	4	5	
PSUG	3	09 1302	PHARMACEUTICAL CHEMISTRY – IV	3	0	4	5	
PSUG	3	09 1303	PHARMACOGNOSY - II	3	0	4	5	
PSUG	3	09 1304	PHARMACEUTICAL ANALYSIS – II	3	0	4	5	
PSUG	3	09 1305	APHE-II	3	0	4	5	25

B.Pharm SEMESTER-IV

Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
PSUG	4	09 1401	PHARMACEUTICS-IV	3	0	4	5	
PSUG	4	09 1402	PHARMACEUTICAL MICROBIOLOGY	3	0	4	5	
PSUG	4	09 1403	PHARMACOGNOSY - II	3	0	0	5	
PSUG	4	09 1404	PATHOPHYSIOLOGY OF COMMON DISEASES	3	0	4	3	
PSUG	4	09 1405	BASIC ELECTRONICS AND COMPUTER APPLICATIONS	3	0	4	5	
PSUG	4	09 1406	PHARMACEUTICAL JURISPRUDENCE & ETHICS	3	0	0	3	
								26

B.Pharm SEMESTER-V

Program	**Semester**	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**	**Total Credit/ Sem.**
PSUG	5	09 1501	PHARMACEUTICS-V	3	0	4	5	
PSUG	5	09 1502	PHARMACEUTICAL CHEMISTRY – V	3	0	4	5	
PSUG	5	09 1503	PHARMACOLOGY - I	3	0	4	5	
PSUG	5	09 1504	PHARMACOGNOSY-IV	3	0	4	5	
PSUG	5	09 1505	PHARMACEUTICS-VI	3	0	4	5	25

B.Pharm SEMESTER-VI

Program	Semester	Course code	Course title	L	T	P	Credits	Total Credit/ Sem.
PSUG	6	09 1601	PHARMACEUTICS-VII	3	0	4	5	
PSUG	6	09 1602	PHARMACEUTICAL CHEMISTRY – VI	3	0	4	5	
PSUG	6	09 1603	PHARMACOLOGY - II	3	0	4	5	
PSUG	6	09 1604	PHARMACOGNOSY-V	3	0	4	5	
PSUG	6	09 1605	PHARMACEUTICAL ANALYSIS-III	3	0	4	5	25

B.Pharm SEMESTER-VII

Program	Semester	Course code	Course title	L	T	P	Credits	Total Credit/ Sem.
PSUG	7	09 1701	PHARMACEUTICS-VIII	3	0	4	5	
PSUG	7	09 1702	PHARMACEUTICAL CHEMISTRY-VII	3	0	4	5	
PSUG	7	09 1703	PHARMACOLOGY - III	3	0	4	5	
PSUG	7	09 1704	PHARMACEUTICAL BIOTECHNOLOGY	3	0	0	3	
PSUG	7	09 1705	PHARMACEUTICAL INDUSTRIAL MANAGEMENT	3	0	0	3	
PSUG	7	09 1706	ELECTIVE	3	0	4	5	
								26

B.Pharm SEMESTER-VIII

Program	Semester	Course code	Course title	L	T	P	Credits	Total Credit/ Sem.
PSUG	8	09 1801	PHARMACEUTICS-IX	3	0	4	5	
PSUG	8	09 1802	PHARMACEUTICAL CHEMISTRY – VIII	3	0	4	5	
PSUG	8	09 1803	PHARMACOLOGY -IV	3	0	0	3	
PSUG	8	09 1804	PHARMACOGNOSY-VI	3	0	4	5	
PSUG	8	09 1805	PROJECT WORK & VIVA VOCE	0	0	12	10	28

PRACTICALS

Eight experiments based on the theory papers in the relevant semesters.

ELECTIVES THEORY AND PRACTICAL

09 17E1 COSMETIC TECHNOLOGY

09 17E2 HERBAL DRUG TECHNOLOGY

09 17E3 BIOASSAYS

09 17E4 HOSPITAL PHARMACY ADMINISTRATION

09 17E5 ADVANCED PHARMACEUTICAL ANALYSIS

DEPARTMENT OF MATHEMATICS

21 1x01 MATHEMATICS- I

L-T-P : 3-1-0 **Credit : 4**

1. ALGEBRA OF MATRICES : Elementary transformation, inverse by row transformation, canonical reduction, rank, solution of simultaneous equations, characteristic equation, Eigen values – & Eigen vectors, Caley's Hamilton theorem, similarity transformation, reduction to diagonal matrices. **Lecture : 8**

2. DIFFERENTIAL CALCULUS : Higher order derivatives (successive differentiation) and Leibnitz theorem, indeterminate form, Tangent and normal, review of maxima & minima ,concavity and convexity of a curve point of inflexion, curvature and radius of curvature , pedal equation asymptotes (for Cartesian curve only) Taylor's and Maclaurin's series, partial derivatives, Euler's theorem on homogeneous function , harmonic function , Taylor's expansion of several variables, maxima and minima of several variable, Lagrange's method for undetermined multipliers. **Lecture : 20**

3. DIFFERENTIAL EQUATION : First order equation, separable, homogeneous , exact ,linear and Bernoulli's form ,second and higher order equation with constant coefficients, Euler's equation: methods of their solution . dependent and independent of solution, Wronskian's system of first order equation **Lecture : 8**

4. INTEGRAL CALCULUS - I : Convergence of improper integral – comparison test. Abel's test, beta & gamma functions (definition & related problems) , error function , differentiation under integral sign – Leibnitz rule. L**ecture : 8**

Text Books :

1. Advance engineering mathematics by H.K.Dass, S.Chand & Company Ltd.
2. Higher engineering mathematics by B.S. Grewal, Khanna Publishers
3. Differential calculus by Das & Mukherjee –U.N. Dhar & sons
4. Integral calculus by Das & Mukherjee – U.N. Dhar & sons

Reference Books :

1. Advance engineering mathematics by E. Kreyszig, 8th Edition, John Wiley & Sons, New York
2. Advance engineering mathematics by Wiley & Barratt- Tata McGraw Hill
3. Linear Algebra by K. Hoffman and R Kunze-Prentice Hall

21 1x02 MATHEMATICS –II

L-T-P : 3-1-0 **Credit : 4**

1. INFINITE SERIES : Notion of convergence and divergence of infinite series - Ratio test , comparison test, Raabe's test, Root test, alternating series – Leibnitz test absolute and conditional convergence. Uniform convergence. **Lecture : 6**

2. FOURIER ANALYSIS : Periodic function : functions of arbitrary period, Even & odd functions, Half Range Expansions, Harmonic analysis, Complex Fourier series, Laplace transform: Definition and properties of Laplace transform, shifting theorem, transform of derivatives and integrals, Multiplication by t^n, Division by t, Evaluation of integrals by L.T., Inverse Transforms. **Lecture : 14**

3. INTEGRAL CALCULUS II : Double & Triple integrals, Rectification, computation of surfaces & volumes, Change of variables in double integrals, Jacobians of transformations, Integrals dependent on parameters-applications. **Lecture : 12**

4. VECTOR CALCULUS : Scalar & vector point function, differentiation of vector, velocity and acceleration, direct derivatives, concept of gradient, divergence curl, line integral, Greens theorem in plane, Gauss & Stoke's theorem and simple application. **Lecture : 12**

Text Books :

1. Advance engineering mathematics by R.K.Jain & S.R.K. Iyengar, Narosa publishing house
2. Higher engineering mathematics by Wiley & Barrett-Tata McGraw hill

Reference Books :

1. Advanced engineering mathematics by Wiley & Barrett – Tata McGraw Hill
2. Advanced engineering mathematics by E. Kreyszig 8th edition, John Wiley & sons. New York
3. Vector analysis 2nd edition by Chatterjee, Prentice Hall of India

21 1x03 MATHEMATICS – III

L-T-P: 3-1-0 **Credit : 4**

1. ORDINARY DIFFERENTIAL EQUATIONS &SPECIAL FUNCTIONS : Series solution of differential equations (Frobenious method), Bessel's equation, Its solution, Bessel's function of first & second kind, Recurrence formula, Legendre's equation, Its solution, Legendre polynomials, Rodrigue's formula, Orthogonality of Legendre polynomial.

Lecture : 10

2. PARTIAL DIFFERENTIAL EQUATION : Basic concept, 1st & 2nd order linear & quasi – linear partial differential equation, Classification of second order P.D.E., Boundary and initial conditions, wave equations, Separation of variables, use of fourier series, D'Alembert's solution of wave equation, Heat equation, Solution by fourier series.

Lecture : 10

3. COMPLEX ANALYSIS - I : Function of complex variables – limit, continuity, differentiability and analyticity of functions Cauchy-Riemann equations, Laplace's equation, harmonic function, Cauchy's integral theorem, Cauchy's integral formula, Taylor's and Laurent series, Residues and its applications to evaluating real integrals.

Lecture : 10

4. PROBABILITY & STATISTICS : Theorems on probability, including Baye's rule, Random variable – cumulative distribution function, Probability mass function, probability density function, Mathematical expectation, mean variance, moment, generating function & characteristics function, standard probability models Binomials, Poisson exponential, Weibull, normal and lognormal, sampling & sampling distribution, Chi- square and F distributions, large and small sample tests of significance. **Lecture : 12**

Text Books :

1. Advanced Engineering Mathematics by R.K.Jain & S.R.K. Iyengar
2. Higher engineering mathematics by B.S. Grewal
3. Fundamentals of mathematical statistics by V.K.Kapoor & S.C. Gupta- sultan & sons

References :

1. Advance Engineering Mathematics by E.Kreyszig 8th edition , John Wiley & sons
2. Complex variable and applications by Churchill & Brown –McGraw hill
3. Elements of Partial Differential equation by I.N.Sneddon - McGraw Hill
4. Introduction to Probability & Statistics for engineering by S.M.Ross – John Wiley and Sons, New York.

21 1304 NUMERICAL METHOD & COMPUTATIONAL TECHNIQUE

L-T-P : 3-1-0 **Credit : 4**

1. Introduction to computer language : Machine language, assembly language, higher level language, compilers, problem solving using computer algorithm, flow chart, examples. **Lecture : 5**

2. C/C++ Programming : Constant & variables, arithmetic expression, I/O statement, specification statement, control statements, subscripted variables, logical expression, function and subroutines, examples of programming should include numerical as well as non numeric applications, matrix operations, searching , sorting etc.

Lecture : 15

3. Iterative Techniques for solution of equations :

i. Solution of non linear equation - Simple iteration scheme, Bisection method, Regula-falsi method, Newton - Raphson method, Secant method, their rates of convergence, order of errors etc.

Lecture : 5

ii. Solution of linear equation – Gaussian elimination, matrix inversion by Gaussian method, computation of determinants, Jacobi and Gauss Seidel iteration method. **Lecture : 4**

4. Polynomial approximation : Interpolation, several form of interpolating polynomials like Lagrangian interpolation of polynomial and Newtons forward and backward difference formula, curve fitting(least square) .

Lecture : 6

5. Numerical integration : Trapezoidal method, Simpson's rule, order of errors in integration. **Lecture : 4**

6. Solution of initial value problem : Euler's method, Runge-Kutta second order and fourth order methods, solution of boundary value problem - Finite difference method.

Text Books:

1. Numerical methods for scientific and engineering computations by M.K. Jain, S.R.K. Iyengar, and R.K.Jain, New Age International Publishers, New Delhi.
2. Introductory Method of Numerical Analysis by S.S. Sastry, Prentice Hall of India Pvt. Ltd.

Reference Books

1. Numerical Analysis in Engineering by Rama B. Bhat, S. Chakravarty, Narosa Publishing House.
2. Advanced Engineering Mathematics by E.Kreyszig, 8th edition by John Wiley & Sons, New York.

21 1x05 DISCRETE MATHEMATICAL STRUCTURE & GRAPH THEORY
L-T-P : 3-1-0

Credit : 4

UNIT-I:
Mathematical Logic and Set Theory: Statement and Notation, Negotiation, Conjunction, Disjunction, Tautologies, Truth tables, Basic concepts of set theory, Inclusion and equality of sets, The power set, Ordered pairs and n-tuples.

UNIT-II:
Relations and Functions: Relation and ordering, Properties of Binary Relations in a set Relation Matrix and the Graphs a Relation, Partition and Covering of a set. Equivalence relation, Partial ordering, Partially ordered set, Functions (definition and introduction), Composition of functions, Inverse functions, Characteristics function of a set.

UNIT-III:
Group Theory: Semigroups and Monoids(defininitions and examples), Homomorphism of semigroups and monomoids, Subsemi groups and submonoids, Groups(definitions and examples) Subgroups and Homomorphisms, Cosets and Lanranges theorem, Normal
subgroups, Codes and group codes.

UNIT-IV:
Rings(definition and examples): Integral domains ring homomorphisms, Ideas of Ring polynomial.

UNIT-V:
Graph Theory: Basic concepts of Graph Theory, Basic definitions, Paths and circuits. Rechability and connectedness, Matrix representation of graphs, Trees and their representation and operations, Rooted trees, Path lengths in rooted trees, Multi graphs and weighted graphs, Shortest paths in weighted graphs.

TEXT BOOKS:
1. Discrete Mathematics Structures with application to Computer Science by J. P.
Tremblay & R. Manohar.
2. Discrete Maths for Computer Scientists & Mathematicians. (Chapter 2, 5, 7) by J. L. Mott, A. Kandel, T. P. Baker

REFERENCES:
Elements of Discrete Mathematics by C. L. Liu.
Discrete Mathematics by Lipschutz
Discrete Mathematics by R.Johnsonbaugh.

DEPARTMENT OF PHYSICS

22 1x01 PHYSICS

L-T-P : 3-0-3

Credit : 5

1. ELECTROSTATICS AND ELECTROMAGNETIC THEORY : Dielectrics -
The three electric vectors, Gauss's law in Dielectrics, Energy stored in Electrostatic field, Boundary Conditions. Continuity Equation for charge, Displacement current, Maxwell's Equations in Differential and Integral form and their Physical significance, Maxwell's Equations in free space and speed of plane electromagnetic waves travelling in vacuum. Poynting theorem and Poynting vectors, electromagnetic waves propagation in dielectrics and conductors.

Lecture : 9

2. OPTICS & LASER : Temporal coherence Michelson's interferometer for measurement of coherence length of source and line width, Spatial coherence, Measurement of spatial coherence using young's Interferometer Fraunhofer diffraction by single slit, double slit and grating.

Lasers and Laser light, Einstein A and B coefficient, Population inversion, Light amplification by optical resonator. Characteristics of Laser, Ruby laser, Working Principle of He-Ne Laser.

3. POLARISATION : Unpolarised light, Production of plane polarised light by Polaroid technique (Principle of action should be emphasized) Brewster's Law, Malu's Law, Double Refraction, Production of Plane, Circular and elliptical, Polarized Light, Analysis of unpolarised light and polarized light, Magneto-optic effect, electro optic effect and photo elastic effect.

Lecture : 7

4. **QUANTUM PHYSICS :** Planck's theory of black body radiation, Compton effect, Photo electric effect, Einstein photo electric equation and its experimental verification

Wave particle duality, De-Broglie waves, De-Broglie wave velocity, Wave and group velocity, Division and Germer experiment, Heisenberg's uncertainty principle, Application of uncertainty principle.

Wave functions and wave equation, physical interpretation of wave function and normalization condition, Expectation values, Schrodinger's wave equation (Time dependent and time independent i.e. steady, state form) in one dimension, quantum-mechanical operators, Particle in a box (Infinite Potential Well), Finite Potential barrier and tunneling.

5. SPECIAL THEORY OF RELATIVITY : Michelson-Morely experiment, Postulates of special theory of relativity, Consequence of special theory of relativity, Lorentz transformation and its application. (Length contraction and time dilation)

6. NANO-PHYSICS : Introduction and Basic definition of Nano Technology, Properties of Nano particles, Elementary ideas of Synthesis of Nano particles, Application of Nano Technology.

Text Books :

1. Concept of Modern Physics by Arthur Beiser: Publication: TMH
2. Elements of electromagnetics by Mathew N.O. Sadiku: Publication: Oxford University Press
3. Introduction to electrodynamics by David J. Griffiths; Pub.: Pearson Education.
4. Optics by Ajoy Ghatak Pub; TMH
5. Fundamentals of Physics extended volume by Resnick, Halliday and Walker; Pub.: John Wiley & Sons. Inc. Asian Edition.
6. Electromagnetic Theory (Electrodynamics) – Dr. K.K.Chopra & G.C.Agrawal, K.Nath & Co.
7. Engineering Physics – Hitendra K.Malik & Ajay Kumar Singh by TMH Publication.

Reference Books :

1. Modern Physics by G. Aruldhas & P. Rajagopal; Pub: Prentice Hall of India.
2. Quantum Physics by H.C. Verma Pub.: Surya Publication .
3. Lasers and Non-Linear Optics by B.B. Laud; Pub: New Age International (P) Ltd.
4. Principles of electricity by Leigh Page and Normal llsley Adams, Pub.: Eurasia Publishing House, New Delhi.

22 1X01 PHYSICS LABORATORY

Minimum eight experiments are required to be performed in a semester :

1. To determine acceleration due to gravity by a Bar Pendulum.
2. To determine input & output characteristics of a PNP Junction Transistor in CE Mode or configuration.
3. To determine Planck's constant.
4. To determine capacitance and permittivity.
5. To measure the numerical aperture of an optical fiber.
6. To obtain the wave length of laser source using grating.
7. To obtain the particle size by Laser
8. To obtain forbidden energy gap of Semiconductor Diode.
9. To obtain loss of energy from transformer and ferrites.
10. To obtain Dielectric constant.
11. To obtain Curie temperature
12. To obtain focal length by Convex mirror using u-v method.

DEPARTMENT OF CHEMISTRY

23 1x01 ENGINEERING CHEMISTRY

L-T-P : 3-0-3 **Credit : 5**

1. WATER TREATMENT : Introduction, characteristics imparted by impurities in water, hardness of water, unit of hardness. Estimation of hardness of water. Disadvantage of hard water, scale and sludge formation in boilers. Caustic embrittlement, Boiler corrosion, Priming and Foaming, Softening methods (soda lime process). Numerical problems. **Lecture : 7**

2. COLLIGATIVE PROPERTIES : Osmosis, Osmotic pressure, Determination of osmotic pressure, Isotonic Soln., Hypertonic solution, Hypotonic solution Lowering of Vapour Pressure, Determination of molecular weight, Elevation in B.P., Depression in F.P. and their uses in the determination of molecular weight, Abnormal behavior. Numerical problems. **Lecture : 7**

3. ELECTRO POTENTIAL AND CELLS : Single electrode potential – definition, sign convention. Construction of Galvanic cell – Classification – Primary, Secondary and Concentration cell. E.M.F. of a cell, definition of Galvanic cell, notation and convention of Galvanic cell. Measurement of single electrode potential and standard electrode potential by Nernst equation. Numerical problems. **Lecture : 7**

4. FUELS : Definition, Classification,

ANALYSIS OF COAL : Proximate and ultimate analysis of coal.

SYNTHESIS OF PETROL : Bergius process and Fischer Tropsch process.

CALORIFIC VALUE : Definition, Gross and net calorific value, Determination of calorific value of solid/liquid fuel using Bomb calorimeter.

COMBUSTION CALCULATION : Analysis of flue gas by Orsat's apparatus.

Numerical problems. **Lecture-7**

5. HIGH POLYMERS : Definition, Classification – Natural and synthetic polymers with examples.

POLYMERIZATION : Definition, Types of polymerizations, addition and condensation with examples, Mechanism of Polymerization - Free radical mechanism (ethylene as an example),

Glass transition temperature, Compounding of resins synthesis – Property and application of Teflon, PMMPA and Phenol Formaldehyde Resin. **Lecture : 7**

6. CORROSION SCIENCE : Corrosion – Definition, Chemical corrosion and electro chemical theory of corrosion. Types of corrosion – Differential aeration corrosion, Pitting corrosion, Water line corrosion, Stress corrosion. Factors affecting the rate of corrosion. Protective measures against corrosion by (i) Modification of environment (ii) Modification of metals (iii) Use of protective coatings. **Lecture : 7**

23 1X01 CHEMISTRY LABORATORY

1. To determine the mol. wt. of a non-volatile substance *urea) by Lands Berger's method/Cottrells' method.
2. To determine the apparent molecular weight of a non-volatile substance (boric acid) in benzene and to determine its degree of association.
3. To determine the velocity constant of hydrolysis of methyl acetate catalyset by HCl
4. To determine the velocity constant of inversion of cane sugar by acids.
5. To determine the total order of reaction between oxalic acid and chromic acid.
6. To determine electrode potential (E^0) of Ag/Ag^+ or Cu/Cu^{2+} or Zn/Zn^{2+}
7. To study concentration cells and hence to determine the value of 2.303RTF=k
8. To estimate Hardness of Water
9. To determine pH of Solution
10. Quantitative Analysis of different ions in inorganic salt mixtures.
11. Test of Adulteration in fat, butter, sugar, turmeric powder, chili powder and pepper.
12. Determination of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) of value of sewage volumetrically.
13. Organic Preparation: Preparation of Aspirin.
14. Test of different organic substances and their functional groups.
15. Analysis of flue gas by Orsat apparatus.
16. To determine the viscosity of a liquid or solution.

Text Books :

1. Chemistry in engineering and technology ; vol-I and II,by J. C. Kuriacose and J.Rajram; Pub.: TMH
2. Engineering chemistry; by Jain and Jain; Pub: Dhanpat Rai Publication
3. A text book of engineering chemistry by Shashi Chawla; Pub.: Dhanpat Rai & Co.
4. Engineering chemistry by B. K. Sharma; Pub.: Krishna Prakashan Media (P) Ltd.
5. Essentials of experimental engineering chemistry by Shashi Chawla, Pub.: Dhanpat Rai and Co.

DEPARTMENT OF HUMANITIES & SOCIAL SCIENCE

24 1301 ORGANIZATIONAL BEHAVIOR & INDUSTRIAL PSYCHOLOGY

L-T-P : 3-0-0 **Credit : 3**

1. **Concept of organization** & organizational Behavior. **Lecture : 2**

2.

(a) Personality : meaning, concept , determinants, personality theories (psychoanalytic Theory, Trait Theory and Self Theory).

(b) Perception-meaning , concept, process of perception, significance of perception.

(c) Leaning- meaning, concept, nature, component of leaning process.

(d) Attitude- meaning, concept, factors in attitude formation, method of finding Employee's attitude.

(e) Value - Meaning and types, value and attitude – similarity and difference.

(f) Motivation- meaning, theory of motivation (Maslow's Theory & Herzberg's Theory). **Lecture : 11**

3.

(a) Group & Group Dynamics - concept, importance, classification of groups , reason for group, formation, group cohesiveness.

(b) Team work :meaning , concept, types , creating, an effective team. **Lecture : 4**

4.

(a) Communication- concept, process, importance, barrier.

(b) Organizational conflict- meaning, concept, types, stages of conflict, resolution of conflict.

(c) Power & politics- nature and concept, Ethics of power & politics, types of power.

(d) Leadership- concept, qualities and functions of a leader, approaches to the analysis of leadership **Lecture : 8**

5. **Concept of organization theory**, concept of organization structure, form of organizational structure,form of organizational culture. **Lecture : 7**

6.

(a) Organizational effectiveness - concept , approaches, criteria of effectiveness.

(b) Organizational change - meaning, factors in Organizational change, process of planned change.

(c) Organizational Development - concept ,need of organizational development, difference between organizational development & management development. **Lecture : 7**

Text Books :

1. Organizational behavior by Stephen P. Robbin & Seema Sanghi- pearson
2. Organizational behavior by L.M. Prasad-S Chand & sons

Reference Book :

1. Organization behavior: managing people and organization by Gregory moorehead – Biztantra
2.

24 1X02 PERSONNEL MANAGEMENT AND INDUSTRIAL RELATION

L-T-P: 3-0-0 **Credits: 3**

1. **Meaning, concept, function**, & importance of personnel management, role of a personnel manager, personnel policies - Need of a personnel policies, organization of personnel Department (functional basis, service basis and chentile basis) **Lecture : 5**

2. **Manpower planning :** Meaning & concept, need for manpower planning, types of manpower planning, meaning and concept of job analysis, job description & job specification, uses of job analysis information, Recruitment, selection – meaning and steps of selection process, meaning of induction **Lecture : 8**

3. **Training and develop :** Meaning, need & importance for training, method of training, development - meaning of development, method of development. **Lecture : 5**

4. (a) Performance appraised : Meaning, Objective, method of performance appraisal .

(b) Transfer : meaning objective, types.

(c) Promotion : Meaning , policies, basis of promotion.

(d) Separation : Resignation, Discharge & Dismissal, Suspension & Retrenchment, Layoff.

Lecture : 6

5. Wages and salary administration :

(a) Meaning purpose & principle of wage & salary administration, factors influencing wage & salary administration.

(b) Meaning of wage &salary, minimum wage , fair wage& living , wage.

(c) Meaning of money and real wage.

(d) Methods of wage payment - time rate & piece rate.

(e) Incentive- Financial Incentive& non financial Incentive, method of wage payment based on result.

Lecture : 7

6. (a) Health, safety and welfare facilities.

(b) social security -

(i) meaning and concepts, objective.

(ii) form of social security- social insurance &social assistance.

(c) Problem arising from disease , invalidity , accident, old age and unemployment.

Lecture : 5

7. (a) Industrial Relation : meaning & concept, changing concept of industrial relation, role played by the employer, trade union & government, current I. R. position in India, I.R. policies of government of India.

(b) Trade Union : Meaning and concept, objective, functions, type, method of trade union.

Lecture : 6

Text Books :

1. Personal management by C.B.Memoria & G.V. Gankar- himalaya
2. Personal management & industrial relation by P.C.Tripathi-S.chand

Reference Book :

1. Industrial relation, Trade Union & Labour Relation by G.P.Sinha & PRN Sinha, Pearson.

24 1X03 SOCIOLOGY AND BUILDING ECONOMICS

L-T-P: 2-1-0 **Credit : 3**

1. Definition scope and use of sociology, its application in architecture**.** **Lecture : 2**

2. Basic concept of sociology, society, groups, community association, institution, culture, civilization and personality in terms of their characteristics and types. **Lecture : 5**

3. Social structure of India : Caste and class and marriage and family, their characteristics. L**ecture :** 5

4. Rural and urban societies : Their characteristics, features and problem , like crime, slum and poverty. **Lecture :** 4

5. Social change : Biological , technological, and cultural factors of social changes , social aspects of housing and neighbourhood in the context of changing society and growing populations. **Lecture :** 4

6. Elements of economics : Concept of utility, total utility, and avg. utility, law of equimarginal utility, concept of demand – factors governing demand for building . **Lecture : 4**

7. Production : Concept of production, factors of production, land, labour, capital, entrepreneur and organization, their characteristics, laws of diminishing returns, division of labours, efficiency of labour.

Lecture : 5

8. Distribution of national income : Rent, wages, interest and profits-inequalities in income distribution causes and courses, roles of demand and supply in the determination of price and under perfect condition.

Lecture : 5

9. Money and Banking : Function of money – inflation and deflation, and their affects on building industry , functions of central and commercial bank **Lecture : 5**

10. Concept of economic planning, objectives of the five years plans with special reference of housing.

Lecture : 3

Text Books :

1. Modern Micro Economic Theory by H.L.Ahuja, S.Chand.
2. Advance Economic Theory by M.L.Jhingan, Konark Publication

Reference Book :

1. A test book of Economic Theory by Stonier & Hague, Pearson.

24 1x04 ENGINEERING ECONOMICS AND MANAGEMENT

L-T-P: 3-0-0 **Credit : 3**

1. ENGINEERING ECONOMY : **Lecture : 7**

(a) Simple and compound interest, Annuities.

(b) Basic methods for making economy studies - (i) Present worth method (ii) future worth method (iii) I.I.R. methods.

(c) Comparison of alternative – (i) Present worth method (ii) future worth method.

2. MANAGEMENT AND ORGANIZATION : (a) Principle of management, (b) element of management, planning, organization direction and control (c) Organizational structure – line, line and staff, functional, divisional, project & Matrix Organizational. **Lecture : 7**

3. PERSONNEL MANAGEMENT : (a) function, Recruitment, selection, Training promotion, discipline, (b) Job evolution, (c) Merit rating, (d) wedge and incentive. **Lecture : 8**

4. MARKING MANAGEMENT : (a) Marking research and sale forecasting (b) Sales management (c) advertisement and sales promotion. **Lecture : 7**

5. ACCOUNTING : Meaning, scope and role of accounting concept and convention, accounting as an information system, Recording of transaction in journal and ledgers, trial-balance preparation of final account. **Lecture : 9**

6. ENTREPRENEURSHIP DEVELOPMENT : Introduction to entrepreneurship, rural entrepreneurship, women entrepreneurship, factor affecting entrepreneurship growth. **Lecture : 4**

Text Books :

1. Engineering economics by Degarmo, Sullivan& Canada, McMillan
2. Double entry book keeping by T.S. Grewal- S. Chand.
3. Principles and practice of management by LM. Prasad - S. Chand & sons.
4. Personnel management by C.B. Memoria & G.V. Gankar- Himalaya
5. Development entrepreneurship by Udai parekh & T Venkateshwara.

Reference Book :

1. Marketing management by P. Kotler.

24 1x05 COMMUNICATIVE ENGLISH

L-T-P : 3-1-0 **Credit : 4**

1. Basic Grammar: Structural pattern, single word substitution: Editing tenses of Verbs. **Lecture : 6**

2. Common errors, comparison, Syntax. **Lecture : 6**

3. Antonyms, Homonyms, Comprehension based on topics of Science & Technology **Lecture : 4**

4. Precis, Paragraph Writing, Technical description **Lecture : 4**

5. Expansion (worked & phrase) **Lecture : 3**

6. Official Correspondence, Memorandum, Circular letter. **Lecture : 3**

7. Applying for a job, Resume **Lecture : 4**

8. Business Correspondence, Report Writing, E-mail. **Lecture : 4**

9. Phonetics (Symbol and Transcription), Pronunciation **Lecture : 4**

10. Reading –developing Reading skill. **Lecture : 4**

11. Group Discussion.

Text Book :

1 English grammar and Effective Business Communication by M.A. Pink & S.E. Thomas – S.Chand & Company Ltd.
2. English grammar by Dr. D .Thakur
3. Comprehensive English grammar by C.J.Joseph & EG Myall – Inter Univ. Press.
4. Technical English by Sharon j Garson and Steve M Garson
5. Gartside's Model Business Letters by Shirley Taylor – Pitman Publishing.

Reference Books :

1. Communication in English for Technical Student by Orient Longman
2. Business Correspondence & Report Writing by R.C. Sharma & Krishna Mohan - Tata McGraw Hill
3. English Pronouncing Dictionary by Daniel Jones. Revised by A.C.Gimson – Universal Book Stall, Delhi.
4. A Student's Grammar of the English Language by Sidney Greendaum & Randolph Quirk (Pearson Education)

24 1306 INDUSTRIAL ECONOMICS & ACCOUNTANCY

L-T-P : 3-1-0 **Credit : 4**

1. Various definitions of Economics : Nature of Economic Problem, Relation between science, Engineering. Technology & Economics **Lecture : 3**

2. Meaning of demand, Law of Demand, Elasticity of demand, Practical importance & application of the concept of elasticity of Demand **Lecture : 5**

3. Meaning of Production and factor of Production : Land, labor, Capital ,Entrepreneur & Organization –their Characteristics law of variable Proportion .Return to Scale **Lecture : 5**

4. Cost Analysis : Various concept of cost, Cost function, Short & Long run cost. Concept of Revenue ,Break-Even Analysis **Lecture : 5**

5. Meaning of Market : Type of market – Perfect completion, Monopoly ,Oligopoly ,Monopolistic competition ,Main feature of these market), Meaning of Supply and Law of Supply, R ole of Demand & Supply in price in prime determination imperfect t competition **Lecture : 7**

6. Engineering Economy :

(a) Simple and compound interest, Annuities, (b)Basic methods For making economy Studies - (i) Present worth method, (ii) Future worth method (iii)I.R.R method (c) Comparison of alternative – (i) Present worth method, (ii\) Future Worth method (iii) I.R.R method. **Lecture : 7**

7. Accounting: Meaning Scope and Role of accounting , Accounting concept & Convention. Accounting as information System. Recording of transaction in journal and Ledgers. Trial –Balance, Preparation of final Account. **Lecture : 9**

Text Book :

1. Modern Micro Economics by Theory - H.L.Ahuja-S.Chand
2. Advance Economic Theory by M .L.Jhingan- Konark Publication
3. Engineering Economics by Degarmo , Sullican & Canada –McMillan
4. Double Entry Book Keeping by T.S.Grewal –S .Chand

Reference Books :

1. Stonier & Hague by A test book of Economic Theory-Pearson
2. Industrial Organisation and Engg. Economics by Banga & Sharma

24 1×07 SUSTAINABLE DEVELOPMENT

L-T-P : 3-1-0 **Credit : 4**

1. **Ecosystem**: Concept, Type, Structure, Function; Ecological succession, Pyramid, degradation and its remedies from Unsustainable development to sustainable development, Concept of sustainable development: Social and environmental issues (local, national and international), Need for studying the economics for sustainable development 10 lectures

2. **Environment and Rehabilitation:** Mined area, Habitats, Water bodies, Mangroves; Global Changes, Biodiversity concerns and precautionary principles, Evaluation of sustainable development 10 lectures

3. **Valuing Market and Non-Market Ecosystem:** Use of monetary valuation, Cost benefit analysis, Technique of monetary valuation, Definition of conventional and green GNP 10 lectures

4. **International trade and sustainable development:** Free trade and globalization vs environment and community, obstacle of free trade 08 lectures

5**. Strategic approaches and laws to sustainability:** New international institutional contexts, commission on sustainable development; Environmental ethics and laws, India's move towards sustainable development 04 lectures

Books Recommended

1. S. Deswal, A. Deswal, An Introduction to environmental science, Dhanpat Rai and Co.
2. N. Das Gupta, Environmental Accounting, Wheeler and co.
3. Daly H.E, Beyond Growth: The Economics of Sustainable Development, Beacon Press
4. D.K. Asthana, Meera Asthana, Environmental Science, S. Chand and co.
5. P.Rogers, K.F Jalal and J.A Boyd, An introduction to sustainable development, Earthscan

Referance Book

1. Willian P. Cunningham,Mary Ann Cunninggham, Principles of environmental science, T.M.H

DEPARTMENT OF CIVIL ENGINEERING

01 1×01 ENGINEERING MECHANICS

L-T-P : 3-0-3 **Credit : 5**

Theory :

1. Statics : Force System : Moment of a force about a point and an axis; Equivalent force and moment, Wrench **Lecture : 7**

2. Equilibrium : Free body diagram; equations of equilibrium; problems in two and three dimension; plane frames and trusses **. Lecture : 6**

3. Friction : Laws of Coulomb friction, impending motion problems involving large and small contact surfaces ; square threaded screw; principle of virtual work and stability. **Lecture : 8**

4. Dynamics : Kinematics and kinetics of particles dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables**. Lecture : 6**

5. Properties of areas : Center of mass; Moments of inertia; kinematics of rigid bodies; Chasle's Theorem, concept of fixed vector; velocity and acceleration of particles in different frames of references. General plane motion; Euler's equation of motion. **Lecture : 8**

6. Work & Energy and impulse and Momentum methods for particles and rigid bodies : Conservation of momentum, coefficient of restitution, moment of momentum equation**. Lecture : 7**

(vector approach to mechanics will be followed for all the topics)

Text Book :

1. Engineering Mechanics by Shames, Pearson's Education .
2. Mechanics for Engineers. Beer, F.P. and Johnston. Tata McGraw Hill. New Delhi
3. Engineering mechanics. Meriam Wiley pub.

Reference Books :

1. Engineering Mechanics. Timoshenko. McGraw Hill lnc.

Practical :

1. Practical based on mechanical advantage of different machines.
2. Moment of inertia.
3. Problem solving based on theory classes.

01 1×02 ENVIRONMENTAL SCIENCE

L-T-P : 3-0-3 **Credit : 5**

Theory :

1. Sustaining Resources : Environmental Quality : Water & Air Pollution. Effects and control of air and Water pollution; Introduction to solid waste and its management. Pollution of groundwater. Surface water and soils. Noise pollution; Renewable and Nonrenewable energy source.

Lecture : 11

2. Toxicological Chemistry and effects and risks of it on human health **Lecture : 6**

3. Environmental Chemical Analysis **Lecture : 6**

4. Humans and Sustainability, Ecology and Sustaining Biodiversity **Lecture : 7**

5. Policy and legislation for environmental protection. Current Environmental issues. **Lecture : 6**

6. Policy and legislation for environmental protection, Current Environmental Issues. **Lecture : 6**

Text Books :

1. Introduction to Environmental Engineering and Science, G.M. Masters. Pearson Education
2. Environmental Science. Miller, Thomson Press .
3. Environmental Science, Wright, Pearson Education.
4. Principles of Environmental SCIENCE, W.P. Cunningham, Tata McGraw Hill.
5. Environmental Chemistry, Sawyer and McCarty, McGraw Hill
6. Environmental Chemistry, Manahan Stanley E. Lewis Publishers.

Practical :

1. Case Analysis based on theory.
2. Determination of simple environmental parameters in laboratory.
3. Paper Presentation on current environmental issues.

01 1303 BUILDING SCIENCE

L-T-P : 3-0-3 **Credit : 5**

Theory :

1. Building construction : Overview of building process; Introduction to Building Law and IS Codes Different types of loads in Buildings, Load Combinations, IS Code provisions for Loads in Buildings. **Lecture : 7**

2. Foundation : shallow foundation (simple calculation) **Lecture : 5**

3. Super structure : Load bearing masonry, arches, lintels, scaffolding, formwork, Floors and roofs – flat and pitched roofs, concerning, floor finishes staircase and other element of construction; Doors and windows, Building services – vertical transportation, plumbing electrical, Ventilation and Air-conditioning, Energy efficiency, Fire protection, Acoustic and sound insulation. Damp proofing, termite proofing, Carpentry and joinery.

Lecture : 10

4. Concrete : Concrete making materials, properties and types of cement, properties of concrete in fresh and hardened state, durability, spatial coherence **Lecture : 7**

5. Building stones : Varieties of Indian stones. Quarrying blasting Dressing of stones, characteristics of good building stones, Slate, Marble artificial stones. Stone preservation. Brick and brick masonry; Manufacture properties. Classification and specification, Brick masonry and principles of design of masonry structure.

Lecture : 9

6. Timber steel : Properties and types miscellaneous materials; polymers and plastics .composites and smart materials. **Lecture : 6**

Text books :

1. Concrete Technology by Neville, A. M. & Brooks, J. J. Pearson Education
2. Civil Engineering Materials by Jackson, N. & Dhir, R. K, ELBS.
3. Building Construction by S. C. Renewal, Character publishing house Amend 1993
4. Civil Engineering Materials, TTTI Chandigarh
5. Construction Technology by Tony Bryan , Wiley
6. Advance Concrete Technology by Zogjin Li , Wiley

Reference Books :

1. "Construction Technology - Volumes 1 and 2, 2nd Edition" by R. Crudely, Longman, UK
2. Building Construction – volumes 1,2,3, and 4, 5th Edition by W. B .McKay. Orient Longman UK 1993
3. "Materials for civil and construction Engineers" by Michael S. Mamlouk and JOHN P. Zaniewski, Addison Longman Inc. USA
4. "Smart structure : Analysis and Design" by A. V. Srinivasan and D. M. McFarland, Cambridge" University UK, 2001.

Practical:

1. Laboratory testing of materials
2. Load Calculations based upon IS Code.
3. Calculation on Brick structure design.

01 1×04 FIELD MEASUREMENT

L-T-P: 3-0-3 **Credit : 5**

Theory :

1. Introduction : Types of surveying, scale, principle of surveying, shrinkage of Maps. **Lecture : 4**

2. Chain surveying : Types of chain, Handling .Erroneous chain Equipments .Principle of chain and equipments, Method of chain survey .Obstacles ,Field book and recording. **Lecture : 7**

3. Compass surveying : Prismatic compass Bearings Traversing ,Local attraction, Adjustment .Plane Table survey .Equipments and uses principle of surveying .Closing error and adjustment methods of locating features .Two point problem and three point problem .Advantages and disadvantage Telescopic alidade.

Lecture : 9

4. Leveling : Scope terms ,Equipments ,Types of level, Adjustment of dumpy level .Methods of leveling book and computation, missing data, Curvature and refraction correction. Reciprocal leveling contouring : Definition, Methods of contour survey, and plotting of contour. Area and volume. **Lecture : 9**

5. Theodolite : Scope, Types, Adjustment of transit theodolite. Measurement of horizontal angles ,Errors and elimination, Methods of traversing, computation of bearings. Coordinate system Gale's traverse table, Missing data, plotting **Lecture : 8**

6. Tachometry : Instrument, Tachometric constant. Analytic lens, principle, Computation, Beaman's Stadia arc, Subtense bar and subtense method, Tachometric plane table, Traversing, plotting. **Lecture : 8**

Text Books :

1. Surveying vol I and II by B. C Punmia, A. K Jain and A. K. Jain Laxmi Publications (P) Ltd., New Delhi.
2. Surveying, vol. I and II by K. R. Arora, Standard Book House, Delhi
3. Surveying : Theory and Practice by R. E. Davis, F. S. Foote and J. W. Kelly, McGraw Hill Book company
4. Surveying and Engineering by Paul Wastson , Wiley.

Practical :

Chain Survey, Compass Surveying, Plane Table Survey, Traversing, Leveling and Layout of a building.

01 1305 ENGINEERING GEOLOGY

L–T–P : 3–0–2 **Credit : 4**

Theory:

1.Basic Geology : General Geology, Mineralogy, Petrology (igneous, sedimentary and metamorphic), Structural geology, Crystallography. **Lecture : 06**

2.Engineering properties of rocks : Geomorphology (Geomorphic processes weathering, Erosion, Origin and formation of solids). **Lecture : 06**

3.Geological hazards (landslides, earthquakes and volcanoes), Groundwater, Recent concepts in Geology, Plate tectonics and Sea – floor spreading. **Lecture : 07**

4. Applied Geology : Geophysical mapping : seismic, resistivity, gravity, radar, geotomography, logging; Geological exploration of an engineering site. **Lecture : 08**

5. S. I. Desk Study : Site investigation Boreholes: Remote sensing, GIS and GPS: Basic principle and their applications in studying and monitoring Lithosphere, Hydrosphere, Cryosphere and Atmosphere. **Lecture : 08**

6.Cut Slopes in rocks and clays; Geological factors affecting the construction of dams, reservoirs and tunnels. Criteria and factors for site selection for Dam, tunnels, waste/radioactive disposal sites, Indian Geology, Outline of stratography of India. **Lecture : 10**

Text Books:

1. Principles of Engineering Geology by Johnston. R. B. and DeGraff. J. V., John Wiley and Sons, New York.
2. Fundamental of Engineering Geology by Waltham, T., Spon Press, London.
3. A Textbook of Engineering and general Geology by Singh. P., S. K. Kataria and Sons, New Delhi.
4. A Textbook of Geology by Mukherjee P. K., Te world press Pvt. Ltd., Kolkata.
5. Engineering Geology by D V Reddy, Vikash Publishing House Pvt. Ltd.
6. Element of Mineralogy in Engineering Geology by Read, H. H. Rutley's, CBS Publisher.
7. Experiments in Engineering Geology by Gokhale, K. V. G. K. and Roa, D. M., Tata McGraw Hill.

Practical:

Mineralogy, Optics, Study of rocks in hand specimen and under microscope; Topographical maps; Structural Geological maps; Structural Geological problems; Engineering Geographical maps and Engineering Geological experiment; Geological fieldwork in and around Patna.

01 1X06 MECHANICS OF SOLID - I

L-T-P : 3-1-2 **Credit : 5**

Theory :

1. **Rigid and deformable solids;** Stress and strain : Tension, compression and shear. **Lecture : 4**
2. **Analysis of stresses,** Basic Equilibrium equations, analysis of Strain Deformation, Strain Displacement Relations, Normal and shear Strains. **Lecture : 7**
3. **Transformation,** principal stresses and strains, Maximum Stresses & Strains, Mohr's Circle, volumetric Strain, compatibility Equations and boundary conditions, Strain rosettes, Velocity Field and Strain Rates. Generalized Hook's Law & Constitutive Relations for Solids, Elastic constants and their relations. **Lecture : 6**
4. **Method of sections** for evaluating internal forces in bodies, review of free body diagrams; axial force, shear and bending moment diagram. **Lecture : 4**
5. **Axially loaded members force** and deflections; Thermal Stresses. **Lecture : 3**
6. **Bending & shear :** classical theory, various cross-sectional shapes and composite sections of beams, shear stresses in beams. **Lecture : 4**
7. **Deflection of beams :** Bending deflection of simple beams by direct integration, singularity function method, Moment – Area Methods, deflection due to shear. **Lecture : 4**
8. **Torsion :** torsion of circular shift, close coiled helical springs, Torsion of thin walled open and closed sections and non-circular sections. **Lecture : 6**
9. **Combined stress;** principle of superposition and its limitations. **Lecture : 4**
10. **Introduction** to energy methods. **Lecture : 3**

Text Books :

1. Mechanics of Solids by E.P.Popov, Pearson Education Pub.
2. Solid Mechanics by S.M.A. Kazimi, Tata McGraw Hill, New Delhi.
3. Strength of Materials by Ryder, G.H., Macmillan Press Ltd.
4. Solid Mechanics by Bhavikatti Vikash ,Publishing House Pvt. Ltd.

Reference Book :

1. Mechanics of Solids : An Introduction by S.H.Crandall, N.C.Dahi and T.V. Lardner, McGraw Hill International and Tokyo.

Practical :

1. Tensile Test for M.S.
2. Hardness
3. Impact Test
4. Test for Anisotropic Substance – Wood, etc.

01 1307 FLUID MECHANICS

L-T-P : 3-1-2 **Credit : 05**

Theory:

Introduction, fluid properties: density, viscosity, compressibility, ideal and real fluids. **Lecture : 04**

1. Hydrostatics; fluid force on plane and curved surfaces, manometry, buoyancy, uniformly accelerated motion. **Lecture : 06**

2. Kinematics of fluid flow. Generalized continuity equation, Irrotational motion and solution to Laplace equation. Concept of stream lines, Equipotential Lines, Flow Nets. **Lecture : 09**

3. Dynamics of fluid flow, Control volume concepts, Euler and Bernoulli's theorems and various application like pivot tube, venturimeter, orifice meter, notches and weir etc; Impulse momentum theory and application. **Lecture : 10**

4. Introduction to Navier Stokes Equation. Flow of fluid in closed conduits, Laminar flow of viscous incompressible fluids, Darcy-Weisbach equation, Moody's diagram, and Minor losses Hardy-cross method for pipe networks. **Lecture : 09**

5. Forces on immersed bodies, concepts of separation, drag force, circulation and lift force. Dimensional Analysis, Model Similitude : Theory and application. **Lecture : 08**

Reference Book/ Text Books:

1. Fluid Mechanics by V.L.Streeter, E.B. and Wylie, McGraw Hill.
2. Fluid Mechanics by Fox & McDonald, John Wiley.
3. Fluid Mechanics by Munson, John Wiley.
4. Fluid Mechanics by F.M. White.
5. Fluid Mechanics with Engineering Application by R.L. Daugherthy, J.B. Franzini, E.J. Finnermore; McGraw Hill, International Ed.
6. I.H. Shames by Fluid Mechanics, PHI.

Practical:

Viscosity, Metacentric height. Orifice meter, Notches, Reynolds number, Impact of jet.

01 1X08 ADVANCED SURVEYING

L-T-P : 3-0-3 **Credit : 5**

Theory:

1. Curve : (a) simple curve - Scope, degree of curve, characteristics, offset from tangent, offset from chord produced. Rankine's method, obstacles. (b) Compound and reverse curve – introduction of cases. (c) Transition curve –compound curve, super elevation, length of transition curve, characteristics equations, shift, tangent length and curve length of combined curve. Computation for setting out of combined curve (d) Vertical curve – scope, assumption of vertical curve, equations, computations for setting out curve, summit and valley curve. **Lecture : 10**

2. Electronic Distance meter : Scope, electromagnetic curve, basic definitions, phase of wave, types of waves, distance by transit time and phase difference, carrier wave, method of modulation. Electro-optical EDM measurement, infra-red EDM instrument, microwave EDM instruments, effect of atmospheric conditions and corrections, slope and height corrections, use of total station. **Lecture : 9**

3. Triangulation : Scope, classification, inter-visibility, satellite station, eccentricity of signals, base line and extension of base line. Theory of error terms, laws of weight, determination of M.P.V., M.P.E, adjustment of geodetic triangle with central station, adjustment of level line, adjustment of spherical triangle. **Lecture : 10**

4. Astronomical Survey : Terms, spherical triangle, spherical trigonometry. Time, sidereal time, apparent time, mean solar time, equation of time, universal time, standard time, conversion of time, determination of time, determination of azimuth, Latitude, Longitude. **Lecture : 4**

5. Geodetic Leveling : Scope, curvature and refraction correction, axis-signal correction, single angle observation, reciprocal leveling. **Lecture : 8**

6. Hydrographic Surveying : Scope, methods of sounding, locating of sounding, three-point problem and shoreline survey. **Lecture : 5**

Text Books:

1. Geodesy by G.L Hosmer, John Wiley & sons, New York.
2. Surveying vol. II and III by B.C. Punmia, A.K. Jain, Laxmi Publications (p) Ltd. New Delhi.
3. Surveying, vol. II and III by K.R. Arora, Standard Book House, Delhi.
4. The Elements of Astronomy for surveyors by J.B. Mackie, Charles Griffin and Company Ltd., High Wycombe, England.
5. Electromagnetic Distance Measurement by C.D. Burnside, Crosby Lockwood and son Ltd., L*on*don.

Practical:

Triangulation, Setting out complex curve, Contour plotting etc.

01 1x09 SOIL MECHANICS – I

L-T-P: 3-0-3 **Credit : 5**

Theory:

1. Introduction, Origin and Classification of soils, soil weight volume relationships, Index properties of soil, soil structures and Clay Minerals**.** **Lecture : 8**

2. Effective stress principle, Surface tension and capillarity, Permeability of soils, Darcy's law, test for determination of permeability, engineering use of permeability. Factors affecting permeability. **Lecture : 4**

3. Seepage analysis, flow nets, flow through dams. **Lecture : 4**

4. Effective stress distribution in soils under hydrodynamic conditions. Quick sand, Piping, Prevention of piping failures. . **Lecture : 4**

5. Compressibility and Consolidation:- Consolidation Process- Spring analogy, Definition, measurement of consolidations- Determination of void ratio at various load increments, Terzaghi's theory of one dimensional consolidation, Determination of Coefficient of consolidation, Analysis of consolidation data. **Lecture : 10**

6. Vertical stress below applied load in soils (Boussinesq, Westergaard, and graphical solutions), one and two-dimensional cases. **Lecture : 5**

7. Compaction characteristics, water content – dry unit weight relationships, OMC, max, Dry unit weight field compaction control. **Lecture : 5**

8. Soil stabilization **Lecture : 2**

Text Books :

1. A Text Book of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, Saikripa Technical consultants, Bangalore.
2. Geotechnical Engineering by S. K. Gulati et. al., TMH Publication Co. Ltd., New Delhi
3. Basic and applied Soil Mechanics by Gopal Ranjan and A. S. R. Rao, Wiley Eastern Ltd., New Delhi.
4. Soil Mechanics and Foundation Engineering by K. R. Arora, Standard Pub. and Dist., Delhi

Reference Books :

1. Soil Mechanics in Engineering Practice by Terzaghi and Pech, John Wiley and Sons Inc New York.
2. Soil Mechanics by Lamb and Whitman, Wiley Eastern Pvt. Ltd., New Delhi.
3. Fundamentals of Soil Mechanics by Taylor, John Wiley and Sons Inc New Delhi.

Practical :

Specific Gravity of Soil, Field Density of soils, Particle size distribution of soils by sieving, Particle size distribution of soils by hydrometer method. Determination of Atterberg's limits, Permeability of soils using falling head method, Permeability of soils using constant head method, Consolidation Characteristics of soils, Proctor's Compaction Test.

01 1x10 Hydraulics & Open Channel Flow

L-T-P : 3-0-0 **Credit : 3**

Theory :

1. Concepts of boundary layer flow : Introduction, boundary layer growth over a flat plate, Boundary layer thickness, laminar boundary layer, turbulent boundary layer, transition from laminar to turbulent flow. **Lecture : 8**

2. Basic concepts of Open Channel flow : Effect of gravity and viscosity on the flow behaviour, prismatic and non-prismatic channels. **Lecture : 5**

3. Uniform flow : Theoretical uniform flow equations; hydraulically efficient sections, velocity distribution in open channels, equation for velocity distribution, velocity distribution coefficients. **Lecture : 6**

Non-uniform flow : specific energy, Critical flow in a rectangular channel, Discharge curve, Dimensionless specific energy and discharge curve, applications of specific energy, momentum principle applied to open channel flow, specific force, small waves and surges applied to an open channel. **Lecture : 8**

4. Gradually varied flow : Equation of gradually varied flow, classification of channel slopes; classification and examples of surface profiles, computation methods for length of surface profile. **Lecture : 10**

5. RVF. Hydraulic jump : Formation, length and loss of energy in a hydraulic jump, Location, elements, characteristics and types of a hydraulic jump. **Lecture : 6**

6. Introduction to Unsteady flow. **Lecture : 2**

Text Books :

1. Flow in Open Channels by K.G. Ranga, Raju, Tata McGraw Hill Publication Co. Ltd., New Delhi.
2. Flow in Open Channel by K.Subramanya, Tata McGraw Hill Publication Co. Ltd., New Delhi.
3. Fluid Mechanics by A. K. Jain, Khanna Publishers, Second Edition, Delhi-6, 1980

Reference Books :

1. Open Channel Hydraulics by V.T.Chow, McGraw Hill International, New York, 1959.
2. Foundation of Fluid Mechanics by S.W. Yuan, Tata McGraw Hill Publication Co. Ltd., New Delhi.
3. Open Channel Hydraulics by R.H. French, McGraw Hill Book co., New York, 1986.
4. Boundary Layer Theory by H.Schlichting, 7th Edition, McGraw Hill Book co., New York, 1979.

01 1X11 STRUCTURAL ANALYSIS - I

L-T-P : 3-1-0 **Credit : 4**

Theory :

1. Basic introductory concepts : structural systems, elements, joints, stability, equilibrium, compatibility, indeterminacy, types of loading. **Lecture : 3**

2. Force-displacement relation, free-body diagrams; analysis of forces in statically determinate structures : trusses (including compound and complex trusses), beams and frames (including internal hinges), cables and three-hinged **Lecture : 10**

3. Stability of Walled Structures **Lecture : 3**

4. Influence lines for beams and trusses under moving loads; Criteria for maxima. **Lecture : 7**

5. Work and energy principles : principle of virtual work, potential energy and Clastingliano's theorems, complementary energy theorems, reciprocal theorems and Mueller Breslau's principle with applications. **Lecture: 7**

6. Analysis of displacements in statically determinate structures : Unit (dummy) load and energy methods, moment area and conjugate beam methods, Williot-Mohr diagram. **Lecture : 5**

7. Introduction to Matrix Methods for determinate structures : Flexibility & Stiffness Methods. **Lecture : 7**

Text Books :

1. Elementary Structural Analysis by Norris, Wilbur and Utku, McGraw Hill.
2. Basic Structural Analysis by C.S. Reddy, Tata McGraw Hill.
3. Intermediate Structural Analysis by C.K.Wang, McGraw Hill
4. Theory of Structures – Volumes 1 and 2 by S. P. Gupta and G. S. Pandit, Tata McGraw Hill.
5. Structural Analysis by L.S.Negi & R.S.Jangid, Tata McGraw Hill.
6. Application of Graphics in Engg. by L.B.Roy, Standard Pub. and Dist., Delhi.
7. Structural Analysis Vol 1 by Bhavikatti Vikash ,Publishing House Pvt. Ltd

01 1X12 ENGINEERING HYDROLOGY

L-T-P : 3-0-2 **Credit : 4**

Theory :

1. Introduction : Hydrologic cycle and processes, Precipitation, Infiltration and Evapotranspiration, Forms of precipitation, measurement, analysis, depth-area-duration and intensity-duration frequency relations. **Lecture : 7**

2. Evaporation : Process, measurement and estimation, Infiltration process, measurement and estimation, Evapotranspiration measurement and estimation, Stream flow measurements. **Lecture : 6**

3. Runoff and Hydrographs, Factors affecting flow hydrograph, Rainfall Runoff correlations, Flow duration curve, Mass curve, Unit hydrograph, its analysis and S-curve hydrograph. synthetic and instantaneous unit hydrographs. **Lecture : 7**

4. Statistical analysis, flood frequency studies, Rational method, time Area curves, Design flood, Design Storm, Risk, reliability and safety factor. **Lecture : 8**

5. Channel and flood routing, time series analysis of droughts and floods. **Lecture : 4**

6. Groundwater hydrology, flow equations confined and unconfined flow, Well hydraulics Steady and unsteady flow, Well losses, Specific capacity. **Lecture : 6**

Reference/Text Books :

1. Engineering Hydrology by K. Subramanya, Tata McGraw Hill Pub., New Delhi.
2. Applied Hydrology by V.T.Chow et. al., McGraw Hill International, New York.
3. Elementary Hydrology by V.P.Singh Prentice Hall.
4. Groundwater by H.M.Raghunath, Wiley Easter Ltd.
5. Groundwater Hydrology by D.K. Todd, John Wiley and sons.

Practical :

Rainfall measurement, evaporation loss measurement, gauge discharge measurement, Infiltration, Hydraulic jump & hump.

01 1X13 MECHANICS OF SOLID - II

L-T-P : 3-0-0 **Credit : 3**

Theory :

1.Introduction to elasticity theory; Simple 2D/3D problems and their solutions. **Lecture : 6**

2.Pure bending of beams with unsymmetrical section; Shear Centre; Torsion of noncircular members. **Lecture : 6**

3.Curved Beams : Beams on elastic foundation. **Lecture : 6**

4.Plastic Theory, plastic hinges and shape factor, uniqueness, upper bound and lower bound theorems; Failure theories. **Lecture : 6**

5.Energy methods : Introduction to viscoelasticity and viscoplasticity; Numerical methods **Lecture : 6**

6.Stability of Equilibrium : columns, Euler's formula, Eccentric loading, end conditions and effective length, Practical Design formulae. **Lecture : 6**

7.Coupled axial force and bending moment problems; coupled torsion and bending moment problems. **Lecture : 6**

Text Books :

1. Advanced Mechanics of Materials by A.P. Boresi and O.M. Sidebottom, Fifth Edition, Wiley, Singapore.
2. Mechanics of Solid, Singh by A.K., PHI, New Delhi.
3. Strength of Materials Vol. 2 by S.P. Timoshenko, CBS Publishers, Delhi.

01 1X14 CIVIL ENGINEERING DRAWING

L-T-P : 0-0-3 **Credit : 2**

Practical :

- Understanding of conventional signs and symbols.
- Drawing of various details of residential buildings components : bonds and brickwork, doors, staircases, simple foundations.
- Site and building planning : Site plants, simple one-bedroom house, two-storied house, multi-storied apartment building, framed buildings in steel and concrete.
- Industrial and laboratory buildings.

- Drawing of framework details, floor and roofing systems, masonry, load bearing and non-load bearing walls.
- Working drawings of buildings.
- Planning and layout of large-scale commercial facilities.
- Introduction to AutoCAD.

Text Books :

(1) Building Drawing by B.P. Verma, Khanna Pub., Delhi

(2) Engineering Drawing by N.D. Bhatt.

01 1X15 SOIL MECHANICS & ROCK MECHANICS

L-T-P : 3-0-3 **Credit : 5**

Theory :

1.Shear Strength of Soil : Engineering use of shear strength, Direct and triaxial shear tests, Mohr-Coulomb strength criterion, drained, consolidated undrained and undrained tests, strength of loose and dense sands, NC and OC soils, dilation, pore pressure and Skempton's pore pressure coefficients. **Lecture : 7**

2. Earth pressure theories & Retaining Walls : Limit equilibrium method, effect of wall movement on earth pressure, pressure at rest, Rankine state of plastic equilibrium, Coulomb's theory, Rebhann and Culmann's graphical methods. Sheet piles – Types and uses of sheet piles, Analysis of Cantilever and anchored sheet piles in cohesionless and cohesive soil, Rowe's theory of moment reduction. **Lecture: 5**

3.Stability of slopes : Limit equilibrium methods, methods of slices, simplified Bishop's method and friction circle method, factors of safety, stability under conditions of submergence, drawdown and steady seepage, location of critical arc, stability number, chart. **Lecture : 9**

4. Engineering properties of rocks : engineering classification of rocks, Surface and sub-surface investigation in rock including geophysical studies. **Lecture : 7**

5.Weathering of rocks : discontinuities, field and laboratory testing of rocks and rock masses, Stress- strain characteristics, Deformability of rocks, Friction and Shear strength, Slope stability, effect of water. **Lecture : 8**

6.Introduction to analysis and design of tunnels, blasting, bolting, tunneling techniques, application. **Lecture : 6**

Text Books :

1. A Text Book of Soil Mechanics and Foundation Engineering, Revised and enlarged 4th Edition 1993 by V.N.S. Murthy, Saikripa Technical Consultants, Bangalore.
2. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R.Rao, Wiley Eastern Ltd., New Delhi.
3. Soil Mechanics and Foundation Engineering by K.R.Arora, Standard Pub. and Dist., Delhi., 1992.
4. Introduction to Rock Mechanics by R.E. Goodman, John Wiley and Sons, New York.
5. Rock Mechanics and Engineering by Jacger, Charles, Cambridge University Press, London.

Reference Books :

(1) Soil Mechanics in Engineering Practice by Terzaghi and Peck, John Wiley and Sons Inc. New York, 1967

(2) Soil Mechanics by Lamb and Whitman, Wiley Eastern Pvt. Ltd., New Delhi, 1969.

(3) Fundamentals of Soil Mechanics by Taylor, John Wiley and Sons Inc New York, 1948.

(4) Tunnels : Planning, Design, Construction by Megaw, T.M. and J.V. Bartlett. International Edition, Ellis Horwood Limited, John Wiley and Sons, New York.

Practical : Direct Shear Test, Vane Shear Test, Unconfined Shear Test, Triaxial Shear Test, Brazilian test for tensile strength of rocks, Bending Test for tensile strength of rocks, Uniaxial Compressive Strength Test.

01 1x16 Structural Analysis – II

L-T-P : 3-0-0 **Credit : 3**

Theory :

(1)Analysis of statically indeterminate structures : fixed beams and propped cantilevers by conjugate beam method; Theorem of three moments. Influence lines for propped cantilevers, continuous beams and two – hinged arches. **Lecture : 12**

(2)Introduction to force and displacement methods : consistent deformation. **Lecture : 6**

(3)Energy method, slope-deflection and moment distribution; Analysis of 2 hinged arches. **Lecture : 6**

(**4) Matrix formulation of force and displacement methods :** Solution of simultaneous equations: Stiffness matrix approach with reference to computer application; generation of frame element stiffness matrix, Torsion effect; Concept of local effects, generation of load vector, Effects of finite joints; application to plane frames, space frames, grid structures. **Lecture : 12**

(5) Finite element Method for 2-D, Plane problems- introduction. **Lecture : 6**

(6) Introduction to Structural analysis Software. **Lecture : 2**

Text Books :

(1) Matrix analysis of framed structures by W.Weaver and J.M.Gore, Van Nostrand.
(2) Basic Structural Analysis by C.S.Reddy, Tata McGraw Hill, New Delhi.
(3) Theory of Matrix Structural Analysis by J.S. Przemieniecki, Dover, New York.
(4) Structural Analysis – A Matrix Approach by G.S. Pandit and S.P. Gupta, Tata McGraw Hill, New Delhi
(5) Matrix Methods of Structural Analysis by M.B. Karchi, Wiley Eastern, New Delhi.
(6) Structural Analysis Vol II by Bhavikatti Vikash ,Publishing House Pvt. Ltd

01 1X17 DESIGN OF CONCRETE STRUCTURE - I

L-T-P: 3-0-3 **Credit : 5**

Theory:

1. Introduction to the design of concrete structure : Working stress and Limit, State Analysis **Lecture : 6**

2. Design of beams for flexure (Working Stress & Limit State Method) **Lecture : 10**

3. Bond, Shear and Torsion : **Lecture : 8**

4. One and two- way slabs. Flat slabs. Ribbed slabs: **Lecture : 8**

5. Axially and eccentrically loaded columns : Isolated and combined footings. **Lecture : 10**

(IS : 456 to be followed with limit state Design method or any other method as recommend in IS code)

Text Books:

1. IS-456-2000 Code of practice of plain and Reinforced concrete.
2. Design of Reinforced concerts structure by P.Dayaratnam, Oxford IBM publication, New Delhi
3. Reinforced concrete Design by S.N.Sinha, Tata McGraw Hill New Delhi

01 1X18 ENVIRONMENTAL ENGINEERING-I

L-T-P: 3-0-3 **Credit : 5**

Theory:

1. Water quantity demand, Design period; population forecast, variation of quantity of water, sources of water: ground and surface, Intakes. **Lecture : 7**

2. Water quality physical chemical and biological parameters: Examination of physical, chemical and biological characteristics of water. **Lecture: 5**

3. Water purification: philosophy of treatment. Unit operations and processes, Design of physical chemical and biological processes: Plain sedimentation, Coagulation and flocculation. **Lecture : 7**

4. Filtration: Slow and rapid sand filters: disinfection. Softening, adsorption and reverse osmosis and other treatment method. **Lecture : 8**

5. Water Storage: Pumping Transportation of water; Water distribution systems and analysis' Appurtenances of water transport and distribution systems, Hardly-Cross method of analysis. **Lecture : 9**

6. Introduction to air noise pollution **Lecture : 6**

Text Books:

1. Environmental Engineering by Peavy H. S, Rowe D.R. and Techobanoglous G. Tata McGraw Hills, New Delhi.
2. Introduction to Environmental Engineering & Science 2nd Ed. by Gilbert M. Masters. Prentice Hall. New Jersey.

Reference Books:

1. Elements of Water Supply and Wastewater Disposal by G.M Fair. J.C.Geyer. D.A. Okan, John Wiley and Sons Inc
2. Water Supply and Sewerage by Terence, J McGhee, McGraw Hill Book Co.
3. Water and Waste Water Technology by M.J. Hammer, John Wiley and Sons. New York
4. CPHEEO Manual on water supply and treatment, Ministry of Urban Development.
5. Environmental Management by GN Pandey ,Publishing House Pvt. Ltd

Practical:

Environmental Chemical Analysis of Water for different Parameter; Visit to a Water W. W. Treatment Plant.

01 1X19 TRANSPORTATION ENGINEERING - I

L-T-P: 3-0-3 **Credit : 5**

Theory:

1. Introduction : Importance of transportation, Different modes of transportation. Characteristic of road transport, importance of roads in India, Scope of Highway Engineering, Classification of roads and road patterns, recently launched highway projects in India. **Lecture : 3**

2. Traffic Engineering : Traffic Characteristic, Traffic Operation, Elements of Design of Intersections. **Lecture : 6**

3. Highway Geometric Design : Introduction, Highway cross- section elements, sight distance, Design of Horizontal Alignment, Design of Vertical alignment, IRC Specifications. **Lecture : 12**

4. Highway Materials : Sub-grade soil, Stone aggregate, Binding material (Bitumen emulsion tar and cut back), modification binders, use of Geo- textiles and Geo- grids, MORT specs, SUPERPAVE **Lecture: 6**

5. Design of highway Pavements : Function and desirable characteristics of pavements, pavements course, Pavements types, comparison of rigid and flexible pavement, pavement components, IRC and AASHTO methods. **Lecture : 8**

6. Highway construction : WBM, WMM, BM, BMM, PC, AC, Mastic Asphalt , BSG, PM, Seal Coat , BSD, Prime coat, Track coat, Highway maintenance and pavement Evaluation highway drainage. **Lecture : 10**

Text Books :

1. Highway Engineering by Khanna, S.K. and Justo, S.E.G., Nemchand Bros., Roorkee.
2. Principle and design of pavements by Kadiyali, L. R., Khanna Publishers, New Delhi

Reference Books:

1. Highway Engineering by Wright, P.H., John Wiley and sons, New York
2. An Introduction to Transportation Engineering and planning by Morlok, E.R., McGraw Hill, Kagakusha international student Education.
3. Introduction to Transportation Engineering by Hay. W.W., John Wiley and sons, New York.
4. Fundamental of Transportation Engineering by Papacostas, C. S., Prentice hall of India, New Delhi
5. Pavement analysis and Design by Huang, Y. H., Prentice Hall, Englewood Cliffs, New Jersey.

Practical:

1. Test on Road Aggregates

a. Aggregate Crushing value test
b. Abrasion test
c. Aggregate Impact test
d. Specific gravity and water absorption test
e. Shape test (Elongation and Flakiness)
f. Stripping value of road aggregate

2. **Tests on Bitumen**

a. Penetration test
b. Softening point test
c. Specific gravity test
d. Viscosity test

01 1X20 DESIGN OF STEEL STRUCTURES

L-T-P:2-0-2 **Credit : 4**

1. Introduction to Design : Design Loads and Load combinations, Working Stress Design, Plastic Design, LRFD Method, Introduction to steel and steel structures. **Lecture : 4**

2. Design of structural Fasteners : rivets, bolts and welds. **Lecture : 6**

3. Design of tension members. **Lecture : 4**

4. Design of compression member, laced and battened columns. **Lecture : 6**

5. Design of flexure members : Beams- rolled sections, built up section, plate Girders- riveted/ bolted and welded, Design of eccentric connections: riveted/ bolted and welded. **Lecture : 8**

6. Design of beam : Columns and columns based welded and riveted column bases- moment resistant connection - semi rigid connection- design of supports. **Lecture : 5**

7. Design of steel industrial sheds. Wind Design. **Lecture : 8**

8. Introduction inelastic action and plastic hinges application of PD and LRFD. **Lecture : 3**

Text Books:

1. Design of steel Structure by A.S Arya and J.I. Ajmani, Nemchand Bros.
2. Design of steel Structure by S.M.A. Kazimi and R.S. Jindal, Prentice Hall (India) New Delhi
3. Design of steel Structures by S.K.Duggal, Tata McGraw Hill, New Delhi

Practical/Sessional :

Based upon theory Classes

01 1x21 CIVIL ENGINEERING PROFESSION & PRACTICE

L-T-P : 0-0-3 **Credit : 2**

Introduction lectures, demonstrations, field visits on activities of department and the civil engineering profession & Ethics.

01 1x22 FOUNDATION ENGINEERING

L-T-P : 3-0-0 **Credit : 3**

THEORY:

1. **Explorations**, Geographical Investigation, Characterization of ground, site investigations, method of drilling, sampling. **Lecture : 4**
2. **Bearing Capacity,** general, local and punching shear failures, correction for size, shape, depth, water table, eccentricity, ultimate and allowable Bearing capacities, Effect of ground water level. **Lecture: 05**
3. **In-situ tests :** SPT, CPT, plates load tests, methods for ultimate bearing capacity based on in situ tests. **Lecture: 03**
4. **Settlement of foundations:** **Lecture: 03**
5. **Pile foundation** : Introduction, Pile classification, Pile installation, cast in sine pile, Driven pile, load carrying capacity of pile by state and dynamic methods, Pile load test, Pile groups, laterally loaded piles. **Lecture: 08**
6. **Caisson and Well Foundation**:- Types of Caisson, Components of Well foundation, Stability analysis of well foundation, Tilt. and Shift. **Lecture: 05**
7. **Expansive Soils :** Identification, swelling pressure, Foundation on expansive soil, Stabilization of expansive soils. **Lecture: 05**
8. **Bridge foundations caissons**, coffer dams. Excavation and dewatering for foundation. Failures and strengthening, Foundations on weak soils, reclaimed areas, swelling soils and foundations on expansive soils, arching in soil. **Lecture : 5**
9. **Machine foundations :** Types, Basic definitions. Degree of Freedom of a Block foundation, General criteria for design of machine foundation, 'Free and forced Vibrations and machine foundations subjected in impact loads. **Lecture : 9**

Text Books:

1. A Text book of soil Mechanics and foundation Engineering, Revised and enlarged 4th edition, 1993. by V.N.S. Murthy, Saikripa Technical Consultants, Bangalore.
2. Basic and Applied soil Mechanics by Gopal Ranjan and A.S.R.Rao, Wiley Eastern Ltd. New Delhi 1992.

Reference Books:

1. Foundation Engineering by R.B. Peck, W. E. Hanson and T. H. Thournburn, John Wiley, New York.
2. Foundation analysis Design by J.E. Bowles, McGraw Hill Book co. New York.
3. Foundation Engineering by G.A.Leonard, McGraw Hill Book co. New York.
4. Engineering Principle of Ground Modification by M.R.Hausmann, McGraw Hill International edition, New York.

01 1X23 ENVIRONMENTAL ENGINEERING - II

L-T-P : 3-0-3 **Credit : 3**

Theory:

1. **Generation and collection of waste-water**, sanitary, storm and combined sewerage systems, Quantities of sanitary wastes and storm water, Design of sewerage system. **Lecture : 7**
2. **Physical, Chemical and Biological characteristics** of waste-water, Primary, Secondary and Tertiary treatment of waste-water. Wastewater; Wastewater Disposal Standards **Lecture : 4**
3. **Basic of microbiology Biological :** Wastewater treatment systems : BDO, Kinetics, Kinetics and Design of Aerobic Processes- Activated sludge process and its modifications. Trickling filter, RBC, Oxidation ponds and Aerated Lagoons. **Lecture : 10**
4. **Anaerobic process** : conventional anaerobic digester, High rate and Hybrid anaerobic reactors, Sludge digestion and handling, Septic tanks, Disposal of effluent and sludge. **Lecture: 9**
5. **Simple design problems** on sewerage, waste-water treatment unit and sludge digestion. **Lecture : 4**
6. **Introduction** to Municipal solid Waste Management's **Lecture : 4**

Text Books :

1. Waste water Engineering Treatment and Reuse by Metcalf & Eddy, TMH Publication.

Reference Books :

1. Elements of water supply and waste-water Disposal by G.M.Fair. J.C.Geyer, D.A.Okan, John Wiley and Sons Inc.
2. Water supply and sewage by Terence, J. McGhee, McGraw Hill Book Co.
3. Water and Waste Water Technology by M.C.Hammer, John Wiley and sons, New York.
4. CPHEEO: Manual on sewerage and Sewage Treatment, Ministry of Work and Housing New Delhi.

01 1X24 TRANSPORTATION ENGINEERING - II

L-T-P: 3-0-0 **Credit : 3**

Theory:

1. **Railway Engineering :**Role of railway in transportation system, railway and highways, comparisons. **Lecture: 4**

2. **Permanent ways** : Alignment and grade, cross section and its elements, gauges, grade compensation and widening of gauges on curves, coning of wheels and traction resistance. **Lecture : 10**

3. **Single and Interlocking,** Points and crossing, station and yards. **Lecture : 10**

4. Introduction to Bridge Engineering:

4.1 Introduction, type of bridge and culvert and their suitability, site selection.
4.2 Determination of scour depth, depth of foundation, linear waterway Economic span, Afflux, Freeboard, clearance.
4.3 Load forces and stresses in bridge structures, IRC loading.
4.4 Type of bridge : Super structures flooring and their choice, Details of bearings and joints in Bridge super structure.
4.5 Type of bridge foundation – spread, raft, well and caissons, sinking of well foundations (design excluded, Method of erection of bridges. **Lecture 10**

5. Introduction to Airports. **Lecture : 08**

Text\ Reference Books:

1. An introduction to Transportation, Engineering and Planning by Morlok, E. R., McGraw Hill Kagakusha International Student Edition.
2. Traffic Engineering and Transportation Planning by Kadiyali, L. R., Khanna Publishers, New Delhi.
3. Introduction to Transportation Engineering by Hay, W. W., John Wiley and sons, New York.
4. Fundamentals of Transportation Engineering by Papacostas, C.S. Prentice Hall of India, New Delhi.
5. Principles of Urban transportation Planning by Hutchinson, B. G., McGraw Hill Book company.
6. A text Book of Railway Engineering by Saxena, S.C.Arora, S. P., Dhanpat Rai & Sons< New Delhi.
7. Railway Track Engineering by Munday, J. S., Tata McGraw Hill, New Delhi.
8. Indian Railway Track by Agarwal, M. M., Sachdeva press, Mayapuri, New Delhi.
9. Railroad Engineering by Hay, W .W. John Wiley and sons, New York. Delhi

01 1x 25 DESIGNS OF HYDRAULIC STRUCTURES

L-T-P : 3-0-3 **Credit : 5**

Theory:

1. DESIGN & MAINTENANCE OF CANALS: Design of canal based on tractive force approach, Maintenance of unlined channels (Based on IS 4839 – 1979 part – I), Maintenance of lined channels (Based on IS 4339 – 1979 part – II). **Lecture : 5**

2. DESIGN OF CANAL OUTLETS. **Lecture : 3**

3. CANAL HEADWORKS

- Selection of site for storage & diversion head works
- Weir or Barrages
- Divide wall, Scouring sluice or under sluices, fish ladder. **Lecture : 5**

4. DAMS

- Gravity dams, earth & rock fill dams, buttress dams & arch dams.
- Spillways & outlet works **Lecture : 10**

5. CANAL REGULATION WORKS

- Head Regulator, Distributary head regulator, Cross regulators
- Necessity of channel falls, types of falls & design of vertical drop fall/Sharda type falls **Lecture : 10**

6. CROSS – DRAINAGE WORKS

- Types of C – D works: Aqueducts, siphon Aqueducts, Super passages, Siphon Super passages, level crossings, Inlet & Outlet.
- Fluming of channels & design of channel transitions. **Lecture : 5**

7. An introduction to river basis development.

Lecture : 4

Text Books :

1. Fundamental of Irrigation Engineering by Bharat Singh, Nemchand Bros., Roorkee, Uttarakhand.
2. Irrigation & Water Power Engineering by Punima B.C., Pande Lal B.B., Laxmi Publication Pvt. Ltd. New Delhi.
3. Water Resource Engineering by Garg S.K., Khanna Publishers, New Delhi.
4. Water Power Engineering by Dandekar MM/ Sharma KN, Vikash Publishing Pvt. Ltd

Reference Books :

1. Water Resources Engineering by R.K. Linsley & J.L.H. Paulhus, McGraw Hill.
2. Hydroelectric Handbooks by W.P. Creager & J.D. Justin, John Wiley & Sons.

PRACTICAL/SESSIONAL:

Design problem based on theory classes.

01 1X26 DESIGN OF CONCRETE STRUCTURES – II

L-T-P : 3-0-3 **Credit : 5**

Theory :

1. **Design** of RCC water tanks, solos, bunkers and simple bridges. **Lecture : 14**
2. **Design** of residential buildings. **Lecture : 14**
3. **Design** of arches and shells. **Lecture : 14**

Text/ Reference Books:

1. Plain and Reinforced Concrete, Vol. I and II. by J. Krishna and O. P. Jain, Nemchand Bros. Roorkee.
2. IS 456, 2000. Code of Practice for Plain and Reinforced concrete.
3. Design Aids for R.C. to IS 456-2000.
4. Design of Reinforced Concrete Structures by P. Dayaratnam, Oxford- IBM Publishing Co., New Delhi.

Practical/Sessional:

Complete design and drawing of two complete projects such as a residential building, a bridge, a stadium, elevated water tank, bunker, silo and shell roof.

01 1X27 CONSTRUCTION PLANNING AND MANAGEMENT L-T-P : 3-0-0 Credit : 3

Theory:

1. **Construction and fabrication methods :** Pre- fabrication techniques; choice of equipment safety features and Regulations. **Lecture : 8**
2. **Value Analysis,** Feasibility studies; Economics of project evaluation: Finance, material and manpower development. **Lecture : 8**
3. **Network analysis,** PERT : Leveling of Resources. **Lecture : 8**
4. **Site organization :** layout: work study: Decision making processes: CPM and L. P. Project monitoring. **Lecture : 10**
5. **Maintenance management :** Case studies. **Lecture : 6**
6. **Introduction** to Project Management Software. **Lecture : 5**

Text Book:

1. Construction Planning and Management by U. K. Srivastav.

01 1X28 CONTRACTS, SPECIFICATION AND ESTIMATION

L- T- P : 0-0-3 **Credit : 2**

Practical/Sessional :

Contracts : Types, item rate contract, Percentage rate contract, Contract for supply of materials, Lump-sum contract. Labour rate contract, Negotiated contract and Piece work agreement.

Tenders : Earnest money. Work order, Informal tender, Security deposit, Liquidated damages, Contract Documents, Awarding and termination of contract, Maintenance period of contract, Refund of security deposit.

Measurement and Payment : Intermediate and running payment. Final payment, Measurement completed work, Measurement book, Loss of measurement book.

Specifications : Introduction, Object of specification, Types, General specification of buildings.

Specification of Materials : Bricks, Cement, Sand, Water, Lime and Reinforcement, Quantity surveying and estimating, Analysis of rates. The evaluation will be based upon submission of a partial or complete estimate of a project.

Text Books :

1. Estimating and Costing by B. N. Dutta, Tagore Palli, Lucknow.
2. Quantity surveying by, P. L. Basin, S. Chand and Company, Delhi.
3. Building Construction and Estimating by G. H. Cooper. McGraw-Hill.
4. Construction Project Scheduling and Control, 2nd Edition by Saleh Mubarak , Wiley

01 1X30 FINITE ELEMENT METHODS

L-T-P : 3-0-0 **Credit : 3**

Theory:

Principles of discretization, Element stiffness mass formulation based on direct, variational and weighted residual techniques and displacements, hybrid stress and mixed approaches, shape functions and numerical integrations. Convergence, displacement formulations for rectangular, triangular and isoparametric elements for two dimensional and axis symmetric stress analysis; thin and thick plates and shells: Seminalytical formulations. Three dimensional elements and degenerated forms. Stiffener elements and modifications such as use of different coordinate systems, use of nonconforming modes and penalty functions.

Text Books:

1. The Finite Element Method by O. C. Zienkiewiez, Tata McGraw Hill.
2. Numerical Methods in Finite Element Method Analysis by Wilson, E. L. And Bathe, K. J., Prentice Hall Englewood Cliffs.

01 1X31 COMPUTER AIDED DESIGN

L-T-P: 3-0-0 **Credit : 3**

Theory:

Engineering design principles, interactive design using workstations, and software tools. Computer graphics. Introduction to GKS. Starnase :onraroes. Computer aided design and drafting, data base management system, simulation and optimization. Applications in Civil Engineering, structural design.

01 1X32 WATER AND LAND MANAGEMENT

L-T-P: 3-0-0 **Credit : 3**

Theory:

1. **Problems of irrigation systems in India**, Soil and Land Irrigability classification, Basic concepts of diagnostic analysis. **Lecture : 3**
2. **Soil, Water Plant Relationship**, Evapotranspiration, crop coefficient, effective rainfall, crop water requirements, irrigation efficiencies. **Lecture : 10**
3. **Irrigation scheduling**, Stressed irrigation, drought and water management policy during drought. **Lecture : 4**
4. **Micro level Planning** for any canal/tube well system, Evaluation of chak planning and design. **Lecture : 3**
5. **Water application methods :** Border irrigation, basin irrigation, furrow irrigation, sprinkler and drip irrigation. **Lecture : 3**

6. Operation and maintenance of irrigation system : rotational water distribution systems- arabandi. Evaluation of irrigation project's performance and improvement. **Lectures : 5**

7. Design of an on farm drainage system, surface drains, sub- surface drains, mole drains and bio-drains: outfall condition, salinity and alkalinity control, operation and maintenance of a drainage system. **Lecture : 6**

8. Evaluation and status of land development in irrigated commands, Norms of land leveling, methods of land leveling. Plane method or centroid method, contour adjustment method. **Lecture : 5**

9. Irrigation behaviour and decision making, Attitudes and their influence on irrigation management, night irrigation, participatory irrigation management, irrigation organizations. **Lecture : 5**

Text Books:

1. Irrigation Theory and Practice by A. M. Michael, Vikas, Pub., New Delhi.
2. FAO Irrigation and Drainage Paper no. 24 & 58, Rome, Italy.
3. Irrigation Engineering by G. L. Aswa, Wiley Eastern, New Delhi.
4. Irrigation Engineering by S. K. Mazumdar, Tata McGraw Hill Pub., New Delhi.

Reference Books :

1. Diagnostic Analysis of Minor irrigation scheme, Publication no. 11, WALMI, Aurangabad (Maharashtra).
2. Application of soil survey in Irrigation Water Management, Publication no. 21, WALMI, Aurangabad (Maharastra).
3. Irrigation : Gravity Methods and Efficiencies, Publication no. 15. WALMI, Aurangabad (Maharashtra).

01 1X33 AIR POLLUTION ENGINEERING

L-T-P: 3-0-0 **Credit : 3**

Theory:

1. Air pollutants, Sources, Classification. **Lecture : 3**

2. Combustion Processes and pollutant emission. **Lecture : 4**

3. Effects on Health, vegetation, materials and atmosphere. **Lecture : 4**

4. Reactions of pollutants in the atmosphere and their effects- Smoke, smog and ozone layer disturbance etc. **Lecture : 8**

5. Atmospheric diffusion of pollutants and their analysis. Transport, transformation and deposition of air contaminants on a global scale. **Lecture : 8**

6. Air Sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards. **Lecture : 5**

7. Control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods, Particulate emission control, settling chambers, cyclone separation. Wet collectors, fabric filters, electrostatic precipitators and other removal methods. **Lecture : 10**

Reference Books:

1. Air Pollution by Rao & Rao, TMH.
2. Air Pollution Control Engineering by Rao, TMH.

01 1X34 AIRPORT PLANNING AND DESIGN

L- T- P: 3-0-0 **Credit : 3**

Theory:

1. Aircraft characteristics related to airport design.

2. Airport configuration : runway configurations, relation of terminal area to runway orientation, Geometric Design of the airfield - ICAO and FAA design standards, runways, taxiways.

3. Holding aprons and aprons : Planning and design of the terminal area- apron – gate system, size and number of gates, aircraft parking configurations, the passenger terminal system.

4. Airport lighting and marking : air traffic control, airport planning and air travel demand forecasting; Structural design of airfield pavements.

01 1x35 RIVER HYDRAULICS AND SEDIMENT TRANSPORT

L-T-P : 3-0-0 **Credit : 3**

Theory:

1. River morphology types and stages of river, phenomenon of floods, flood damages, means of flood control, river training works, groynes and spurs, embankments, cut-offs and river control structures.

2. **Sediment transport principle**, mechanics of aggradation and degradation, of river beds and bank erosion, Bed load, suspended load and total load, River measurement, gauge discharge and sediment.

Text Books:

1. Mechanics of Sediment Transport and Alluvium Stream Problems by R. J. Grade and K. G. Rangaraju, Wiley Eastern Ltd., New Delhi.
2. Manual of River Behaviors, Control and Training by D. V. Joglekar, CBIP, Pub., No. 60, 1971.
3. Irrigation Engg. by G. L. Aswa, New Agro Int. (P) Ltd. Pub., New Delhi.
4. River Engg. by M.S. Peterson, PHI, New Delhi

01 1x36 CIVIL ENGINEERING DRAWING USING AUTOCAD

L-T-P: 3-0-0 **Credit : 3**

Theory: Introduction to Auto Cad :

Loading and configuring AutoCAD. Creating viewing and editing the drawing in Auto Cad, Different compound entries, From Table menu, From bottom menu, Data entries, Absolute coordinates, Relative and Polar coordinates, World coordinates, Pointing with key boards, object snap etc. Advanced user Interfaces. Menu bar and pull Down menus Icon menu dialogue Boxes, Utility, Commands, All the available commands in Auto Cad, Edit and Enquiry Commands, Display Controls, Dimensioning and crosshatching, Exercise 3 Nos. Plotting, Sessional Examinations.

01 1X37 STRUCTURAL DYNAMICS

L-T-P: 3-0-0 **Credit : 3**

Theory:

Formulation and solution of SDOF and MDOF dynamics systems; Undamped and Damped systems; Free and Forced vibration; Duhamel's integration; Dynamic load factor; Modal Analysis; Continuous systems, Axial and transverse vibration of beams. Vibrations of plates; support motion; Energy Principles and Hamilton's Equations; Introduction random vibration.

Text Book

1.Dynamics of Structures by Patrick Paultre, Wiely
2. Dynamics of Structures by Clough & Penzine , MC- Graw- Hill

01 1X38 SOLID WASTE MANAGEMENT

L-T-P: 3-0-0 **Credit : 3**

Theory:

Solid wastes-Sources, nature and characteristics of municipal solid waste, Quantities and qualities, Rates of generation and factors affecting them, Potential of diseases, nuisances and other problems due to solid waste management, Solid wastes management-Generation, on-site storage, collection, separation, processing and disposal On-site storage methods-containers, their type, size and location, Collection systems-Vehicles, routing, route balancing and transfer stations , Processing methods, recovery and reuse of materials and energy, Disposal methods such as sanitary landfill biological digestion etc. Industrial and hazardous solid waste management, Urban solid waste management and its modeling.

01 1X39 TRAFFIC ENGINEERING

L-T-P: 3-0-0 **Credit : 3**

Theory: Introduction, Traffic survey speed, Journey and Delay Surveys, Vehicles Volume counts, O-D survey. Use of Photographic Technique in Traffic survey, Elements of Parking survey Analysis and Interpretation of Traffic Studied Statistical Methods of Traffic Engineering, Speed studies, Traffic forecasting Traffic Controls; Traffic signs, Road marking , Traffic signals Highway capacity analysis for rural roads and urban roads Traffic Regulations, Regulation of traffic, Design of controlled and uncontrolled intersections Traffic safety; Road accidents , Causes and Prevention, Street Lighting and Traffic management.

01 1X40 DESIGN OF WATER RETAINING, PLATE AND SHELL STRUCTURES

L-T-P: 3-0-0 **Credit : 3**

Theory: Pure bending of plates; Symmetric bending of circular plates; small deflection of laterally load plates; Rectangular plates with various edge conditions; Continuous rectangular plates; Plates of various shapes; Application for water tanks, Shell as space enclosure, geometry, classification, principal and Gauss curvature; General Theory of thin elastic shells; Shallow and high rise shells; Circular long and short cylindrical shells, beam-arch approximation for long shells; shells of double curvature, surfaces of revolution and translation; Circular, elliptical hyperbolic paraboloids, conoids and funicular shells-membrane and approximate bending theories; Closed form and numerical method of analysis of Synclastic and Anticlastic shells.

01 1X41 INDUSTRIAL WASTE TREATMENT

L-T-P: 3-0-0 **Credit : 3**

Theory:

Industrial waste waters nature and effects, Water pollution and problem pollutants, stream sanitation, deoxy-generation and self purification in streams, sources and characteristics of industrial waste-waters, sampling and analysis, in-plant waste control and water reuse, different methods of treatment, aeration, sedimentation, combined biological, physical and chemical process, application of treatment method to some selected industry, introduction to ISO:14,000, life cycle analysis etc.

01 1X42 TRANSPORTATION SYSTEM AND PLANNING

L-T-P : 3-0-0 **Credit : 3**

Theory:

Introduction to Transportation planning process, Transportation Surveys, Models for Trip Generation, Trip Distribution, Traffic Assignment and modal split, Network Analysis, Shortest path Algorithms, Minimum Tree, Land-use Transport Models, Calibration of Transportation Models, Economic Evaluation of Transportation plans, Facility Location Problems, vehicle Operating Costs.

Text Books :

1. Regional Development Planning in India by Prakash Rao and Sundaram, Vikas Publishing House.
2. Urban Transportation Systems Planning by B.G.Hutchinson, Introduction to McGraw Hill.
3. Urban Public Transportation Systems and Technology by Vukan R. Vuchin, Prentice Hall Inc.,N.J.
4. Public Transportation Planning Operations and Management by G.E. Gray and L.A. Hoel, Prentice Hall Inc.

01 1X43 WATER RESOURCES PLANNING AND MANAGEMENT

L-T-P : 3-0-0 **Credit: 3**

Theory:

Purpose and scope of water resources development, water resources of world and Asian continent , water resources potential and utilization in India, turns boundary features, functions of water in land development and social planning, integrated river basin development; water supply and demand assessment, types of consumptive and non-consumptive uses of water resources ; single and multipurpose water users-compatibility of different uses; allocation of available water resources , Reservoir planning, Systems concept in engineering , system analysis , optimization techniques, linear programming, dynamic programming, water resources planning, and project formulation, economics of water resources development; conjunctive use; interstate and international issues, environmental impact.

Text Books :

1. Water Resources Engineering by R.K.Linsley and J.B.Franzini, McGraw Hill Book Co.,New York.
2. Water Resources System Planning & Economics by R.S. Varshney, Nem Chand, Bros. Roorkee.
3. Water Resources Systems Engg. by W.A. Hall and J.C. Dracup, McGraw Hill Book Co., New York.
4. Water Resources Engineering by Larry W. Mays , Wiely

01 1X44 SOIL DYNAMICS

L-T-P : 3-0-0 **Credit : 3**

Theory :

Principles of dynamics and vibration, Single degree and Multiple degree of freedom systems- free and forced vibrations, Dampening and Soil Spring Constants, Introduction to vibration of continuous systems – wave propagation in soil media, Laboratory and In-situ determination of dynamic soil properties, Introduction to machine foundations and its practical considerations for construction IS code of practice, Examples, Soil Liquefaction.

Text Book :

1. Handbook of Machine Foundations by Srinivasulu and Vidyanathan, TMH, New Delhi.

01 1X45 ADVANCED FOUNDATION ENGINEERING

L-T-P : 3-0-0 **Credit : 3**

Theory:

Conventional method of Design of Isolated footings, Strip footings, Raft foundations, Piled Raft foundations, Well foundations ,Floating foundations. Determination of pile capacities, negative skin friction and group action of piles considering stress-strain characteristics of real soils, Deep open cuts, Coffer dams, Batter piles, Anchor piles and determination of pull out resistance, Legal aspects of problems in Foundation Engineering.

Critical study of nature and complexities of soil structure interaction; Application of advanced techniques of analysis such as the finite element method , finite differences, relaxation and interaction for the evaluation of soil-structure interaction for different types of structures under various conditions of loading and subsoil characteristics; Preparation of comprehensive design oriented computer programmes for specific problems. Interaction problems based on the theory of sub grade reaction such as beams , footing, rafts, bulkheads etc., Legal Aspects of problems in Foundation Engineering.

Text Books:

1. Analytical and computer method in foundation by J.E.Bowels, McGraw Hill Books Co., New York.
2. Numerical Methods in Geotechnical Engineering by C.S. Desai and J.T. Cristian, McGraw-Hill Book Co., New York.

01 1X46 WATER POWER ENGINEERING

L-T-P : 3-0-0 **Credit : 3**

Theory :

Comparison of hydro-power and thermal power, combined power systems and grids, assessment of available hydropower, necessity of storage and pondage, flow duration curve and their uses, types of hydropower plant, design of power house structures; intakes, conveyance systems, foreway, surgetanks, power house, tail race, types and selection of turbines, water hammer analysis.

Text Books :

1. Water Power Engg. by M.M Dandekar and K.N. Sharma, Vikas Publishing house, New Delhi.
2. Hydropower Structures by R.S.Varshney, Nem Chand and Bros., Roorkee.

01 1X47 BRIDGE ENGINEERING

L-T-P : 3-0-0 **Credit : 3**

Theory :

Brief historical review, Different types of Bridges and span range, Bridge codes, Bridge super structures- Reinforced concrete slab bridge deck, Plate girder bridges, Composite bridges, prestressed concrete bridges, Steel trussed bridges; Orthotropic plate theory, Determination of rigidity parameters, Load distribution in different girders – Courbon"s method, Morice-Little method, Box girder bridges – finite element and finite strip analysis, finite difference analysis of deck slab, grillage analysis, Cable stayed and suspension bridges; Bridge construction; Bridge maintenance.

Reference/Text Books:

1. Bridge Engineering by Vector et. al.,TMH.

01 1X48 SYSTEMS ENGINEERING

L-T-P : 3-0-0 **Credit : 3**

Theory :

Introduction to the course and its importance, Optimization methods:-Introduction, Problem formulation, Introduction to mathematical principles in optimization, Solution techniques for linear and integer problems Introduction to non-linear problems, simplex and dual simplex methods, Civil Engineering Case Studies, Transportation Model, Degeneracy and dual simplex methods, civil engineering case studies. Transportation model. Degeneracy and assignment problem, Project scheduling, queuing system and their characteristics, PERT & CPM, inventory and crew scheduling.

01 1X49 ENVIRONMENTAL IMPACT ASSESSMENT

L-T-P : 3-0-0 **Credit : 3**

Theory :

Technical and procedural aspect of Environmental impact assessment, Guidelines and aspects of environmental protection, Determination of Baseline environment, General framework for characterizing environmental dislocation/disruption due to pollution, application of mathematical models for water quality systems, Stream and Estuarine models for pollution control. Socio-economic aspects, measures effectiveness of pollution control activities, various method of total impact assessment, Environmental auditing.

Text books :

1. Environmental Impact Assessment by Canter, McGraw Hill Inc.,

01 1X50 PRE-STRESSED CONCRETE DESIGN

L-T-P : 3-0-0 **Credit : 3**

Theory :

Concept on mechanics; materials; properties of section; stress analysis- three methods: prestressing and post stressing; Beam design – no tension and ultimate; Poles and slab panels; Loss assessment; Composite beams; Design for shear. Large span structure; Structural forms and design principles; Special material, open web and built-up structures.

01 1X51 DESIGN OF DAMS

L-T-P : 3-0-0 **Credit : 3**

Theory:

Gravity on Mechanics, Buttress dams, Rock fill dams; Application of analogy techniques; Spillways techniques, classification, design considerations; Contraction joints, treatment of foundations, design of hydropower installation and intake structures.

01 1X52 IRRIGATION ENGINEERING

L-T-P : 3-0-0 **Credit : 3**

1. Irrigation Principles and Practices : Introduction. Necessity, Advantages and disadvantages of irrigation, classification, method Irrigation**.** **Lecture : 5**

2. Soil water plant and Their Relationship : Soil Classification, Soil- water plant relation , soil moisture relationship, Water Requirement of Crops; Optimum Use of water, Factors affecting water requirement of crops, Duty, Delta; and their relationship. Water Requirement by inductive methods, Critical Coefficients Consumptive use of requirement by climatologically approach, FAO methods for Reference evapotranspiration **Lecture : 12**

3. Irrigation Efficiencies. **Lecture : 3**

4. Irrigation Scheduling : for both Irrigated dry and irrigated wet crops, irrigation scheduling in command areas. **Lecture : 4**

5. Flow Irrigation : Classification of canals, Canals alignments, Components of permanent canal system, Canal capacity, canal losses, Lined channels & their design, Kennedy's slit theory and design of channels on its basis, Lacey's slit theory and regime equations, various types of relations, Design of channels based on Lacey's equation. **Lecture : 12**

6. LIFT IRRIGATION : Classification, Location, Water lifting arrangement, Yield of wells. **Lecture : 6**

Text Books :

1. Fundamental of Irrigation Engineering by Bharat Singh, Nemchand Bros., Roorkee, Uttarakhand.
2. Irrigation & Water Power Engineering by Punima B.C., Pande Lal B.B., Laxmi Publication Pvt. Ltd. New Delhi.
3. Water Resource Engineering by Garg S.K., Khanna Publishers, New Delhi.
4. Irrigation Theory & Practice by Micheal A.M., Vikas Publication, New Delhi.

Reference Book :

1. Water Resources Engineering by R.K. Linsley & J.L.H. Paulhus, McGraw Hill.

01 1x53 LAND DRAINAGE

L-T-P : 3-0-0 **Credit : 3**

1. INTRODUCTION : Forms and nature of occurrence of watering soils – Soil moisture characteristic, Darcy's law & Richards equation – Soil water movement above water level. **Lecture : 3**

2. AGRICULTURE DRAINAGE : Needs for drainage – Drainage and crop production, drainage to control water logging & salinity. **Lecture : 2**

3. DRAINAGE SYSTEMS : Components of a drainage system, Field drainage system (i) Surface drainage system, (ii) sub surface drainage systems and (iii) Compound drainage systems. **Lecture : 3**

4. DRAINAGE INVESTIGATIONS: Water table dissolves salts in ground water, hydraulic conductivity, depth of impermeable layer, hydraulic conductivity, drainage coefficient, flow at the junction of two drains.

Lecture : 10

5. SURFACE DRAINS: hydraulic design of a surface drains and its related structures, construction and maintenance of surface drain's. **Lecture : 4**

6. SUBSURFACE DRAINS: Types – design of depth of subsurface drains, design of spacing of subsurface drains (i) for steady state condition (ii) for unsteady state condition – diameter of pipe drains, grade of pipe drains, design of envelop, construction and maintenance, economics of subsurface drains. **Lecture : 12**

7. SOIL SALINITY: definitions, saline, alkaline and saline, alkali soils, drainage for salinity control, land reclamation techniques for salt affected soils. **Lecture : 8**

Text Books:

1. Drainage Manual "US Department of the interior", Bureau off reclamation, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Drainage Principles & Application, International Institute Land Reclamation & improvement, Waganingen, The Netherlands publication.
3. Drainage Engineering by J.N. Luthin, John Wiley & Sons, New York, USA.

Reference Books:

1. Diagnosis & Improvement of saline & alkali soil, Agriculture Hand book no 60, US Deptt. of Agriculture.
2. Hand book of Drainage of Irrigated areas in India, LBII/WAPCOS (India) Ltd., Technical Report no. 5, New Delhi.
3. Hand book of Irrigation Technology, VOL II, Hermah J. Finkel, CRC Press.

01 1x54 FLOODS & DROUGHTS

L-T-P: 3-0-0

Credit : 3

1. FLOODS

- Introduction
- Rational Method
- Empirical Formulae
- Unit Hydrograph Method
- Flood Frequency Studies
- Gumbel's Method
- Log Pearson Type III Distribution
- Partial Duration Series
- Regional Flood Frequency Analysis
- Limitations of Frequency Studies
- Design Flood
- Design Storm **Lecture : 12**

2. FLOOD ROUTING

- Introduction
- Basic equations
- Hydrologic storage routing
- Attenuation
- Hydrologic channel routing
- Hydraulic method of flood routing
- Routing in conceptual hydrograph development
- Clark's method for IUH
- Flood control
- Flood forecasting
- Flood control in India with special reference to Bihar **Lecture : 15**

3. FLOOD MANAGEMENT TECHNIQUES

Introduction Flood Control and Management-Catchment Area treatment- Structural Measures- Non- structural Measures. **Lecture : 5**

4. DROUGHTS

- Climatic Regions

- Arid region
- Semi-arid region
- Humid regions

- Drought

- Drought and rainfall
- Drought classification
- Drought, rainfall and temperature

- Effects of drought

- Effects on ground water
- Effects on water quality
- Effects on socio economic status

- Drought Control

- Supply oriented drought control measures
- Demand oriented drought control measures.

Text Books :

1. Engineering Hydrology by Muteraja.
2. Engineering Hydrology by Subramaniam
3. Watershed Hydrology by R. Suresh, Standard.

01 1X55 GROUND WATER ENGINEERING

L- T- P : 3-0-0 **Credit : 3**

1. Introduction : Ground water development in India. Characteristics of fluid and the Medium. Soil moisture, Classification of subsurface water, Darey's law, Range of validity of Darey's law, Co-efficient of permeability.

2. General Hydro- dynamical Equations for the flow of Fluids through Porous media. The Equation of continuity, Equation of motion, Dupuit's equations for unconfined seepage flow, Plane free surface flow with horizontal impervious base without infiltration. Plane free surface flow with horizontal impervious boundary with infiltration and evaporation. Confined and semi-confined flow.

3. Mechanics of Flow towards Well aquifers, Classification. Specific yield, Storage co-efficient, Land susidence due to ground water withdrawals, unconfined wells. Discharge of an ordinary perfect well as a function drawdown.

4. Unconfined flow towards well with uniform infiltration from the ground surface. Confined radial flow towards the well. Discharge as a function of drawdown, well efficiency, Radius of influence, Determination of permeability by one or two well methods.

5. Lowering of ground water table, Unsteady confined flow, Well losses.

6. Geophysical Investigations Surface geophysical techniques, Electrical resistivity, Seismic refraction and reflection, other methods.

7. **Ground Water Quality :** Water sampling, Potable water standards of WHO, Ground Water Basin Management and Conjuctive Use of Surface and Ground Water A case study, Investigation design, construction and maintenance of tube, wells, filter materials and education wells.

Text Books :

1. Ground water Hydrology by M. H. Raghunath, New Age Publication, New Delhi.
2. Irrigation Engineering and Hydraulic Structures by Sahasrabuddhe. S. R., Katson, Ludhiana, 1975.

Reference Book :

1. 'Ground Water Hydrology' by Todd, David Keith (2007), Wiley India Edition, New Delhi – 110002.

01 1x56 ADVANCED SOIL MECHANICS

L- T- P : 3-0-0 **Credit : 3**

1. Soil Structure & Mineralogy : Soil texture, Solid particles in soil, Atomic & molecular bond. Interparticle forces in a soil mass. Single grained structure, Honey- comb structures. Flocculent & disperse, structures, Structure of connected soil.

2. Clay minerals.

3. Soil Water : Modes of occurance of water in soils- Absorbed water, Double layer, Capillary water – Stress condition in soil- Effective & neutral pressures.

4. Capillary permeability test, Drainage & Dewatering Ditches & sumps, Well point system, Shallow well system. Deep well drainage, Electro-Osmosis method, Protective filters.

5. Shear Strength Use of Stress path in triaxial test- Undrained & drained tests for Normally Consolidated & Over Consolidated clay samples.

6. Skempton's pore-pressure parameters, Choice of shear parameters, Stability of open cut – braced open cut. Bishop's rigorous method, Limit equilibrium approach.

7. Bulk Head & Cofferdams : Classification – cantilever sheet pile wall in cohesionless and in cohesive soils Arching in soils, Classes of underground conduits, loads on positive projecting and negative projecting conduits.

Text Book :

1. Soil Mechanics, Lambe T. W. And Whitman, R. V. (1979), John Wiley & Sons Inc.
2. Soil Mechanics and Foundation Engineering, V. N. S. Murthy, Sai Kripa Publication, Bangalore.
3. Geotechnical Engineering, S. K. Gulathy et. al., TMH Publication New Delhi.

01 1x57 ADVANCED STRUCTURAL ANALYSIS

L- T- P : 3-0-0 **Credit : 3**

1. Matrix method in skeletal structural analysis : force and displacement methods including analysis substructures Non-linear and Elasto-plastic analysis.

2. **Analysis of plates**, Folded plates and singly curved shells, conventional and approximate methods.

01 1x58 INTRODUCTION TO EARTHQUAKE RESISTANT DESIGN METHODS

L-T-P - 3-0-0

Credit : 3

1. **INTRODUCTION** :-

Earthquakes, Epicentre, Earthquake waves, Seismic Regions, Intensity of Earthquakes, Magnitude and Energy of an Earthquake, Consequences of Earthquakes, Seismic Zoning, IS Recommendations.

Lecture : 06

2. **DYNAMICS OF ELASTIC SYSTEMS**:

Vibrations of single degree of Freedom System, Sources of vibrations, Types of vibrations, Degree of Freedom, Free and forced vibrations, vibrations of single Degree Freedom systems(Damped and undamped), Viscous Damping.

Lecture : 08

3. **DYNAMICS OF SOILS AND SEISMIC RESPONSE** :-

Dynamic behaviour of soil- stress condition of soil, settlement of dry sand, Liquefaction of saturated cohesionless soil, factors affecting liquefaction characteristics, Dynamic soil properties- Field tests and Laboratory tests, Prevention of liquefaction, Seismic Considerations for foundations- shallow and Deep foundation. **Lecture: 06**

4. **VIBRATION OF CONTINOUS SYSTEM** :-

Introduction to two Degree Freedom system, Multi Degree freedom system, Vibrations of continuous system, Axial and flexural free vibrations of Beime Forced vibrations-Earth quake excitations. **Lecture: 08**

5. **EARTHQUAKE RESISTANT**:-

“Design of Structures Design Data and philosophy of design, Seismic co-efficient, Permissible stresses and load factors. Seismic analysis of multi storied Buildings. I.S. recommendations. **Lecture: 08**

6. **EARTHQUAKE RESISTANT**:-

“Construction of Buildings “Recommendations of IS 4326, provisions of Horizontal band, provision of vertical re-enforcements, Special considerations for earthquake resistant foundation design for buildings.

Lecture: 06

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

05 1301 OBJECT ORIENTED PROGRAMMING

L- T- P : 3-0-3 **Credit : 5**

1. Introduction to C++ : Object Oriented Technology, Advantages of OOP, Input- output in C++, Tokens, Keywords, Identifiers, Data Types C++, Derives data types. The void data type, Type Modifiers, Typecasting, Constant, Operator, Precedence of Operators, Strings. **Lecture : 3**

2. Control Structures : Decision making statements like if-else, Nested if-else, goto, break, continue, switch case, Loop statement like for loop, nested for loop, while loop, do-while loop. **Lecture : 3**

3. Functions : Parts of Function, User- defined Functions, Value- Returning Functions, void Functions, Value Parameters, Function overloading, Virtual Functions. **Lecture : 3**

4. Classes and Data Abstraction : Structure in C++, Class, Build- in Operations on Classes, Assignment Operator and Classes, Class Scope, Reference parameters and Class Objects (Variables), Member functions, Accessor and Mutator Functions, Constructors, default Constructor, Destructors. **Lecture : 15**

5. Overloading & Templates : Operator Overloading, Function Overloading, Function Templates, Class Templates. **Lecture : 5**

6. Inheritance : Single and Multiple Inheritance, virtual Base class, Abstract Class, Pointer and Inheritance, Overloading Member Function. **Lecture : 5**

7. Pointers and Arrays : Void Pointers, Pointer to Class, Pointer to Object, The this Pointer, Void Pointer, Arrays. **Lecture : 6**

8. Exception Handling : The keywords try, throw and catch. Creating own Exception Classes, Exception Handling Techniques (Terminate the Program, Fix the Error and Continue, Log the Error and Continue), Stack Unwinding. **Lecture : 5**

Text Books :

1. Thinking in C++, Volume 1 & 2 by Bruce Eckel, Chuck Allison, Pearson Education
2. Mastering C++, 1/e by Venugopal, Tata McGraw Hill.
3. Object Oriented Programming with C++, 3/e by E. Balaguruswamy, Tata McGraw Hill.
4. Starting Out with Object Oriented Programming in C++, by Tony Gaddis, Wiley India.

Reference Books :

1. The C++ Programming language 3/e by Bjarne Stroustrup, Pearson Education.
2. C++, How to Programme, 4e, by Deitel, Pearson Education.
3. Big C++ by Cay Horstmann, Wiley India.
4. C++ Primer, 3e by Stanley B. Lippmann, Josee Lajoie, Pearson Education.
5. C++ and Object Oriented Programming Paradigm, 2e by Debasish Jana, PHI.
6. Programming with C++, 2/e by Ravichandran, Tata McGraw Hill.
7. C++ Programming Black Book by Steven Holzner, Dreamtech Press.

Programming Lab (OOP)

Writing programs using classes and objects, constructors and destructors, Inheritance properties, Overloading operators, Use of pointers list representation, Programs and virtual functions, file handling, I. O. Manipulator using C++.

05 1X02 COMPUTER ARCHITECTURE

L-T-P : 3-0–0 **Credit : 3**

1. Introduction: Computer Arithmetic, Instruction sets, Introduction to computer organization, CPU Design. **Lecture : 8**

2.Micro programmed Control: Control Memory, Address sequencing, Micro program example. **Lecture : 5**

3.Memory and Input- Output Systems: Hierarchical memory structure, Cache memories, set Associative memory, Virtual Memory, Paging, Segmentation, Input- Output Interface. Asynchronous Data transfer, Programmed I.Q., Interrupts, Direct Memory access. **Lecture : 15**

4.Introduction to Parallel Processing: Evolution of computer systems (RISC vs. CISC), Parallelism in uniprocessor systems, Architectural classification schemes. **Lecture : 5**

5.Principles of Pipelining and Vector Processing : Pipelining, Overlapped parallelism, Principles of designing pipelines Processors, Vector processing requirements. **Lecture : 5**

6.Structures & Algorithms for Array Processors : SIMD Array processors, SIMD Interconnection networks. **Lecture : 4**

Text Books :

1. Computer System architecture, 3e by M. Morris Mano, Pearson Education.
2. Computer architecture and parallel processing by Kal Hwang, Briggs, McGraw Hill.
3. Computer Architecture by Carter, Tata McGraw Hill.

05 1X03 DATA STRUCTURES

L–T-P : 3-0-0 **Credit : 3**

1. Introduction to algorithm - Analysis for time and space requirements. **Lecture : 2**

2. Linear Data Structures and their Sequential Representation: Array, stack, queue, circular queue and their operations and applications. **Lecture : 7**

3. Linear Data Structures and their Linked Representation: Linked linear list, circularly linked linear list Doubly linked list, linked stack, linked queue and their operations and applications. **Lecture : 10**

4. Nonlinear Data Structures : Binary trees, binary search trees, representations, operations, thread representations, sequential representation traversals, applications, B-tree, Operation on B- tree, AVL Search tree and operations, Huffman algorithm, height Balanced Tree. **Lecture : 14**

5. Sorting and Searching : Bubble Sort, Insertion Sort, selection Sort, Heap Sort, Quick Sort, Radix Sort, Linear and Binary search, Union-Find, Hashing methods, etc. **Lecture : 10**

Text Books :

1. Data Structure Using C by ISRD group, Tata McGraw Hill.
2. Data Structures by Lipschutz & Pai, Tata McGraw Hill.
3. Data Structure using C and C++ by Langsam, Pearson Education.
4. Data Structure by E. Horowitz and S. Sahni.
5. Data Management & File Structures. 2E, by Mary E. S. Loomis, PHI.
6. Data Structures & Algorithm Analysis in C++, 2e, by Mark Allen Weiss, Pearson Education.
7. An Introduction to Data Structures with applications, Second Edition, by J. P. Tremblay and P. G. Sorenson, Tata McGraw Hill.

Reference Book :

1. Data Structure using Java by Langsam, Moshe Augenstein and aaron M, Tenenbaum.
2. C and Data Structures by P. S. Deshpande. Wiley India.

05 1X04 OBJECT ORIENTED ANALYSIS AND DESIGN

L-T-P : 3-0-0 **Credit : 3**

1. Introduction : Object Oriented Development & themes, Usefulness of OOPS, Object Modeling Technique. **Lecture : 6**

2. Object Technique : Link Association, Generalization, Inheritance, Aggregation, Abstract Classes, Dynamic Modeling event & States. State Diagram, Nested State Diagram, Relation of Object & Dynamic Model, Functional Modeling, Data Flow Diagram, SSD, Use Case. **Lecture : 15**

3. Design Methodology : OMT Methodology, Analysis, Iterating the Analysis, System Design, Object Design, Comparison of Methodologies. **Lecture : 15**

4. Case Studies : Object oriented Language Relational Database. **Lecture : 8**

Text Books:

1. Object Oriented Modeling and Design by Rumbaugh, Pearson Education.

2. Object Oriented Analysis and Design: Understanding System Development with UML by Mike O Doherty, Wiley India.

3. Object Oriented Analysis and Design by Kahate, Tata McGraw Hill.

Reference Books:

1. Object Oriented Analysis and Design with Application by Gradv Booch, Pearson Education.

05 1X05 SYSTEMS PROGRAMMING

L-T-P : 3-0-3 **Credit : 5**

1. Introduction : System software and its components. **Lecture : 2**

2. Assemblers : Elements of assembly language programming, Assembly process, Machine Dependent Assembler, Machine- Independent Assembler, Design of multipass / 2-pass assembler, single pass assembler. **Lecture : 10**

3. Macros and Macro Processor : Macro definition and call Macro expansion, Nested Macro calls, Design of a Macro preprocessor. **Lecture : 8**

4. Loaders & Linkers : Basic Loader Function, Machine- dependent Loader, machine- Independent Loader, Loader Design option, Absolute loader, Bootstrap Loader, Relocation and linking concepts, Design of a linker, self Relocating programs and Overlay structure. **Lecture : 10**

5. Compiler: Machine- Dependent Compiler, Machine- Independent Compiler, Compiler Design (Options, Interpreter, P-code Compiler), Compiler-, Case study of Compiler, **Lecture : 10**

6. Software Tools : Software Tools for Program Development, Editors, Debug, Monitors, Programmes, Environments user Interfaces. **Lecture : 2**

Text Books :

1. System Software : An Introduction to Systems Programming (3rd Edition) by Leland L. Beck, Pearson Education.
2. System programming by John J. Donovan.
3. System programming and operating systems by D. M. Dhamdere.
4. IBM PC assembly language & Programming by Peter Abel, Niyaz Nizamuddin, Pearson Education.
5. Assembly Language Programming for IBM PC Family by William B. Jones, Dreamtech Press.

Programming Lab (System Programming)

Symbol table (Tree Storage), construction, Implementation of single pass, two pass, Assembler, Macro Processor, module binder (with limited instruction set). Implementation of software tools like Text editor, Interpreter, program generator etc.

05 1X06 DESIGN AND ANALYSIS OF ALGORITHMS

L-T-P : 3-0-0 **Credit : 3**

1. Introduction : Algorithm, performance evaluation of algorithms, space & time complexity, notion of optimality. **Lecture : 5**

2. Divide and Conquer : Finding the maximum and minimum- Quick Sort – Selection- Strassen's matrix multiplication etc. **Lecture : 4**

3. Greedy Algorithm : Knapsack Problem, (Knapsack, Fractional Knapsack), Activity selection problem, Huffman's Codes, Minimum Spanning Tree, Kruskal's Algorithm, prim's Algorithm, dijkstra's Algorithm, etc. **Lecture : 6**

4. Dynamic Programming : Knapsack problem DP solution, Activity selection problem DP solution. All pairs shortest paths, Travelling salesman problem. **Lecture : 4**

5. Randomized Algorithms and Amortized Analysis : Basics ideas of randomized Algorithms (Las Vegas and Monte Carlo types), Simple examples (Randomized Quick sort and its analysis, Min-cut algorithm and its analysis), Amortized analysis and its significance (Illustration through examples). **Lecture : 6**

6. Graph Algorithms : Breadth First Search (BFS), Depth First Search (DFS), Strongly Connected Components. Euler Tour, Minimum Spanning Tree, Kruskal's Algorithm. Prim's algorithm. Single Source Shortest Path. **Lecture : 14**

7. Introduction to NP-Completeness : Basic concepts. **Lecture : 3**

Text Books:

1. Introduction to Algorithm, 2e, by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, PHI.
2. Beginning Algorithms by Simen Harris, James Ross, Wiley India.
3. Fundamentals of Computer Algorithms by E. Horowitz and S. Sahni, Galgotia.
4. Algorithms by Richard Johansonbaugh and Marcus Schaefer, Pearson Algorithm.

Reference Books :

1. The design and analysis of computer algorithms by A.V. Aho, J.E. Hopcroft and J.D Ullman, Pearson Education.
2. Algorithms – Introduction to Design & Analysis by S.Basse, Pearson Education
3. Algorithms and Complexity by H.S.Wilf, PHI.

05 1X07 WEB APPLICATION DESIGN AND DEVELOPMENT

L- T- P : 3- 0- 3 **Credit : 5**

1. Database Connectivity : Concept of JDBC (Java Database Connectivity), working with SQL, Stored Procedures. **Lecture : 5**

2. Client Server Side Programming : Java Script- Introduction, data types, variables, operators, Array Objects, Date, Objects, String Objects, Document Object Model, Image Object, Event handling, Browser Object, Window Object, Location Object, History Object, Submit event and data validation. Understanding Servlet programming, its Life- Cycle, Servlet Configuration, understanding Servlet sessions, understanding of JSP and JSLT, JSP documents, Elements, tag extensions, tag libraries, validation, translation time mechanism translation- time classes, Understanding Java Server Pages Standard Tag Library, tags in JSLT, core tag library, XML tag library using Internationalization Actions. **Lecture : 20**

3. J2EE : Advantages of J2EE, Enterprise Architecture Types, Understanding EJB, its architecture, EJB Roles, Benefits and limitations of Enterprise beans, session beans: Stateful and Stateless beans, Entity Beans, Beans Managed Persistence, Container Managed Persistence, Introduction to Web Containers. **Lecture : 10**

4. Network Programming : Java Socket programming for TCP and UDP, RMI (Remote Method Invocation). **Lecture : 2**

5. Case Study : Web Applications, Web Applications Life Cycle, Enterprise Application Development process, Deploying Web Applications. **Lecture : 5**

Text Books:

1. Java Server Programming J2EE, 1.4 Edition Black Book (Dreamtech Press)
2. Core Java TM Volume II by Cay S. Horstmann & Gray Cornell (Pearson)

Reference Book:

1. J2EE 1.4 Bible by McGovern (Wiley India)

05 1X08 FUNDAMENTALS OF DATA COMMUNICATION

L- T- P : 3- 0- 0 **Credit : 3**

1. Introduction : Data Communication, Network Architecture, Protocols & Standard. **Lecture : 2**

2. Signal, Noise, Modulation & Demodulation : Signal analysis, Signal-to-noise ratio, Bit rate, Baud, Digital Modulation. **Lecture : 3**

3. Transmission Media : Guided transmission Media, Wireless Transmission. Digital transmission. **Lecture : 2**

4. Multiplexing : Time Division Multiplexing, Frequency Division Multiplex, Frequency Division multiplexing. **Lecture : 4**

5. Data Communication Codes, Error Control and Data Format: Data communication Character codes, Bar codes, Error Control & Detection, Character Synchronization. **Lecture : 4**

6. Data Communication Hardware: Data Communication Hardware & circuits, serial interfaces. **Lecture : 3**

7. Data Communication Equipment : Digital service unit, Channels service unit, Bell- system Compatible voice band modem. Asynchronous and Synchronous voice band modem. **Lecture : 5**

8. Circuit Switching : Switching Networks, Circuit Switching Networks, Circuit Switching concepts, Routing in Circuit Switching Networks Control Signaling. **Lecture : 5**

9. Packet Switching : Packet Switching Principles, outing, X .25 **Lecture : 2**

10. Asynchronous transfer mode : Protocol Architecture, ATM Logical Connection, ATM Cell, Transmission of ATM Cells, ATM Service categories, ATM adaptation layer. **Lecture : 4**

11. Routing in Switched Network : Routing in circuit-switching & Packet switching network. **Lecture : 5**

12. Integrated Service Data Network : Public Switch Data Network. X. 25 user-to-network Interface protocol. ISDN . **Lecture : 4**

Text Book:

1. Introduction to data Communication and Networking by Wayne Tomasi Pearson Education.
2. Data and Computer Communication by William Stallings, Pearson Education.
3. Communication system and network by Ray Horak, Wiley India.

05 1X09 DATABASE SYSTEMS

L -T – P: 3–0–3 **Credit : 5**

1. Introduction : Purpose of database systems, View of data, data models, & interface, database language, transaction management, storage management, database administrator, database users, overall systems structure, Classification of Database Management System, Three-Schema Architecture. **Lecture : 3**

2. Data Modeling: Entity-Relationship Model, Basic concepts, design issues, mapping constraints, keys, E-R features, design of an E-R database schema, reduction of an E-R schema to tables. **Lecture : 5**

3. Relational Model: Structure of relational database, relational algebra, tulip relational calculus, domain relational calculus, extended relational-algebra operations, modification of the database and view, SQL and Other. **Lecture : 5**

4. Relational Languages: Background, basic structure, set operations, aggregate functions, null values, nested sub-queries, derived database, joined relations, DOL embedded SQL and other SL features, query-by-example. **Lecture : 5**

5. Integrity Constraints: Domain constraints, referential integrity, assertions, triggers and functional dependencies. **Lecture : 3**

6. Relational Database Design: Pitfalls in relational database design, decomposition, normalization using functional, multi-valued and join dependencies, domain key normal form and alternative approaches to database design. **Lecture : 5**

7. Query Processing: Overview, catalog information for cost estimation, measures of query cost, selection operation, other operations, evaluation of expressions, Translating SQL query into Relational Algebra, transformation of relational expressions, query optimization. **Lecture : 8**

8. Transactions: Transaction concept, transaction state, System log, Commit point, Desirable Properties of a Transaction, concurrent executions, serializability, recoverability, implementation of isolation, transaction definition in SQL, Testing for serializability. **Lecture : 8**

Text Books:

1. Database System Concepts, 3rd edition by A. Silberschatz, H.F .Korth,& S. Sudhatshan, McGraw Hill,
2. Fundamental of Database System by Elmasri, Navthe, Somayajulu, and Gupta, Pearson Education.
3. Introduction to Database Management system by ISRD Group, Tata McGraw Hill.
4. An Introduction to database system by C.J. Date, A. Kanana, S.Swamynathan, Pearson Education.

Reference books:

1. Database management System by Rajesh Narang, PHI
2. Database Systems by Rob Coronel, Galgotia Publication.

05 1X10 PRINCIPLES OF PROGRAMMING LANGUAGES

L- T- P : 3–0–0 **Credit : 3**

1. Language Design Issues : Impact on Programming paradigm, Role of Programming Environment. **Lecture : 3**

2. Impact of Machine Architecture : Computer H/w, Firmware Computer, Transistor and virtual Architecture **Lecture : 5**

3. Language Translation Issues : Programming Language Syntax, Stages in translation, Formal Translation model (BNF Grammars, etc.), Formal properties of Languages, Languages Semantics Program Verification. **Lecture : 5**

4. Data Types : Properties of Types and Objects, Scalar Data Types, Composite Data Types, Structures Data Types, Abstract Data Types, Encapsulation by subprogram, Type Definitions. **Lecture : 4**

5. Inheritance: Derived class, Abstract Class, Inheritance & software Reuse, Polymorphism. **Lecture : 4**

6. Sequence Control : Implicit & Explicit Sequence control, Sequencing with Arithmetic Expression Sequence control, between statements, sequencing with Non-arithmetic Expression. **Lecture : 5**

7. Subprogram Control : Subprogram sequence control, Attributes of Data Control Parameter transmission, Static Scope, Dynamic scope, Block Structure. **Lecture : 5**

8. Storage Management : Element Requiring Storage. Programmer and system Controlled Storage, Static storage management,Heap storage management. **Lecture : 4**

9. Distributed Processing : Exceptions & Exception Handlers, Co-routines, Scheduled Subprogram, Parallel Programming, Persistence data & Transaction Systems, Network & Client server Computing. **Lecture : 4**

10. Case Study : Comparison between Ada, C, C++, Fortran, Java, LISP, ML, Perl, Prolog, Smalltalk, Postscript. **Lecture : 4**

Text Book:

1. Programming Languages: Design and Implementation, 4/e by Terrance W. Pratt, Marvin V. Zelkovitz, T. V. Gopal, Pearson Education.
2. Programming Languages: Concepts and Constructs by R. Sethi**,** Pearson Education.

Reference Books:

1. Fundamentals of Programming Languages by E. Horowitz, Galgotia,
2. Programming Languages , Paradigm and Practice by D. Appleby, McGraw Hill.

05 1X11 FORMAL LANGUAGES AND AUTOMATA THEORY

L–T–P : 3–0–0 **Credit : 3**

1. Introduction to Automata : Study and central concepts of automata theory, An informal picture of finite automata, deterministic and non-deterministic finite automata, application of finites automata, finite automata with epsilon transitions. **Lecture : 3**

2. Regular expression and Languages : Regular expression, finite automata and regular expressions, applications of regular expressions, algebraic law of regular expressions. **Lecture : 6**

3. Properties of Regular Language: Proving languages not to be regular, closure properties of regular languages, equivalence and minimization of automata. **Lecture : 4**

4. Context-free Grammars and Languages: Parse trees, Applications of context free grammars, Ambiguity in grammars and languages. **Lecture : 6**

5. Pushdown Automata: Pushdown automata (PDA), the language of PDA, equivalence of PDA's and CFG's, deterministic pushdown automata. **Lecture : 6**

6. Properties of Context-Free Languages: Normal forms of context free grammars, pumping lemma for context free languages, closure properties of context free languages. **Lecture : 5**

7. Introduction to Turing Machine: Te Turing machine, programming techniques for Turing machine, extensions to the basic Turing machine, restricted Turing machines, Turing machines and Computers, Undecidable Problem about Turing machine, Post's Correspondence Problems. **Lecture : 7**

8. Intractable Problem: The Classes P & NP, NP-Complete Problem, Example of P & NP Problem. **Lecture : 5**

Text Book:

1. Introduction to Automata Theory, Languages, and Computation, 2e by John E, Hopcroft, Rajeev Motwani, Jeffery D. Ullman , Pearson Education.
2. Theory of Computer Science (Automata, Languages and Computation), 2e by K. L. P. Mishra and N. Chandrasekharan, PHI

05 1X12 REAL TIME SYSTEMS

L – T – P: 3 – 0 – 0 **Credit : 3**

1. Introduction : Hard vs. Soft real time systems, a reference model of real time system. **Lecture : 2**

2. Real-time scheduling : Clock driven approach, Weighted Round-robin approach, Priority driven approach, Dynamic vs, static system, EDF and LST algorithm, Offline vs. online Scheduling. **Lecture : 8**

3. Resource and Resource Access control : Resource contention, resource access control, Non-primitive critical section, Basic Priority- Inheritance protocol, Basic Priority Ceiling Protocol, Stack based, Priority-ceiling protocol, preemption ceiling protocol, controlling access to multiple–Unit resource and data object. **Lecture : 10**

4. Multiprocessor scheduling, Resource Access Control, and Synchronization : Model of multiprocessor & distributed systems, task assignment, multiprocessor Priority-ceiling protocol, Scheduling algorithm for end-to-end periodic tasks, schedulability of fixed-priority end-to-end periodic Tasks, Predictability & Validation of dynamic multiprocessor system, Scheduling flexible computations and tasks with temporal distance constraints. **Lecture : 14**

5. Real-Time Communication : Model of Real-Time communication. Priority based discipline for switched network, weighted round-robin service disciplines, medium access-control protocol of broadcast network. **Lecture : 8**

Text Books:

1. Real-Time system by Jane W. S. Liu, Pearson Education
2. Real-Time systems by C. M. Krishna and K. G. Shin, McGraw Hill
3. Real-time Systems Design and analysis: an Engineer Handbook by Laplante, PHI

Reference Books:

1. Embedded Real Time system concept design and programming by Dr. K. V.K.K. Prasad, Willy India.

05 1x13 COMPUTER NETWORKS

L–T– P : 3–0–0 **Credit : 3**

1. Introduction : Network Hardware & Software, OSI Reference Model, TCP/IP Model, Comparison of the OSI & TCP/IP model. **Lecture : 2**

2. The Physical Link layer : Guided Transmission Media, Physical Layer Standard. **Lecture : 2**

3. The Data Link Layer : Need for Data Link Control, Service provided by the Data Link Layer, Frame Design Consideration, Flow control Mechanism, Data Link Error control, Error Control in Stop-and-wait Mechanism & Sliding Window Mechanism, Sequence numbering, Piggybacking Acknowledgements, Data Link Management. **Lecture : 8**

4. MAC Protocols : Random access Protocols – ALOHA. **Lecture : 2**

5. IEEE 802.3 Ethernet : Contention Access, CSMA/CD, Physical Topology of Ethernet, Ethernet Repeater, Types of Ethernet. **Lecture : 5**

6. Bridges and Layer-2 Switches : LAN Bridge, Transparent Bridges, Spanning tree algorithm. Source routing bridge, route discovery in source routing, layer 2 Ethernet switches. **Lecture : 5**

7. The network layer : network layer design issue, purpose of network layer, Functions of the Network Layer. **Lecture : 5**

8. Introduction to Internet Protocol : IPv4 Format, ICMP. **Lecture : 2**

9. Routing Algorithms : Static Routing, Dynamic Routing, Distance Vector Routing Algorithm, Routing Information Protocol, Link State Routing, OSPF Routing Protocol. Interior and Exterior Protocol, and Border Gateway Protocol. **Lecture : 10**

10. Introduction to Transport Layer: TCP & UDP. **Lecture : 1**

11. Introduction to Application Layer: TCP/IP Application Protocol. **Lecture : 1**

Text Book:

1. Data Communication & Networking by Forouzan, Tata McGraw Hill.
2. Computer Network, 4e, by Andrew S. Tenenbaum, Pearson Education/ PHI.
3. Data Communication and Computer Networks, by Prakash C.Gupta, PHI.
4. Networking Ali-in-one Desk Reference by Doug Lowe, Wiley Dreamtech

Reference Books:

1. Computer Networking: A Top-Down Approach featuring the Internet, 3e by James F.Kurose.
2. Computer Network by Godbole, Tata McGraw Hill.
3. Computer Networking, by Stanford H. Rowe, Marsha L. Schuh

05 1x14 SOFTWARE ENGINEERING

L–T–P : 3–0–3 **Credit : 5**

1. Introduction : S/W Engineering Discipline-Evolution and Impact, Program vs S/W Product, Emergence of S/W Engineering.

2. Software Life Cycle Models : Waterfall, prototyping, Evolutionary, Spiral models and their comparisons.

3. Software Project Management : Project Manager responsibilities, project planning, Project Size estimation Metrics Project Estimation, Techniques, COCOMO, Staffing Level Estimation, Scheduling, Organization & Team Structures Staffing, Risk Management, S/W Configuration Management.

4. Requirements Analysis and Specification : Requirement Gathering and Analysis, SRS, Formal System Development Techniques, Axiomatic and Algebraic Specification.

5. Software Design : Overview, Cohesion and Coupling, S/W Design Approaches, Object- oriented vs. Function-Operated Design.

6. Function- Oriented S/W Design : SA/ SD Methodology, Structured Analysis, DFDs, Structured Design, Detailed Design, Design Preview.

7. Object Modeling using UML : Overview, UML, UML Diagrams, Use Case Model, Class Diagram etc.

8. Object Oriented Software Development : Design Patterns, Object- Oriented analysis and Design Process, OOD Goodness Criteria.

9. User Interface Design : Characteristics, Basic Concepts, Types, Components Based GUI Development, User Interface Design Methodology.

10. Coding and Testing : Coding, Code Review, Testing, unit Testing, Black Box Testing, White- Box Testing, Debugging, Program Analysis Tools, Integration Testing, System Testing, General Issues.

11. Software Reliability and Quality Management : S/W Reliability, Statistical Testing, S/W Quality, S/W Quality management System ISO 9000, SEI CMM, Personal Software Process, Six Sigma.

12. Computer Aided Software Engineering: CASE and its Scope, Environment, Support, Other Characteristics.

13. Software Maintenance : Characteristics, S/W Reverse Engineering, S/W Maintenance Process Models, Estimation of Maintenance Cost.

14. Software Reuse : Basic Issues, Reuse Approach, Reuse at Organization Level.

Text Books:

1. Fundamental of Software Engineering by Rajeev Mall, PHI.
2. Software Engineering by James F. Peters, Wiley.
3. Software Engineering A. Practitioner's Approach by Pressman, MGH.

Reference Books:

1. Software Project Management From Concept to Development by Kieron Conway, Dreamtech Press.
2. Software Engineering by Sommerville, Pearson Education.
3. Software Engineering by Jawadekar, TMH.

05 1X15 DISTRIBUTED COMPUTING

L-T-P : 3-0-3 **Credit : 5**

1. Fundamentals : Definition Evaluation of distributed Computing System, Distributed Computer System Models. Distributed Operating System Designing a distributed Operating System, Introduction of distributed computing environment. **Lecture : 5**

2. Massage Passing : Introduction, Design features, Issues in IPC by message passing, synchronization Buffering, Multidiagram messages, encoding and decoding message data. **Lecture : 4**

3. Remote Procedure Calls : Introduction, The RPC Model. Transparency of RPC. Implementing RPC mechanism RPC messages server management, parameter- passing and call semantic, Communication protocols for RPC's. **Lecture : 10**

4. Distributed Shared Memory : Introduction. Architecture of DSM Systems Design and implementation, granularly, Structure shared memory space Consistency models, replacement strategy, Thrashing. **Lecture : 9**

5. Resource Management : Desirable feature, Task assignment approach, Load-balancing approach, Load-sharing approach. **Lecture : 4**

6. Process Management : Process Migration, Threads **Lecture : 2**

7. Distributed File System : Intake, Desirable features, File model, File accessing models, File-sharing semantic, File-catching schemes, File replication, Fault tolerance, Automatic transactions, Design principle. **Lecture : 8**

Text Book:

1. Distributed Computing by Liu. Pearson Education.
2. Distributed Computing by Hagit Attiya and Jennifer Welch, Wiley India.

3. Distributed Operating Systems : Concept and Design by P.K. Sinha, PHI
4. Distributed Operating System by Tenenbaum. Pearson Education

05 1x16 COMPILER DESIGN

L–T–P : 3–0–3 **Credit : 5**

1. Introduction to Compilers : Compilers and translators, The phases of a compiler, Compiler writing tools, The lexical and System structure of a language, Operators, Assignment statements and parameter translation.
Lecture : 2

2. Lexical Analysis : The role of the lexical analyzer, Specification of tokens, Lexical analysis tool.
Lecture : 2

3. Syntax Analysis : Role of Parser, CFG, Top – down parsing, Operator – precedence parsing, LR Parsers, The Canonical Collection of LR (0) items, Constructing SLR, Canonical LR and LALR parsing tables, Uase of ambiguous grammars in LR parsing, An automatic parser generator, Implementation of LR parsing tables and constructing LALR sets of items. **Lecture : 10**

4. Syntax Directed Translation : Syntax tree, Bottom-up evolution of S-attributed definitions, L-attributed common top-down translation, Bottom-up evaluation of inherited attributed, Recursive evaluators. **Lecture : 5**

5. Type Checking : Static Dynamic Checking, Type expression, Type Checking, Type Equivalence, Type Conversion. **Lecture : 2**

6. Symbol Tables : Structure of Symbol Table, Simple Symbol Table (Linear Table, Ordered List, Tree, Hash Table, Scoped Symbol Table (Nested Lexical Scoping, One Table per Scope, One Table for all Scopes).
Lecture : 3

7. Intermediate Code Generation : Intermediate Language, Intermediate representation Technique, Three-address code, Translation of assignment statements, Boolean expressions, Control Flow, Case Statement and Function Call. **Lecture : 4**

8. Code Generation : Factors affecting code generation, Basic Block, Code generation for tree, Register and assignment, DAG representation, Code generation using dynamic programming, code- generator generators**.**
Lecture : 4

9. Error Detection and Recovery : Errors, Lexical-Phase errors, Syntactic-Phase errors, Semantic errors.
Lecture : 2

10. Code Optimization : Need for optimization of Basic Blocks, Loops in flow graph, Optimizing transformation Compile time evaluation, common sub-expression elimination, Variable Propagation, Code Movement Optimization, Strength Reduction, Dead code optimization, Loop Optimization), Local Optimization, Global Optimization, Computing Global data flow equation, Setting up data flow Equations, Data Flow Analysis**.** **Lecture : 10**

Text Books:

1. Compilers Principles .Techniques. And Tools by Alfred V. Aho. Ravi Sethi Jeffery D. Ullman. Pearson Education.
2. Compiler Design by Santanu Chattopadhyay. PHI

Reference Book

Modern Compiler Design by Dick Grune . E. Bal. Ceriel J.H.Jacobs. And Koen G. Langendoen Viley Dreamtech.

Programming Lab (System Programming)

Design of lexical analyzers. Design of parsers like recursive – descent parser for a block structured language with typical constructs, Typical exercises using LEX and YACC, Quadruples/Triplex generation using LAX and YACC for a subset of a block structured language,LR (0), SLR, LALR error detection and recovering with code optimization.

05 1x17 ARTIFICIAL INTELLIGENCE

L-T-P : 3-0-3 **Credit : 5**

1. Introduction : Why AI, Importance of AI. LISP, Prolog and other programming language for AI.
Lecture : 3

2. Search Strategies : Representation Scheme, Blind Search technique, Heuristic Search technique, Game search, Graph search (algorithm A and A*), Properties of A* algorithm, monotone – Specialized production systems – AO * algorithm. **Lecture : 15**

3. Searching Game Trees : Minimax procedure, alpha-beta pruning – Introduction to predicate calculus – Resolution refutation systems – Answer extraction. **Lecture : 4**

4. Knowledge Representation, Reasoning : Knowledge representation, Knowledge acquisition, Logical Representation scheme, procedural representation schema, network representation scheme, STRIPS robot problem solving system, Structured representations of knowledge (Semantic Nets, Frames, Scripts), KRR system, KR language, Domain modeling, Semantic net. **Lecture : 8**

5. Uncertainly : Non monotonic & monotonic reasoning, confidence factors, Bayes theorem, Dempster & Shafer's, Theory of evidence, Non-classical logic, Fuzzy reasoning. **Lecture : 6**

6. Natural Language Processing : An Introduction to Natural language Understanding, Perception, Learning. **Lecture : 4**

7. Applications of Artificial Intelligence : Al in E-commerce, Al in Industry, Al in Medicine **Lecture : 2**

Text Books:

1. Introduction to Artificial Intelligence by Rajendra Akerkar, PHI
2. Introduction to Artificial Intelligence by Eugene Charniak, Pearson Education.
3. Artificial Intelligence by Rich & Knight. Tata McGraw Hills.
4. Introduction to Artificial Intelligence & Expert system by Dan W. Patterson, PHI

Reference Book:

1. Artificial Intelligence. A Modern Approach by Stuart Russell. Peter Norving and Pearson Education.
2. Introduction to Expert System, Peter Jackson. Pearson Education.
3. Artificial Intelligence application programming by M. Tim Jones, Dreamtech Press

Programming Lab (AI)

Implementation in all algorithms in LISP/Prolog

05 1x18 CRYPTOGRAPHY

L–T–P : 3–0–0 **Credit : 3**

1. Introduction : The OSI Security Architecture, Security attack, Security Services, Security Mechanism, A model for Network Security. **Lecture : 4**

2. Symmetric Cipher : Classical Encryption Techniques, Symmetric Cipher Model, Block Cipher Principles, DES, Cryptanalysis, Block Cipher Design Principle, The Euclidean Algorithm, Finite field of Form GP(p), Advance Encryption Standard (AES), AES Cipher, Multiple Encryption and Triple DES, Stream, Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random number generation. **Lecture : 15**

3. Public Key Encryption and Hash Function : Fermat's & Euler's Theorems, The Chinese Remainder Theorem, RSA Algorithm, Diffe-Hellman Key Exchange, Elliptic Curve Cryptography, Massage authentication code, Security of Hash Functions and MAACs, Secure Hash algorithm, Whirlpool, HMAC, CMAC, Digital Signature. **Lecture : 12**

4. Network Security Applications : Kerberos, X.509 Authentication Service, S/MIME, IP Security Architecture, Encapsulating Security Payload, Secure Socket Layer (SSL), Transport layer security, Secure Electronic Transaction. **Lecture : 6**

5. System Security : Intrusion detection, Password Management, Virus countermeasure, Denial of Service Attack, Firewall design principles, Trusted System. **Lecture : 6**

Text Book :

1. Cryptography and Network Security : Principle and Practice, 4e by William Stalling, Pearson Education/PHI.

Reference Books :

1. Beginning Cryptography with Java by David Hook, Wiley Dreamtech.
2. Modern Cryptography Theory & Practices by Wenbo Mao, Pearson Education.
3. Cryptography for Database and Internet Application by Nick Galbreath, Wiley Dreamtech.
4. Network Security : Private Communication in a Public World, 2e, by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson Education.

05 1x19 MOBILE AND WIRELESS COMPUTING

L–T–P : 3–0–0 **Credit : 3**

1. Introduction : Mobile computing, Middleware and Gateway **Lecture : 1**

2. Mobile Computing Architecture : Architecture for mobile computing, Three-tier architecture, Design consideration for mobile computing, Mobile computing through Internet. **Lecture : 3**

3. Mobile Computing through telephony : Multiple access, Mobile computing through telephone, IVR system, voice XML. **Lecture : 3**

4. The Mobile Radio Environment : Representation of a mobile radio signal, Causes of propagation path loss and Classification of channels, Definitions of necessary terms (averages, PDF, CPD etc.), Delay spread and coherence band width, Diversity schemes, Combining techniques. **Lecture : 2**

5. Mobile Radio Interference : Co-channel and adjacent-channel interference, Near-end-to-far end ratio. Inter symbol and Simulcast Interference. **Lecture : 2**

6. Frequency Plans & Cellular Concept : Channelized schemes and frequency reuse, FDM, TDM, Spread Spectrum & Frequency hopping, Cellular concept, Frequency reuses and cell separation, HO, Spectral efficiency and cellular schemes, Separation between co-channel cells**.** **Lecture : 8**

7. Digital Cellular Mobile System : GSM, GPRS, Numbers & Identities for Mobile. **Lecture : 8**

8. Personal Area Network : Bluetooth technology, Protocol and etc. **Lecture : 3**

9. Cellular CDMA : Narrowband & Wideband wave propagations, Key elements in designing cellular, Spectrum techniques in modulation, Capacities of multiple-access schemes, DS-CDMA, FH-CDMA, TH-CDMA. **Lecture : 5**

10. Mobile-IP **:** IP packer delivery, agent advertisement & discovery, Registration, Tunneling and encapsulation, IPv6, DHCP, Ad-hoc network, Mobile Transport layer. **Lecture : 4**

11. WAP : WAP architecture, Wireless Markup language, WML Script, MMS, Case study of Nokia phone simulator. **Lecture : 4**

Text Books :

1. Mobile Computing by Asoke K Talukder. Roopa R Yavagal. Tata McGraw Hill.
2. Mobile Communication by Jochen Schiller. Pearson Education.
3. Wireless and Monile All – IP Network by Yi- Bing Line, Ai Chun Pang. Wiley India.
4. Mobile Computing by Hansmann. Wiley India.
5. Mobile and Personal Communication system & services by Raj Pandya. PHI.
6. Mobile and Wireless Design Essentials by Martyn Mallick. Wiley Dreamtech.
7. The Wireless Application Protocol by Sandeep Singhal, et al... Pearson Education.
8. Bluetooth Technology and its applications with Java and J2ME, by C.S.R. Prabhu and A. Prathap Reddi PHI.

Reference Books:

1. Modern Wireless communication by Simon Haykins, and Michael Mohar. Pearson Education.
2. Cracking the code WAP Bluetooth and 3G programming by Dreamtech Software Team.

05 1x20 PROJECT – 1

L–T–P : 0–0–6 **Credit : 4**

05 1x21 INDUSTRIAL TRAINING

L–T–P : 0–0–0 **Credit : 2**

05 1x22 DATA MINING

L–T–P : 3–0–3 **Credit : 5**

1. Introduction : Motivated Data Mining Data Mining on what kind of Data, Data Mining Functionalities, Classification of Data Mining System, Major issues in Data Mining. **Lecture : 3**

2. Data Warehouse and OLAP Technology for Data Mining : Data Warehouse, Data Warehouse Architecture, Data Warehouse Implementation, Development of Data cube technology, Data Warehousing to Data Mining. **Lecture : 5**

3. Data Preprocessing : Data cleaning, Data Integration and Transformation, Data Reduction, Discrimination and concept Hierarchy Generation. **Lecture : 4**

4. Data Mining Primitives, Primitives, Languages and System Architectures : Data Mining Primitives, Data Mining query language, Designing GUI on a Data Mining query language, Architectures of Data Mining System. **Lecture : 5**

5. Mining Association rules in large database : Association rules mining, Mining single-dimensional Boolean Association rules from transaction database, mining multilevel Association rules from transaction database, Mining

multidimensional Association rules from relational databases and Data warehouses, Association mining to correlation analysis, Constraint based association mining. **Lecture : 7**

6. Classification and Prediction : What is classification and prediction, Issues regarding classification and prediction, Classification by decision tree Induction, Bayesian Classification, Classification by Back propagation, Classification based on concepts from association rule mining, Prediction, Classification accuracy**.** **Lecture : 6**

7. Cluster Analysis : What is cluster analysis, Types of data in cluster analysis, A categorization of major clustering methods, Partitioning methods, Hierarchical Methods, Density based methods, Grid based methods, Model based clustering methods. **Lecture : 6**

8. Applications and trends in Data Mining : Data mining applications, Social impacts of Data Mining, Trends in Data Mining. **Lecture : 4**

Text Books :

1. Data Mining Concepts and Techniques by Jiawei Han, Micheline Kamber, Elsevier.
2. Data Mining. A tutorial-based Primer by Roiger, Michael W. Geatz and Pearson Education.
3. Data Mining Introductory & advanced topic by Margaret H. Dunham , Pearson Education

Reference Books :

1. Data Mining : Next Generation Challenges and Future Direction by Kargupta, et al, PHI.
2. Data Warehousing, Data Mining & OLAP by Alex Berson Stephen J.Smith.

05 1x23 PARALLEL COMPUTING

L–T–P : 3–0–0 **Credit : 3**

1. Introduction to parallel computing : Motivating parallelism, Scope, Processor Array, Multiprocessor, Multicomputer. **Lecture : 3**

2. Parallel Programming Platforms : Implicit Parallelism, Limitation of memory System performance, Dichotomy of parallel computing platform, Physical organization of platform, Communication costs in parallel. **Lecture : 6**

3. Parallel Programming Language : Fortran 90, Sequent C, nCube C, OCCAM, C-LINDA. **Lecture : 6**

4. Principle of parallel algorithm design : Preliminaries, Decomposition techniques, Tasks & Interactions, Mapping techniques for load balancing, Parallel algorithm model. **Lecture : 6**

5. Communication Operation : One-to-all broadcast, All-to-all reduction, All-to-all Broadcase and reduction, All reduce & Prefix-sum operation, All-to-all personalized communication, Circular sift, Improving speed. **Lecture : 7**

6. Analytical Modeling of Parallel Programs : Performance Metrics for parallel systems, Effect of granularity on performance. Minimum execution time & Minimum cost optimal execution time, Programming using the Massage-Passing paradigm. **Lecture : 5**

7. Dense Matrix Algorithm : Matrix vector & Matrix-matrix multiplication. **Lecture : 3**

8. Sorting and Graph algorithm : Issues in sorting on parallel computers, Sorting networks, Different sorting techniques in parallel computing, Minimal spanning tree. All-pair shortest path, Connected components, Algorithm for Sparse Graph, Dynamic Programming**.** **Lecture : 6**

Text Books :

1. Introduction to Parallel Computing by Ananth Grama , Anshul Gupta , George Karypis. Vipin Kumar, Pearson Education .
2. Parallel Computing by Michael J. Quin. Tata McGraw Hill.
3. Advanced Computer Architecture: Parallelism. Scalability. Programmability by Kai Hwang , McGraw Hill
4. Foundation of parallel processing by Ratan K Ghosh , Rajat Moona , Phalgun Gupta , Narosa publishing House

05 1x24 PROJECT – II

L–T–P : 0–0–9 **Credit : 6**

05 1x25 ADVANCED COMPUTER ARCHITECTURE

L–T–P : 3–0–0 **Credit : 3**

1. Grain size & Latency, Grain Packing and Scheduling, Calculation of communication delay, Bernstein's conditions, Levels of parallelism, Properties of parallelism, Software parallelism, Hardware parallelism, Application modules of parallel computers. **Lecture : 12**

2. Speedup Performance Laws : Amdahl's Law for fixed workload, Gustafson's law for scaled problems, Memory bounded speedup model. **Lecture : 12**

3. PRAM models and PRAM variants. **Lecture : 20**

Text Books :

1. Computer architecture and parallel processing by Kai Hwang and Briggs, McGraw Hills.
2. Advance computer architecture by Dezso Sima, Terence Foutain and Peter Kacsuk, Pearson Education
3. Advance Computer Architecture: A System Design approach by Kain. PHI.
4. Foundations of parallel processing by Ratan K Ghosh, Rajat Moona, Phalguni Gupta,, Narosa Publishing House .

05 1x26 PERFORMANCE EVALUATION OF COMPUTER SYSTEMS

L-T-P : 3–0–0 **Credit: 3**

1. Computer Performance Evaluation Nature and Affecting Factors : Motivations for evaluation, System as a collection of resources, performance measures, Operating system and Support programs, Compiler, Interpreters and Translators, Application programs, File and Database Organization .System reliability and availability, Human factors. **Lecture : 5**

2. The Approach to Performance Evaluation : New system design, Development and tuning of existing system, Workload Analysis. **Lecture : 6**

3. Job Processing and Simulation : Workload Definition and description, workload quantification in new system design and development, workload simulation, work stream generators, nature of a system model, single server model, Scheduling job performance measures, multiple server model, Simple job-processing simulator. **Lecture : 6**

4. Measurements : Introduction what do we measure and how? **Lecture : 3**

5. Monitoring System : Software monitors, hardware monitors, post measure data analysis, application program monitors**.** **Lecture : 4**

6. Tunning : Introduction, measure of performance and their interpretations, performance tunning scheme, examples of some areas of performance tunning**.** **Lecture : 4**

7. Models : Why models, mathematical model, the modeling process. **Lecture : 2**

8. System Reliability : H/w and S/w reliability, system reliability and availability, series and parallel systems, fault rates and failure probabilities**.** **Lecture : 4**

9. Queuing Theory and Models : Poisson Birth process , steady state queue behavior, steady-state queue behavior, network of queue, steady-state solution, parallel server systems, time sharing system model. **Lecture : 4**

10. Administration of the Computer Center and S/W Selection techniques : Duties and responsibility of the computer centre director or manager, recruitment techniques, importance of quality control, computer selection techniques, Installation planning, software selection and evaluation, Guide line for selecting appropriate languages. **Lecture : 4**

05 1x27 OPTIMIZATION THEORY

L–T–P : 3–0–0 **Credit : 3**

1. Introduction to Optimization : Introduction engineering application of optimization, statement and classification of optimization problems, optimization techniques. **Lecture : 4**

2. Classical Optimization Techniques : Introduction single variable optimization, multivariable optimization with no constraints multivariable optimization with equality and inequality constraints. **Lecture : 10**

3. Linear programming : Introduction, standard form and geometry of LP; motivation to the simplex method, simplex algorithm, Two-phase method, Revised simplex method, duality and decomposition principle and sensitivity analysis**.** **Lecture : 10**

4. Non-linear Programmers : Introduction, unimodes function, elimination methods, unrestricted search, quadratic and cubic interpolation methods, Direct root method, Direct and Random Search method, The simplex method, Steepest Dissent method, Conjugate gradients method and Gauss-Newton method. **Lecture : 10**

5. Integer and Stochastic Programmers : Introduction, Integer linear programming, Methods for solving integer linear programming problems, Stochastic linear programming, Quadratic programming, separable programming. **Lecture : 8**

Text Book :

1. Optimization for Engineering Design : Algorithm and example by Kalyanmoy Deb, PHI

05 1x28 PATTERN RECOGNITION

L–T–P : 3–0–0 **Credit : 3**

1. Pattern Recognition Overview : Overview, Pattern Recognition, Classification and Description, patterns and Feature Extraction, Training and Learning in PR System, Pattern Recognition Approaches **Lecture : 6**

2. Statistical Pattern Recognition : Introduction, The Gaussian case and Class Dependence Discriminate Functions, Extensions, Classifier Performance, RISK and Errors. **Lecture : 6**

3. Supervised Learning : Parametric Estimation and Supervised Learning, Maximum Likelihood Estimation Approach, Bayesian Parameter Estimation Approach, Non-parametric Approaches, Parzen Windows, K-Non-Parametric Estimation, Nearest Neighbour Rule, Linear Discriminate Functions and the Discrete and Binary Feature Cases: Introduction, Discrete and Binary Classification Problems, Techniques to Directly Obtain Linear Classifiers. **Lecture : 10**

4. Syntactic Pattern Recognition : Overview Quantifying Structure in Pattern Description and Recognition, Grammar Based Approach and Application, String Generation as Pattern Description, Recognition by String Matching and Parsing, The Cocke-Younger Kasami (ck) parsing algorithm. **Lecture : 10**

5. Neural Pattern Recognition : Introduction to Neural Networks, Neural Network Structure from Pattern Recognition Application, Physical Neural Network, The Artificial Neural Network Model, Neural Network Based Pattern Associators. **Lecture : 10**

Text Books :

1. Pattern Recognition and Image Analysis by Gose. Johnsonbaugh, Jost, PHI
2. Pattern Recognition: Technique and Application by Rajan Singhal, Oxford .
3. Pattern Recognition Principles by J.T.Tou and R.C .Gonzalez, Addison Wesley.

05 1x29 INTRODUCTION TO JAVA PROGRAMMING LANGUAGE

L–T–P : 3–0–3 **Credit: 5**

1. Introduction to Java : Feature to Java, Java Virtual Machine, Differences between C++ and Java, Part of Java, API Document, Starting a Java Program. Important Classes, Formatting the Output **Lecture : 2**

2. Naming Conventions and Data Types : Naming Conventions in Java. Data types in Java, Literals**.** **Lecture : 1**

3. Operators and Control Statements in Java : Arithmetic Operators, Unary Operators, Relational Operators, Logical Operators, Boolean Operators, Bitwise Operators, Ternary Operators, New Operator, Cast Operator, If .... else statement, Switch statement, Break statement, Continue statement, Return statement, do … while loop, while loop, for loop. **Lecture : 4**

4. Input and Output : Accepting Input from the keyboard, reading input in Java, Util, Scanner class, displaying output with System.out.print(), Displaying formatted output with string, Format. **Lecture : 2**

5. Arrays and Strings : Types of Arrays, Array name, Length, Command Line Arguments, Creating Strings, String Class Methods, String Comparison, Immutability of Strings, Creating String Buffer Objects, String Buffer Class Methods, String Builder Class, String Builder Class Methods. **Lecture : 3**

6. Wrapper Classes : Number class, Character class, Byte class, Short class, Integer class, Long class, Float class, Double class, Boolean class, Math class**.** **Lecture : 3**

7. Introduction to OOPS : Problems in procedure oriented approach, Features of Object Oriented Programming System, Object creation, Initializing the instance variable, Constructors. **Lecture : 2**

8. Methods of Java : Method Prototype, Method Body, Understanding Methods, Static Methods, Static Block, The keyword 'this', Instance Methods, Passing Primitive Data Types to Methods, Passing Objects to Methods, Passing Arrays to Methods, Recursion, Factory Methods. **Lecture : 4**

9. Inheritance and Polymorphism : Inheritance, The Keyword **'super'**, The Protected Specified, Types of Inheritance, Polymorphism with variables, Polymorphism using methods, Polymorphism with Static Methods, Polymorphism with Private Methods, Abstract Classes. **Lecture : 3**

10. Packages : Package, Different types of Packages, Interface in a Package, Access Specifies in Java. **Lecture : 3**

11. Exceptional handling : Errors in Java Program, Exceptions throws and throw clause, Types of exceptions, Re-throwing an exception**.** **Lecture : 2**

12. Threads : Single and Multitasking, Creating and terminating the thread, Single and Multi tasking using threads, Deadlock of threads, Thread communication. **Lecture : 3**

13. Introduction to AWT and Applets : AWT components, Creating and closing the frame, Drawing in the frame, Displaying dots and text in the frame, Event Handling, Listeners and Listener methods, Creating and uses of Applets, An applet with swing components, Applet parameters. **Lecture : 4**

14. Introduction on Java database connectivity : Database servers and clients, JDBC, Connecting to a Database, Stored Procedures and Callable Statement, Storing file and Image into database, retrieving a file and images from database, Types of JDBC drivers**.** **Lecture : 4**

Text Books :

1. Core Java by R Nageswara & Kogent Solution Inc, Dreamtech.
2. The Complete Reference Java Tata McGraw Hill.
3. Java 6 Programming Black Book, w/CD by Kogent Solutions Inc,, Dreamtech .

Reference Books:

1. Professional Java, JDK 6 Ed. by Richardson Avondolio Wrox.
2. Programming with Java by E Balagurusamy Tata McGraw Hill.

05 1x30 GENETIC ALGORITHMS

L–T–P : 3–0–0 **Credit : 3**

1. Introduction to Genetic Algorithm : Genetic Algorithms, Traditional and Search Methods and their Differences, A simple Genetic Algorithm. **Lecture : 6**

2. Genetic Algorithms Revisited : The Fundamental Theorem, Schema processing two & k- Armed Bandit Problem, Hypothesis Schemata and Revisited. **Lecture : 6**

3. Computer Implementation of A Genetic Algorithm : Data Structures, Reproduction. Crossover and Mutation, A Time to Cross, A Time to Reproduce, How well does it Work Mapping Objective Functions to fitness form, Fitness Scaling, Coding, A Multiparameter Mapped, Fixed-Point Coding, Discretization, Constraints. **Lecture : 15**

4. Applications of Genetic Algorithms : The Rise of Genetic Algorithms, Genetic Algorithm Applications of Historical Interest, De jong and Function Optimization, Improvements in Basic Technique, Current Application of genetic Algorithms, Genetics-Based Machine Learning, When it Came, What is Classifier System, Rule and Message, Genetic Algorithm. **Lecture : 15**

Text Books :

1. Genetic algorithm by David E. Goldberg, Pearson Education.
2. Introduction to Genetic Algorithm by Mitchell, PHI.

05 1x31 NATURAL LANGUAGE PROCESSING

L–T–P : 3–0–0 **Credit : 3**

1. Introduction : Structure of English (and/or some Indian Language), Basic Parsing Techniques, Augmented Transition, New York Grammars, Lexical Functional Grammar, Generalized Phrase, Structure Grammar, Deterministic Parsing **Lecture : 10**

2. Semantics : Representation of Semantics, Semantic Interpretation, Knowledge Representation in Natural Language, Using Prototypical/Word Knowledge, Discourse, Speech Acts, Natural Language Generation. **Lecture : 12**

3. Algorithms and data structures for implementing natural language processing systems. **Lecture : 10**

4. Applications : Question Answering Systems, Natural Language Interfaces to Databases, Machine Translation. **Lecture : 10**

Text Books:

1. Natural Language Processing, A Paninian Perspective by Akshar Bharati PHI.

05 1x32 COMPUTATIONAL GEOMETRY

L–T–P : 3–0–0 **Credit : 3**

1. Geometric Data Structures : Points, Polygons, Edges, Geometric objects in space, Finding intersection of a line and a triangle**.** **Lecture : 4**

2. Incremental Insertion : Finding star shaped polygons, Finding convex hulls, Point enclosure, The ray-shooting and the signed angle method, Line clipping, Polygon clipping, Triangulating monotone polygons. **Lecture : 10**

3. Incremental selection : Different methods for finding convex hulls, Removing hidden surfaces, Intersection of convex polygons, Finding Delaney Triangulations. **Lecture : 10**

4. Plane-Sweep Algorithms : Finding the intersections of line segments, Finding convex hulls, Contour of the union of rectangles, Decomposing polygons into monotone pieces. **Lecture : 8**

5. Divided and conquer Algorithms : Computing the intersection of half planes, Finding the kernel of polygon. Finding Voronoi regions, Merge Hull, Closest points, Polygon triangulation. **Lecture : 6**

6. Spatial Subdivision Methods : The Grid method, Quad trees. Two-dimensional search tree, Removing hidden surfaces. **Lecture : 6**

05 1x33 COMPUTER GRAPHICS

L–T–P : 3–0–0 **Credit: 3**

1. Graphics Techniques : Jag Free Images on a Raster CRT .Interactive Graphics processor for Digital Logic situation System, Interactive techniques for 3-D shaded Graphics. **Lecture : 10**

2. Graphics Standards 3D Models : Device Independence Al in Graphics Software, Implementation of Graphics Kernel System (GKS)**.** **Lecture : 8**

3. Graphical Workstations : Routing output to workstations, Types of GKS, Workstations. **Lecture : 8**

4. Evaluation of Various 3D Models : Computer Animation, 3D Shaded computer Animation the use of 3D abstract Graphical types in computer Graphics and Animation, 3-Dimensional Reconstruction, A case study. **Lecture : 16**

Text Books:

1. Computer Graphics C Version by Donald Hearn, and M.Pauline Baker, Pearson Education.
2. Mathematical Elements for Computer Graphics by Roger. Tata McGraw Hill
3. Computer Graphics by Hearn, and Baker, PHI.
4. Computer Graphics by ISRD Group, Tata McGraw Hill.
5. Computer Graphics by Hanmanddn, BPB Publishers, 2005.

05 1x34 NEURAL NETWORKS AND APPLICATIONS

L-T-P : 3-0-3 **Credit : 3**

1. Introduction : Background, Knowledge Based Information Processing, Neural Information Processing, Hybrid Intelligence. **Lecture : 2**

2. Basic Neural Computational Models : Introduction, basic concepts of Neural Network, Inference and Leaning, Classification Models, Association Model, Optimization Models, Self-Organization Models. General Issues, Hardware Implementation. **Lecture : 6**

3. Learning : Supervised and Unsupervised: Introduction, Supervised and Unsupervised Learning, Al Learning, Neural Network Learning, Genetic Algorithms. **Lecture : 6**

4. Knowledge-Based Neural Networks : Introduction, Rule-Based Neural Networks, Radial Basics Function Networks (RBFN), Network Training, Network Revision, Issues, Example of Theory Revision, Decision of Theory Revision, Decision Tree-Based Neural Networks, Constraint-Based Neural Networks. **Lecture : 10**

5. Interment Learning : Introduction, Fundamental Principles, Symbolic Methods, Neural Network Approaches, The Incremental RBCN. **Lecture : 4**

6. Mathematical Modeling : Introduction, Mathematical Modeling in General, The applications of Neural Networks, Neural Networks as Mathematical Models, Knowledge-Based approaches. **Lecture : 4**

7. Discovery : Introduction, Symbolic Methods and Neural Network Methods. **Lecture : 4**

8. Structures and Sequences : Introduction, Connectionist Representation, A Hybrid Network Approach. **Lecture : 3**

9. Learning Spatiotemporal Patterns : Introduction, Spatio-temporal Neural Networks, Learning Procedures, Knowledge Procedures**.** **Lecture : 3**

Text Books :

1. Neural Network by Simon Haykin, Pearson Education/PHI
2. Neural Networks Algorithms Application and Programming Techniques by James. A freeman David M. Skapura. PHI
3. Neural Network using MATLAB 6.0 by Siva Adam , Tata McGraw Hill
4. Neural Network: A classroom Approach by Satish Kumar, Tata McGraw Hill.

05 1x35 SPEECH PROCESSING

L–T–P: 3–0–0 **Credit : 3**

1. Speech Signal and Processing : Speech Production mechanism, Classification of speech sounds, Nature of Speech Signal, Model of Speech production, Purpose of Speech Signal Processing, Digital Models for Speech Signal, Digital Processing of Speech Signals, Significance of short-term analysis**.** **Lecture : 10**

2. Time Domain Methods for Speech Processing : Time domain parameters of speech, Methods for extracting the parameters. Zero crossing, Auto correlation function, Pitch estimation. **Lecture : 10**

3. Frequency Domain Methods for Speech Processing : Short-time Fourier analysis, Filter-bank analysis, Spectrographic analysis, Format extraction, Pitch extraction, Analysis. **Lecture : 8**

4. Synthesis System Linear Predictive Coding of Speech : Formulation of linear prediction problem in time domain solution of normal equation, Interpretation of linear prediction in auto correlation and spectral domains, Application of Speech Signal Processing: Speech recognition, Speech Synthesis and Speaker identification and verification. **Lecture : 15**

Text Book :

1. Speech and Language Processing by Daniel Jurafsky & James H. Martin, Pearson Education.

05 1x36 DISTRIBUTED DATABASE

L–T–P : 3–0–0 **Credit : 3**

1. Introduction : Distributed Database System, Promises Complicating Factors, Problem Areas. **Lecture : 3**

2. Distributed Database Architecture : DBMS Standardization, Architectural Models, Distributed DBMS Architecture. **Lecture : 6**

3. Distributed Database Design : Alternate Design Strategies, Distributed Design Issue, Fragmentation, Allocation. **Lecture : 6**

4. Semantic Data Control : View Management, Data Security, Semantic integrity control.

5. Query : Overview of Query Processing, Query Decomposition and data Localization, Optimization of Distributed Queries. **Lecture : 10**

6. Introduction to Transaction Management : Properties types of Transaction **Lecture : 3**

7. Distributed DBMS Reliability : Reliability Concepts and measures, Failures and fault Tolerance in Distributed Systems, Failures in Distributed DBMS. **Lecture : 6**

8. Parallel Database System : Database Servers, Parallel Architectures, Parallel DBMS Techniques, Parallel Execution Problems. **Lecture : 6**

Text Book :

1. Principles of Distributed Database System by Ozsu. Validities and Sridhar, Pearson.

Reference Book :

1. Database System Concepts. Silberschatz Korth Sudarshan , McGraw Hill

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGG.

04 1301 BASIC ELECTRONICS

L-T-P : 3-1-2 **Credit : 5**

1. PN junction diode : Depletion layer, barrier potential, forward and reverse bias, break down voltage, PIV characteristics of PN junction diode, knee voltage, ideal PN junction diode, junction capacitance, break down diode(zener diode).
Photo diode and light emitting diode. **Lecture : 10**

2. Rectifiers and filters : Half wave and full wave rectifiers(centre tape and bridge), regulation ripple factor, R-C ,L-C and Pi filters. Clipping and clamping circuit, voltage multiplier. **Lecture : 8**

3. BJT introduction : Basic theory and operation of PNP and NPN transistors, characteristics of C-B,C-E,C-C configuration.
Biasing : Base bias, emitter feedback bias, voltage divider bias, load line, operating point.
Incremental analysis using h model. **Lecture : 12**

4. FET : introduction, operation, JFET parameters, JFET characteristics, JFET amplifiers.
MOS FET : Introduction, operation , MOSFET parameters . **Lecture : 4**

5. Feedback amplifiers. **Lecture : 2**

6. Integrated circuit : Characteristics of ideal, operational amplifiers. Application as inverting, non inverting amplifiers. Summer, difference, differentiator, integrator. **Lecture : 4**

7. Principle and application of SCR and UJT. **Lecture : 2**

Text Books :

1. Electronic devices and circuit theory by Boylestad and Nashelsky, Pearson
2. Electronic principle by Albert Malvino & Davis J Bates, TMH
3. Art of electronics by Paul H Horowitz, Oxford

Reference :

1. Introduction to electronic circuit design by Spencer, Pearson.
2. Device electronics for integrated circuits by Muller And Kamins With Masun Chan, Wiley student edition
3. Principles of electronics by V K Mehta and Rohit Mehta, Chand.
4. Electronic circuit and system by R J Smith. Wiley.

Basic Electronic Lab :

1. Introduction to DMM(digital multi meter)
2. Introduction to passive components(resistance, capacitance and inductors)
3. Introduction to cathode ray oscilloscope(CRO) - time period measurement., study of different wave forms, measurement of frequency of sinusoidal waveforms by Lissajou's figure.
4. Introduction to connectors- multi-strand wires and single strand wires and bread boards.
5. Study of output characteristics of diode, BJT,FET,UJT & SCR.
6. Application of diodes, BJT, FET, UJT & SCR-Clipping & clamping, rectification, RC coupled CE and CS FET amplifiers, relaxation oscillators
7. Application of μA 741- inverting amplifiers, summer amplifiers, difference amplifiers, integrator and differentiators.

Text Book : Lab manual by Maheshwari, PHI

04 1302 DIGITAL ELECTRONICS

L-T-P : 3-1-2 **Credit : 5**

1. Digital Principle : Analog vs Digital, Number system, Computer Codes, Digital Signals, Waveforms Positive and Negative logic, Logic Gate : basic, universal and others, Truth Table, Logic functions, IC Chips, Timing Diagram, Electrical analogy. **Lecture : 4**

2. Boolean laws and theorems : Logic functions, conversion of logic functions into truth table and vice versa. SOP and POS forms of representation, min terms and max terms, simplification of logic functions by theorems and Karnaugh's map, don't care conditions, design of special purpose computers and related practical problems. **Lecture : 5**

3. Analysis and synthesis of combinational logic circuits : Adder and substructures (look ahead adders), Multiplexers, de multiplexers, Encoders, decoders, code convertors, magnitude comparators, parity generators and checkers. **Lecture : 6**

4. Integrated circuit logic families : RTL, DTL, TTL, CMOS, IIL/I^2L (integrated injection logic & emitter coupled logic). **Lecture : 4**

5. Sequential circuit blocks and latches, flip flops- race around condition, master slave and edge triggered, SR, JK, D & T Flip Flop, shift registers, counters- synchronous and asynchronous: design of ripple counter. **Lecture : 10**

6. Timing circuit : multi vibrators, mono stable and astable timer: LM555. **Lecture : 4**

7. Use of building blocks in designing larger systems such as digital to analog converters(DAC) weighted resistors and r-2r , analog to digital(ADC)- comparator, counter and succession. **Lecture : 5**

8. Memories : static and dynamic RAMs, ROM, EPROM, EEPROM. **Lecture : 4**

Text Books :

1. Digital systems - Principles and Applications by Tocci, Widmar and Jain, Pearson
2. Digital fundamentals by Floyd And Jain, Pearson

Reference books :

1. Fundamentals of VHDL design by Stephen Brown and Zovenkeo Vraseseic, TMH
2. Introduction To Logic Design With Cd Rom by Alan B Marcovity, TMH,
3. Fundamentals Of Digital Logic With Verilog Design by Stephen Brown, TMH
4. Modern digital electronics by R.P Jain, TMH

04 1x03 INTRODUCTION TO COMMUNICATION SYSTEMS

L-T-P: 3-0-3 **Credit : 5**

1. Periodic signals (sinusoidal, rectangular, saw tooth and triangular wave) and its Fourier series expansion with single side representation in real frequency domain and with double side representation in rotating phasor domain. **Lecture : 3**

2. Aperiodic signal : A signal pulse event and its Fourier transform; impulse response of a linear time invariant system, convolution and response to arbitrary input. **Lecture : 3**

3. Block diagram of communication system and comparative study of analog and digital communication. **Lecture : 3**

4. Modulation (upward frequency translation) & demodulation (downward frequency translation) and the need for modulation: broad classification of modulation [linear (amplitude-AM) and exponential (frequency-FM and phase-PM)] **Lecture : 3**

5. Generation of double side band (DSB) with carrier, double side band with suppressed carrier (DSBSC) and single side band with suppressed carrier: demodulation of double side band with carrier – incoherent detector or envelope detector, peak diode detector, coherent or synchronous detection of DSBSC and single side band with suppressed carrier. **Lecture : 6**

6. Analog pulse, modulation : PAM, PWM, PPM and demodulation; comparative study of various analog pulse modulation; comparison of incoherent and coherent detection. **Lecture : 6**

7. Superhetrodyne Receivers : Intermediate Frequency and its advantages, alignment and tracking, image rejection and IC version of the Receiver. **Lecture : 3**

7. Frequency Multiplexing in carrier Telephony. **Lecture : 1**

8. Generation of FM signals (direct and indirect methods) and demodulation. **Lecture : 3**

9. Comparative study of SNR in AM, FM and PM System and use of emphasis Circuit in FM for SNR optimization. **Lecture : 2**

10. Television-block diagram of the transmitter and receiver : description and working of video camera ;description working of B-W colour TV receiver ;description of the composite signal in B-W colour TV. **Lecture : 6**

11. CCD Flat Panel Displays. **Lecture : 3**

Text Book :

1. Radio systems for Technicians by D.C.Green, Longman.

Reference Books ;

1. Communication system by Bruce carison . TMH.
2. Electronic Communication system by Kennedy IV Edition. TMH.
3. Electronic Communication system by Roddey & Coolen, Pearson.
4. Telecommunication system Engg. by Freeman John Wiley
5. Communication system by Haykin,Wiley

LABORATORY COMMUNICATION SYSTEMS

1. Use of Quadrant multiplier Chip for generating and synchronous detection of DSB suppressed carrier.
2. Characterization and design of SAW filter.
3. Use of saw filter as Band pass Filter for generating and synchronous detection of SSB suppressed carrier.
4. Characterization of ceramic or quartz filter and design of band Pass Filter using crystals Filters

5. Pilot Carrier Insertion in SSB with suppressed carrier signal and generating a synchronous carrier by sensing the pilot using PPL chip and using this carrier for synchronous detection.

6. Realization of 2^{nd} order and 4^{th} order filters using Switch Capacitors Elements and making a comparative study of switched capacitors and conventional filters.

7. Generation of FM using VCO and demodulation using PLL chip.

8. Generation of FM using variable reactance of JFET.

9. Generation of FM using varactor diode.

10. Generation of AM signal using base/collector modulation and in coherent detection / envelope detection/diode peak detection of AM signal(DSB with carrier).

11. Study of AM receiver stage and checking the waveforms on CRO.

12. Study the FM receiver stage and checking the waveform on CRO.

Text Book :

1. Learning electronic communication through experimentation using electronic work bench by Berube, Pub. Pearson

Reference Books :

1. Communication system by Bruce Carison,TMH;
2. Electronic communication system by Kennedy, iv Edition, TMH
3. Television engineering by Grob

04 1x04 ANALOG ELECTRONICS

L-T-P : 3-0-3 **Credit : 5**

1. Four ideal amplifiers : Ideal voltage amplifiers, ideal current amplifiers, ideal transresistance amplifiers and ideal transconductance amplifiers and distortions(amplitude or harmonic distortions, frequency distortion and phase distortion); **Lecture : 4**

2. Mid frequency amplifiers :

a. Analysis of CB,CE &CC amplifiers using hybrid model(chapter eight of integrated electronics by Millman & Halkias).

b. Low and High Frequency analysis of CB, CE & CC (Chapter 11 and Chapter 12 except Section 12-10 and 12-11.

c. rise time method for determination of f_b using the formula of $t_r f_h$ – 0.35 and 10% sag method for the determination of f_{lower} using sag method. **Lecture : 15**

3. Bootstrapping in emitter follower, Darlington pair, cascade amplifier, CC-CB cascade. **Lecture : 4**

4. Multistage amplifiers and band width shrinkage in multi stage amplifiers. **Lecture : 3**

5. Incremental model of FET and incremental analysis of common source at low & high frequencies. **Lecture : 3**

6. Noise and noise figure in amplifiers : Thermal noise, shot noise, flicker noise, Friss formula **Lecture : 4**

7. Class A, Class B and Class AB power amplifiers with reference to Complementary Symmetry Amplifiers. **Lecture : 5**

8. Barkhausen criteria and oscillator : Wien bridge, RC phase shift, quadrature, Hartley, Colpitts oscillator. **Lecture : 6**

9. Tuned amplifiers-single tuned amplifiers **Lecture : 4**

Text Books :

1. Micro Electronics by Millman And Grabel , McGRAW HILL
2. electronics by Millman & Halkias , McGRAW HILL

References :

1. Micro electronics circuit by Sedra and Smith, Oxford University;
2. Micro electronics circuit analysis and design, by Rashid , PWS publication house;
3. Semi conductor circuit application- an introduction to transistors and IC ‘s by Malvino, TMH;
4. Electronic devices and integrated circuit- BP Singh and Rekha Singh, Pearson education
5. Electronic Principles, 7^{th} Ed. by Albert Malvino & Davis J.Bates, TMH.

04 1x05 OPTICAL FIBER COMMUNICATION

L-T-P: 3-1-0 **Credit : 4**

1. Historical note of comparative study with respect to RF and microwave communication . **Lecture : 1**

2. **Block diagram** of an optical fibre communication system **Lecture : 1**

3. **Optical fibre :** Basic optical laws and definitions, principles of light propagation in fibres, ray theory, optical fibre materials, fibre fabrication, optical fibre cables **Lecture : 9**

4. **Signal degradation in optical fibres :** attenuation, chromatic dispersion and inter modal dispersion, dispersion shifted and flattened fibres. **Lecture : 3**

5. **Optical Modulator :** LED&LASER diodes-basic concepts ,operation ,modulation methods, power efficiency. **Lecture : 6**

6. **Optical Detector :** PIN & APD-OPERATION, detector noise ,response time ,photodiode materials. **Lecture : 3**

7. **Splices**, Connectors. Couplers and Grating**.** **Lecture : 7**

8. **Optical Transmitters*.*** **Lecture : 5**

9. **Optical Receivers.** **Lecture : 5**

10. **Optical link Design.** **Lecture : 5**

Text Book :

1. Fibre Optic System by John Powers, IRWIN;

References Books :

1. Optical Fibre Communication by Keiser. TMH;
2. Optical Fibre Communication by Senior , PHI;
3. Optical Communication Systems by Gowar. PHI
4. Opto Electronics-An Introduction by Wilson & Hawkes, PHI.
5. Fiber Optic communication by Palais, Pearson.

04 1x06 INTELLIGENT INSTRUMENTATION

L-T-P: 3-0-3 **Credit : 5**

Theory :

1. Intelligence, features characterizing intelligence, intelligent instrumentation system: features of intelligent instrumentation, components of intelligent instrumentation, block diagram of intelligent instrumentation.

Lecture : 6

2. Signal amplification & attenuation (OP-AMP based), instrumentation amplifier (circuit diagram, high CMRR & other features), signal linearization(different types such as diode resistor combination, OP-AMP based etc.), bias removal signal filtering (output from ideal filters, output from constant – k filters, matching of filter sections, active analog filters). **Lecture : 10**

3. OP-AMP based voltage to current converter, current to voltage conversion, signal integration, voltage follower (pre amplifier), voltage comparator, phase locked loop, signal addition, signal multiplication, signal transmission, description of spike filter. **Lecture : 8**

4. Smart sensors : Primary sensors, excitation, compensation, information coding/processing, data compensation, standard for smart sensor interface. **Lecture : 10**

5. Interfacing instruments and computers : basic issues of interfacing, address decoding, data transfer control, A/D convertor, D/A convertors, sample & hold circuit, other interface considerations.

Lecture : 8

Text Books :

1. Principles of measurements and instrumentation by Alan S Morris, PHI
2. Intelligent instrumentation by Bamay, G.C.Prentice Hall

Reference Books :

1. Sensors and transducers by Parranabis, PHI
2. Introduction to digital signal processing: MGH

INTELLIGENT INSTRUMENTS LAB :

As per syllabus experiments are to be framed. Minimum 8 experiments are required to be performed in a semester.

04 1x07 ELECTRONIC INSTRUMENTATION

L-T-P: 3-0-3 **Credit : 5**

1. ERROR IN MEASUREMENTS : classification of errors, statistical analysis of errors, probable errors and limiting errors. **Lecture : 5**

2. ELECTRONIC INSTRUMENTS : Special purpose CROs (double trace, storage and digital CRO), vector voltmeter, frequency meter, universal counter and its uses for measurement of frequency, time and pulse width. **Lecture : 5**

3. WAVE ANALYSIS : Wave analyser, frequency selective wave analyser and heterodyne wave analyser, distortion measurement, resonant circuit harmonic analyzer and fundamental harmonic analyser, spectrum analyser. **Lecture : 10**

4. MEASUREMENT OF NON ELECTRICAL QUANTITIES : Piezoelectric transducers, digital displacement transducers,(shaft angle encoder) measurement of velocity, flow of liquid, liquid levels, digital temperature measurements. **Lecture : 10**

5. DATA ACQUISITION SYSTEM : signal conditioning, sample and hold circuits and multiplexing, telemetry: DC telemetry, position telemetry AC telemetry PULSE telemetry AND RADIO telemetry: modulation: amplitude, frequency and pulse modulation: signal recovery: signal filtering, signal averaging, signal correlation and signal coding. Data processing. **Lecture : 12**

Text Books :

1. Electronic measurements and instrumentation by R. Prasad. Khanna Publishers Delhi
2. Electronic instrumentation and measurements techniques by WD Coopers and A.D. Helfric, PHI

Reference Books :

1. Electronic measurements by Terman and Petit
2. Instruments and measurements for electronics by CM Herrick

ELECTRONIC INSTRUMENTATION LAB

As per syllabus experiments are to be framed. Minimum 8 experiments are required to be performed in a semester.

04 1308 SOLID STATE PHYSICS & DEVICES

L-T-P : 3-0-3 **Credit : 5**

1. **History** of development of electronic devices. **Lecture : 3**
2. **Review of device physics :** Photo-ionic emission, thermionic emission, gas discharge tubes, vacuum tubes-diodes, triodes, tetrads and pentodes. **Lecture : 3**
3. **Crystal growth :** Bulk and epitaxial **Lecture : 1**
4. **IC technology :** Oxidation, diffusion, ion implantation, lithography, thin film deposition (CVD, sputtering, evaporation,) process integration, process flow for PN diodes, BJT and MOSFETS fabrication. **Lecture : 5**
5. **Physics and technology of classical diodes :**

- Semiconductor carrier modelling- bonding model, energy band model, carriers, band gap, carrier properties(effective mass, intrinsic carrier concentration, doping) density of states, Fermi function, equilibrium carrier concentration (formula for n and p and np product). Charge neutrality relationship, determination of Fermi level, carrier conc. Temperature dependence.
- Carrier Action Drift Mobility Drift Current, Resistivity, Diffusion Current. Total current. relation between the diffusion constants. And mobility (Einstein's relationship). Recombination generation (Band to Band, R-G Centres, Auger, impact ionization). Equation of state Continuity equation, Minority Carrier Diffusion Equation.
- PN Junction Diode Step junction, Built-in potential, Depletion width. Depletion Approximation .Electrostatic relationship (charge density depletion with potential , electric field)for Va=0 and Va<>0 Ideal Diode Equation(qualitative and quantitative derivation :Band Model , Assumptions Approximation .Boundary Condition),Deviation from Ideal (R-G Current, series Resistance ,High Level Injection).Junction Breakdown (Avalanche and Zener),Reverse Bias Junction Capacitance ,forward Bias Diffusion Capacitance ,Qualitative understanding of Turn on and Turn-off transients.
- Zener Diode Backward diode Tunnel diodes Varactor diode, Schottky diode. **Lecture : 13**

6. **Physics and technologies of BJT :** operational considerations, modes and configurations, performance parameters (emitter efficiency, base transport factor, common base current gain, common emitter current gain and their derivation for an ideal transistor, deviation from ideal (base width modulation punch through, avalanche breakdown, geometrical effects, R-G current), small signal modelling, qualitative understanding of switch response. **Lecture : 6**
7. **Physics and technologies of FET :** Junction FET(theory of application, I-V relationship), MOS capacitor(energy band diagram, gate voltage relationship, capacitance- voltage characteristics), MOSFET (theory of operation, threshold voltage, I-V characteristics) NON IDEAL MOS (M-S work function difference, oxide charges, threshold adjustment and considerations) **Lecture : 5**
8. **Physics and technologies of UJT and SCR :** silicon controlled rectifier(theory of operation, switching consideration), uni junction transistor(theory of operation) **Lecture : 2**
9. **Photonics :** Photo diodes (pin and avlanche), solar cell, LED , solid state LASER diodes. **Lecture : 3**
10. **CCD and CCD cameras.** **Lecture : 1**

Text Book :

1. Solid sate electronic devices by Streetmen And Banerjee, Pearson:
2. Basic principles- semiconductor physics and devices by Nearmen,TMH
3. Semiconductor devices by Kano, Pearson

References :

1. Electronic Materials and Devices by Kasp. TMP.
2. Theory of Semiconductor Devices by Karl Hess, PHI.
3. Semiconductor Devices by Jasprit Singh, Wiley Student Edition.
4. Device electronics for Integrated Circuits by Muller & Kamins, Wiley Student Edition.

04 1x09 ADVANCED ELECTROMAGNETIC FIELD

L-T-P: 3-1-0 **Credit: 4**

1. **Guided waves & wave guide :** Waves between parallel planes. TM & TE waves, Their propagation and attenuation in parallel plane guides, Rectangular wave guides – TE & TM waves in rectangular guides, Wave impedance, Circular wave guides, Introduction to resonators. **Lecture : 15**

2. **Radiation :** Potential function & electromagnetic fields, a small current element radiation, Power radiated by current element & radiation resistance, Radiation from quarter wave monopole & half wave dipole. **Lecture : 9**
3. **Antenna :** Network theorem, two element array, linear array, multiplication of patterns, binomial array. **Lecture : 6**
4. **Directional properties and Gain terminal impedance :** Types of antenna – mutual impedance of antenna, travelling wave antenna, rhombic antenna, Yagi antenna. **Lecture : 3**
5. **Propagation of EMF waves**, various paths, space waves, surface waves & propagation along spherical earth. **Lecture : 4**
6. **Tropospheric propagation**, mechanisms of tropospheric wave propagation, duct and super – refraction. **Lecture : 3**
7. **Nature and properties of ionosphere :** Critical frequency, MUF, effect of geo – bar magnet, solar activity, and fading of ionospheric waves. **Lecture : 6**

Text Books:

1. Electromagnetic waves and radiating systems by Jordan & Balmain, PHI.

04 1x10 DIGITAL SIGNAL PROCESSING

L-T-P: 3-0-3 **Credit: 5**

Theory:

1. **Overview of DSP**, Basic Elements of DSP system, Advantages of DSP over Analog, Classification of signals, Concept of frequency in continuous time and discrete time, continuous time and discrete time sinusoidal signals. **Lecture : 10**
2. **Discrete time systems :** Linear time invariant, Response of LTI system – convolution sum, description of discrete time system by difference equation & complete solution of difference equation, Implementation of discrete time systems, Correlation of discrete time signals. **Lecture : 14**
3. **Z – Transform** and its application to the analysis of LTI Systems. **Lecture : 3**
4. **Discrete Time** Fourier Transform, properties of DTFT. **Lecture : 3**
5. **Frequency domain** representation of LTI Systems. **Lecture : 3**
6. **Sampling and reconstruction** of Analog signals. **Lecture : 3**
7. **Discrete Fourier series**, Discrete Fourier transform properties of DFT, FFT. **Lecture : 6**
8. **Digital filter structure :** FIR & IIR designs. **Lecture : 6**

Text Books:

1. Digital Signal Processing by Proakis & Manolakis, Pearson.
2. Digital Signal Processing by Ingle & Proakis, Thomson.

Reference Books:

1. Digital Time Signal Processing by Oppenheim & Schafer, Pearson.
2. Digital Signal Processing Computer Based Approach by Mitra, TMH.

Practical :

Perform the experiments using MATLAB :

1. To represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine).
2. To develop program for discrete convolution.
3. To develop program for discrete correlation
4. To understand stability test
5. To understand sampling theorem
6. To design analog filters (low-pass, high pass, band pass, band stop)
7. To design digital filters (low-pass, high pass, band pass, band stop)
8. To design fir filters using windows techniques
9. To develop a program to compare direct realization values of IIR digital filters.
10. To develop a program for computing parallel realization values of IIR digital filters.
11. To develop a program to computing cascading realization values of IIR digital filters
12. To develop a program to computing inverse Z- transformation of a rotational transfer function.

04 1x11 MICROWAVE ENGINEERING

L-T-P : 3-0-3 **Credit : 5**

1. **Microwave oscillators and amplifiers,** advantages and uses of microwave, limitations of conventional vacuum tubes at UHF and microwave frequency, UHF and microwave BJT **Lecture : 3**
2. **Muticavity klystron**, Reflex klystron, Muticavity travelling wave type magnetron, Backward wave oscillator, Gunn oscillator, Tunnel diode, IMPATT diode. **Lecture : 12**
3. **Microwave components :** Coupling probes & Loops, Attenuator, sorting plunger, Magic tee, Directional coupler, Phase Shifters, Isolators & circulators. **Lecture : 6**
4. **Microwave measurement :** Measurement of power, Standing wave detectors and its uses, Impedance measurement, Measurement of frequencies by wave meters, Attenuation Measurement, Noise factor measurement. **Lecture : 6**
5. **Microwave receiver :** Block Diagram representation, Varactor Diode as mixer, antenna noise and noise temperature. **Lecture : 6**
6. **Antenna-Log-Periodic Antenna**, Slot, Horn & Parabolic antenna (Dish Antenna). **Lecture : 4**
7. Microwave Links & space communication: Geostationary satellites, Up – Down Links, Fading effect, Atmospheric effects, and solar activities. **Lecture : 6**

Text Books:

1. Microwave devices and circuits by Samuel Y. Laio, PHI.

Reference Books:

1. Microwave & Radar Engineering by M. Kulkarni, Umesh Publications.
2. Foundations of Microwave Engineering by R.F. Collins, McGraw Hill.
3. Microwave Principles by Reich et. Al. , Van Hestrand
4. Communication in Space by Jaffen, Halt Renetat Winston.

04 1x12 ELECTRICAL & ELECTRONIC MATERIAL

L-T-P: 3-1-0 **Credit : 4**

1. **Band theory of Solids :** Energy band diagram, E – K Diagram, Reduced E – K Diagram, Insulators, Semiconductors & Conductors. **Lecture : 6**
2. **Dielectric behavior of materials :** Polarization, Dielectric constant at low frequency & high frequency, Dielectric loss, Piezo Electricity & Ferro Electricity. **Lecture : 6**
3. **Magnetic behavior of materials :** Diamagnetism, Para magnetism, Ferromagnetism & Ferrimagnetisms, Soft & Hard magnetic materials and their applications. **Lecture : 6**
4. Semiconductor : Single Crystal, Poly Crystal and Amorphous, Fermi – Dirac Distribution, Hall effect, Intrinsic & Extrinsic, N type & P type, Crystal growth – (1.) Preparation of electronic grade poly crystal in Siemens reactor, (2.) Czochrarloski Method & Float Zone method of bulk single crystal ingot preparation (3.) Mirror finished wafer preparation (4.) Epitaxial film growth – Chemical vapor phase deposition & Liquid phase epitaxy (5.) Molecular beam epitaxy. **Lecture : 12**
5. **Concepts of Phonons :** Quantization of lattice vibration. **Lecture : 2**
6. **Special classification of semiconductor material :** Degenerate (Semi-Metal) and none degenerate semiconductor: Elemental and compound semiconductor, direct & indirect band gap material. **Lecture : 3**
7. **Superconductors :** Low & High temperature (YBaCuO) superconductors, Meissner effect, Applications. **Lecture : 3**
8. **Printed Circuit Board :** Manufacturing process, Single & Double sided boards, surface mounted devices. **Lecture : 6**

Reference Books:

1. Solid State Physics by Kittel, McGraw Hill.
2. Principles of Electric Engineering Materials & Devices by S.O. Kasp, McGraw Hill.
3. Structure & properties of materials (VOL VI), Electronic Properties by Robert M. Rose, Lawrence A. Shepherd & John Wulf, Wiley Eastern Ltd.

04 1x13 ELECTRICAL & ELECTRONIC MATERIAL LAB

1. Four point probe for resistively measurement.
2. Measurement of Hall Effect in semiconductor.

3. C – V Measurement in silicon oxide sample for interface states.
4. Photoconductivity Measurement.
5. Measurement of Planck's constant by photo cell.
6. Dielectric constant Measurement.
7. Kerr Effect Measurement.
8. Biot Savart's Law Experiment.
9. B-H Curve Experiment.

04 1x14 PROJECT- I

L-T-P: 0-0-9 **Credit : 6**

04 1x15 INDUSTRIAL TRAINING

L-T-P: 0-0-3 **Credit : 2**

ELECTIVES

04 1x61 MICROELECTRONICS : IC DESIGN & FABRICATION

L-T-P: 3-1-0 **Credit : 4**

1. **Introduction to MOS technology :** Introduction to IC technology, MOS & related VLSI technology, Basic MOS transistors (Enhancement mode and depletion mode), NMOS process, CMOS process (P – Well, N – Well, Twin – tub processes), Bi CMOS process flow, aspects of CMOS & Bi CMOS devices. **Lecture : 6**
2. **Basic electrical properties of MOS circuits :** MOSFET Threshold voltage, I – V relationship for MOSFET, MOSFET trans conductance, the pass transistor, NMOS inverter, Pull – UP to Pull – Down ratio for NMOS inverter driven by NMOS inverter and pass transistor, different forms of pull – up (Load resistor, depletion mode NMOS, Enhancement mode pull – up, CMOS pull – up), CMOS inverter, MOS transistor circuit model, Latch up in CMOS circuits, Bi CMOS inverter, comparative aspects of CMOS and Bipolar transistors. **Lecture : 7**
3. **MOS circuit design processes :** MOS Layers, Stick Diagrams (NMOS design style, CMOS design style), Euler path and design optimization, design rules & layout (Lambda based design rules, contact cuts, double metal MOS process rules, CMOS Lambda based design rules), Two micron double metal double poly CMOS rules. **Lecture : 5**
4. **Basic circuit concepts :** Sheet resistance, area capacitance of layers, inverter delays, driving large capacitive loads, propagation delay (cascaded pass transistors, design of long poly silicon wires), wiring capacitances (fringing fields, interlayer capacitance, peripheral capacitance). **Lecture : 6**
5. **Scaling of MOS circuits :** Scaling models & scaling factors (gate area, gate capacitance, channel current density, channel resistance, gate delay, maximum operating frequency, saturation current, current density, power dissipation), Limitation of scaling. **Lecture : 4**
6. **Subsystem design and layout :** Switch logic (pass transistors and transmission gates), gate logic (inverter, Two input CMOS NAND & NOR gates), Structure design of a parity generator. **Lecture : 4**
7. **Memory and aspects of system timing :** System timing considerations, one transistor dynamic memory cell, three transistor dynamic RAM cell (Area, dissipation, volatility), RAM Arrays. **Lecture : 4**
8. **Practical aspects :** Optimization of NMOS & CMOS inverters, input output pads, aspects of design tools (Graphical and tree layout, design verification, design rule checkers, circuit extractors, simulators). **Lecture : 4**
9. **Crystal growth and doping :** Starting materials, Czochralski technique, Gradient freeze technique, Considerations for proper crystal growth (role of point defects, thermal gradients, turbulences, pull and spin rate, crystal orientation, crystal hardening techniques), Doping (rapid stirring conditions, partial stirring conditions, radial doping variations), Zone processes (Zone refining, Zone leveling, neutron transmutation doping) **Lecture : 3**
10. **Diffusion -** Diffusion in a concentration gradient, Diffusion equation, Impurity behavior in Silicon, diffusion systems for Silicon, redistribution during oxide growth, diffusion during oxide growth, cooperative diffusion, evaluation techniques for diffused layers in Silicon. **Lecture : 2**
11. **Epitaxy :** Nucleation and growth, doping, dislocation, thermally induced strain, Molecular Beam exitaxy, Vapor phase epitaxy for Silicon, Liquid phase epitaxy. **Lecture : 2**

12. **Ion-Implantation :** Penetration range (nuclear and electronic stopping, Transverse effects), Implantation damage, annealing, Ion – Implantation systems, process consideration, high energy and high current implants. **Lecture : 2**
13. **Native Films :** Thermal Oxidation of silicon (kinetics of oxide growth, oxidation systems, oxidation induced stacking faults, properties of thermal oxides), Thermal nitridation of Silicon, Plasma processes. **Lecture : 2**
14. **Deposited Films :** Films deposition methods (vacuum evaporation, sputter deposition, Chemical vapor Deposition), Film characteristics (step coverage, grown habit, mechanical stress, electromigration) **Lecture : 2**
15. **Etching and Cleaning :** wet chemical etching in silicon based processes, Dry physical etching, Dry chemical etching, Reactive Ion etching, Etch induced damage, Cleaning (wet and dry) **Lecture : 2**
16. **Lithography :** Photoreactive materials, pattern generation and mask making, pattern transfer- optical printing, advanced techniques (short wavelength, multilayer resist, phase shifting masks, Electron beam techniques, X-ray printing), Mask defects, Pattern transfer defects **Lecture : 2**
17. **Process integration :** Isolation, (P-N junction, Mesa, Oxide), self alignment, local oxidation, planarization, metallization, gettering, Process flow for CMOS**-** **Lecture : 2**

Projects :

Design, layout (using Electric freeware) and process integration of a MOS based circuit

Text Books :

1. Basic VLSI Design by Pucknell and Eshraghian
2. VLSI Fabrication Principles by Sorab Gandhi

Reference Books :

1. The science and engineering of Microelectronic Fabrication by Stephen Campbell
2. VLSI Design by Sujata Pandey and Manoj Pandey
3. CMOS VLSI design by Wolfe

04 1x62 DIGITAL SIGNAL PROCESSORS

L-T-P : 3-1-0 **Credit: 4**

1. **Introduction:** Discrete-Time Signals, Shanon's sampling theorem, Difference equation description, characteristics of digital filters and time domain analysis, properties of discrete time system (linearity, time-variance, and convolution), BIBO stability, Z-transformation and their application in solving difference equations, Relationship between Laplace and Z-transforms. **Lecture : 7**
2. **Frequency domain analysis:** Discrete Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT), Periodic convolution, Direct evaluation of DFT, FFT algorithms-decimation in time and frequency, Relationship between Fourier and Z- transforms. **Lecture : 8**
3. **Digital Filter Structures:** Direct form I&II, cascade, parallel and ladder realization. **Lecture : 5**
4. **Filter function Approximations and Transformations:** Review of approximations of ideal analog filter response, Butterworth filter ,Chebyshev Type I & II. **Lecture : 6**
5. **Frequency Transformations:** Frequency transformation in analog domain, frequency transformation in digital domain. **Lecture : 4**
6. **Design of IIR Filter:** Design based on analog filter approximations, Impulse invariance method, Matched Z-transformation, Bilinear transformation. **Lecture : 7**
7. **Design of FIR Filters:** Symmetric and antisymmetric FIR filters, design of linear phase FIR filters using windows and frequency-sampling methods, design of optimum equiripple linear phase FIR filters, comparison of FIR and IIR filters. **Lecture : 8**

Text Books :

1. Digital signal Processing, Principles Algorithms and Applications by John G. Proakis, Dimitris G. Mamalakis,
2. Digital signal Processing by Alan V. Oppenheim Ronald W. Schafer, PHI, India

Reference Book:

1. Digital Filter Design by Antonious, McGraw Hill, International Editions

04 1x63 BIO-MEDICAL SENSORS AND TRANSDUCERS

L-T-P : 3-1-0 **Credit: 4**

1. **Different Transduction principles :** Classification of transducers, selecting of transducers, circuit based on transduction. Temperature transducers : thermo-resistive transducers, thermoelectric, p-n junction, chemical thermometry. Displacement transducers: potentiometer, resistive strain gauges, inductive displacement, capacitive displacement transducer, force transducer; Pressure transducer : variable capacitance pressure transducers, LVDT transducers, strain gauge transducers, semiconductor transducers, catheter tip transducers. Photoelectric transducers: photo-emissive tubes, photovoltaic cell. Flow transducers: different types of flow sensors and detectors, Piezoelectric transducers and their applications.

Lecture : 14

2. **Study of biological sensors :** Sensors / receptors in the human body, basic organization of nervous system-neural mechanism and circuit processing. Chemoreceptor: hot and cold receptors, barro receptors, sensors for smell, sound, vision, osmolality and taste. Sensor models in the time and frequency domains. **Lecture : 4**
3. **Biochemical Transducers :** Electrode theory: electrode-tissue interface, metal-electrolyte interface, electrode-skin interface, electrode impedance, electrical conductivity of electrode jellies and creams. Biopotential electrodes: microelectrodes, body surface electrodes, needle electrodes. Reference electrodes: hydrogen electrodes, silver-silver chloride electrodes, Calomel electrodes, Recording electrodes for ECG, EEG, and EMG, Transducers for the measurement of ions and dissolved gases, pH electrode, specific ion electrodes.

Lecture : 12

4. **Bio sensors :** Ion exchange membrane electrodes, enzyme electrode, glucose sensors, immunosensors, Basic principles of MOSFET biosensors & BIOMEMS. **Lecture : 5**
5. **Optical sensor :** Photo detectors, optical fiber sensors, and indicator mediated transducers, general principles of optical sensing, optical fiber temperature sensors. Pulse sensor: photoelectric pulse transducer, strain gauge pulse transducer. **Lecture : 5**

Text Books :

1. "Handbook of Biomedical Instrumentation" by R. S. Khandpur, Tata McGraw Hill.
2. "Transducers for Biomedical Instruments" by S.C. Cobbold, Prentice Hall.
3. "Engineering Principles in Physiology Vol. I" by Brown & Gann, Academic Press.
4. "Introduction to Biomedical Equipment Technology" by Carr & Brown, Pearson Education, Asia.
5. "Principles of Medical Electronics & Biomedical Instrumentation" by Rao & Guha, University Press, India.

Reference Books :

1. "Regulation & Control in Physiological System" by Iberall & Guyton, Instruments Society USA.
2. "Touch Heat & Pain" by A.V.S. De Renck, Churchill Ltd. London.
3. "Handbook of Bio medical Instrumentation" by Harry Thomas , Reston, Virginia.
4. "Applied Bio Sensors" by D. L. Wise, Butterworth, London.

04 1x64 TV ENGINEERING

L-T-P : 3-1-0 **Credit : 4**

1. **Picture transmission**, sound transmission, picture reception, sound reception synchronization, receiver controls, color television. Analysis and Synthesis of Television Pictures: Gross structure, image continuity, number of scanning lines, flicker, fine structure, tonal gradation. Video signal dimensions, horizontal syne details, vertical syne details, scanning sequence details, functions of vertical pulse train, syne details of 525-line system.
2. **Amplitude Modulation**, channel bandwidth, vestigial side band transmission, Transmission efficiency, complete channel bandwidth, reception of vestigial side band signals, frequency modulation, FM channel bandwidth, channel bandwidth for color transmission, allocation of frequency bands for television signal transmission, television standards.
3. **Monochrome picture tube,** Beam deflection, screen phosphor, faceplate, picture tube characteristics, picture tube circuit controls. Television Camera Tubes: Basic principle, Image orthicon, Vidicon.

4. **Television transmitter**, positive and negative modulation. Television Receiver: Receiver sections, vestigial side band correction, choice of intermediate frequencies, picture tube circuitry, & controls, sound signal separation, sound section, Syne processing & AFC circuit, vertical Deflection circuit, Horizontal Deflection circuit, Television signal propagation and antennas: Television Transmission antennas, Television receiver antennas, Color Television antennas.
5. **Compatibility**, natural light, color perception, three-color television camera, the luminance signal, values of Luminance & color difference signals on Colors, color television display tubes (Delta gun, PIL, Irinitron) , Color signal transmission, bandwidth for color signal transmission.

Text Book:

1. Monochrome and Color Television by R R Gulati; New Age International.

Reference Book :

1. TV and Video Engineering by Dhake,; TMH.

04 1x65 MICROCONTROLLERS

L-T-P : 3-1-0 **Credit : 4**

1. **Different types of microcontrollers :** Embedded microcontrollers, external memory microcontrollers, processor architecture, Harvard Vs Princeton. **Lecture : 4**
2. **Microcontrollers :** Overview of 8051 microcontroller, application areas, compares and contrasts Microprocessor and Microcontrollers. **Lecture : 2**
3. **8051 Microcontrollers Architecture :** 8051 pin description , conception about program counter, data pointer register bank, flags , program status word (PSW) , internal memory, RAM memory, ROM memory map, stack and stack pointer, input and output ports, External memory , counters and timers , serial data, input/output interrupts. **Lecture : 8**
4. **8051 Addressing modes :** Immediate and register addressing modes. Accessing memory using various addressing modes, Bit address for I/O and RAM. **Lecture : 3**
5. **Basic assembly language programming concepts :** assembling and running an 8051 program. 8051 assembly language programming concepts using arithmetic , logical , data mover, call, jump, loop, time delay instructions and subroutines. **Lecture : 8**
6. **I/O port programming :** 8051 I/O port assembly language programming concepts. **Lecture : 3**
7. **Assembly language programs** based on rotate, compare and data serialization concepts. **Lecture : 3**
8. **8051 timers programming in assembly :** 8051 timers programming concept, counter programming. **Lecture : 5**
9. **Interrupts programming in assembly :** Programming timer interrupts. **Lecture : 3**
10. **Real world interfacing or 8051 :** Intelligent LCD display, interfacing keyboard to 8051. **Lecture : 5**
11. **PIC Microcontrollers :** Introduction to PIC Microcontrollers , Architecture and pipelining. Program memory considerations. Addressing modes. CPU Registers . instruction set , simple operation. **Lecture : 6**

Text Books:

1. The 8051 Microcontroller and Embedded system by M.A. Mazidi, Pearson/PHI.
2. Design with PIC Microcontrollers by John B. Peatman, Pearson.

Reference Books:

1. The 8051 microcontroller by Kenneth Ayala, Thomson Learning.
2. Embedded microcomputer systems by J.W. Valvano Brooks, Thomson Learning.
3. Microcontrollers and Microcomputers by Fredrick M. Cady, Oxford University press

04 1x66 DIGITAL SYSTEM DESIGN

L-T-P : 3-0-3 **Credit : 5**

Theory :

1. **Introduction to Computer**-aided design tools for digital systems. Hardware description languages; introduction to VHLD, data objects, classes and data types, operators, Overloading, logical operators. Types of delay Entity and architecture declaration. Introduction to behavioural. Dataflow and structural models.
2. **Assignment statements**. Sequential statements and process, conditional statements, case statement. Array and loops, resolution functions, Packages and libraries. Concurrent statements. Subprograms: Application of functions and procedures, structural modeling. Declaration structural layout and generics.
3. **VHDL Models** and Simulation of combinational circuits such as Multiplexers, Demultiplexers, encoders, decoders, code converters, comparators, implementation of Boolean functions etc. VHDL Models and Simulation of Sequential Circuits Shift Registers, Counters etc.
4. **Basic components of a computer**, specifications, architecture of a simple microcomputer system, implementation of a simple microcomputer system using VHDL.
5. **Programmable logic devices :** ROM, PLAs, PALs, GAL, CPLDs, and FPGA, design implementation using CPLDs and FPGAs.

Practical :

1. Design all gates using VHDL.
2. Write VHDL program for the following circuits, check the waveforms and the hardware generated – (a) half adder (b) full adder.
3. Write VHDL program for the following circuits, check the waveforms and the hardware generated - (a) multiplexer (b) demultipiexer
4. Write VHDL program for the following circuits, check the waveforms and the hardware generated - (a) decoder (b) encoder
5. Write a VHDL program for a comparator and check the waveforms and hardware generated.
6. Write a VHDL program for a code converter and check the waveforms and the hardware generated.
7. Write the VHDL program for a FLIP-FLOP and check the waveforms and hardware generated.
8. Write the VHDL program for a counter and check the waveforms and hardware generated.
9. Write the VHDL program for the following circuits, check the waveforms and hardware generated - (a) register (b) shift register
10. Implement any three (given above) on FPGA/CPLE kit.

Reference books:

1. IEEE standard VHDL language reference manual(1993).
2. Digital design and modelling with VHDL and synthesis by KC Chang; IEEE computer society press .
3. A VHDL Primer by Bhaskar, Apprentice Hall (1995).
4. Digital system design using VHDL by Charles. H. Roth; PWS (1998).
5. VHDL Analysis & modeling of digital systems by Nawabi Z; McGraw Hill.
6. VHDL- 4TH EDITION by Perry : TMH (2002).
7. Introduction of digital systems by Ereegovac, Lang & Moreno: John Wiley(1999).
8. Fundamentals of digital logic with VHDL design by Brown & Vranesic; TMH(2000).
9. Modern digital electronics third edition by R.P. Jain; TMH(2003).

04 1x67 DIGITAL IMAGE PROCESSING

L-T-P : 3-0-3 **Credit : 5**

1. **INTRODUCTION :** Background, Digital image representation, Fundamentals step in image processing, Elements of a Digital Image Processing System.

   DIGITAL IMAGE FUNDAMENTALS : Elements of visual perception, A simple image model, Sampling & quantization, Some basic relationship between pixels, imaging geometry.
2. **IMAGE TRANSFORMS :** Introduction to the Fourier transform, the discrete Fourier transform, Some properties of the Two – Dimensional Fourier transform, Other separable image transforms.
3. **IMAGE ENHANCEMENT :** Spatial domain methods, Frequency domain methods, Some simple intensity transformations, Histogram processing, Image subtraction, image averaging, Background, Smoothing Filters, sharpening Filters, Low pass filtering, high pass Filtering, Generation of spatial masks from frequency domain specification.

4 & 5. IMAGE RESTORING: Degradations model – Definitions, Degradation model for continuous functions, Diagonalization of the circulant and the block circulant matrices, Circulant matrices, Block circulant matrices, Effects of Digonalization on the degradation model, algebraic approach to restoration, Unconstrained restoration, constrained restoration, Inverse filtering – Formulation, Removal of blur caused by uniform linear motion, restoration in the spatial domain, Geometric transformation.

6 & 7. IMAGE COMPRESSION: Fundamentals – coding redundancy, Interpixel redundancy, Psycovisual redundancy, Fidelity criteria, Image compression models – the source Encoder and Decoder, The channel Encoder and Decoder. Elements of information theory – Measuring information, The information channel, fundamental coding theorems, Using information theory. Error – free compression – Variable – Length coding, Bit – Plane coding, Lossless predictive coding. Lossy compression – Lossy predictive coding, Transform coding.

Text Books :

1. Digital Image Processing, (2nd edition) by Rafael .C. Gonzalez & Richard E. Woods Pearson Education, New Delhi.

Reference Books :

1. Digital Image Processing by W.K. Pratt., John Wiley & sons.
2. Fundamentals of Digital Image Processing by A.K. Jain, PHI, New Delhi.
3. Image Processing, Analysis And Machine Visions by M. Sonka et. al., Thomson Learning, Indian Edition.

04 1x68 BIOMEDICAL INSTRUMENTATION AND IMAGING

L-T-P : 3-0-3 **Credit : 5**

1. Introduction : Medical Instrumentation System, Man Instrumentation System, Brief idea of cardiovascular, Nervous & respiratory system. **Lecture : 6**

Text Books :

1. "Biomedical Instrumentation & Measurements" by Cromwell.
2. "Biomedical Instrumentation" by Dr. M. Arumugham
3. "Medical Electronics & Biomedical Instrumentation" by Rajarao & Guha.

2. Resting & action potential, Polarization & depolarization, Propagation & action potential, Bioelectronic potential. **Lecture : 7**

Text Books :

1. "Biomedical Instrumentation & Measurements" by Cromwell.
2. "Biomedical Instrumentation" by Dr. M. Arumugham
3. "Medical Electronics & Biomedical Instrumentation" by Rajarao & Guha.

3. Biopotential electrode, Active & passive transducers, Biochemical transducers. **Lecture : 6**

Text Books :

1. "Biomedical Instrumentation & Measurements" by Cromwell.
2. "Biomedical Instrumentation" by Dr. M. Arumugham
3. "Medical Electronics & Biomedical Instrumentation" by Rajarao & Guha.

4. ECG electrodes & leads, Measurement of blood pressure, blood flow & heart sounds. **Lecture : 6**

Text Books :

1. "Biomedical Instrumentation & Measurements" by Cromwell.
2. "Biomedical Instrumentation" by Dr. M. Arumugham
3. "Medical Electronics & Biomedical Instrumentation" by Rajarao & Guha.

5. Non-invasive instrumentation, Patient monitoring system, Electrical safety of patients in hospital, Defibrillator, Pace maker. **Lecture : 6**

Text Books :

1. "Biomedical Instrumentation & Measurements" by Cromwell.
2. "Biomedical Instrumentation" by Dr. M. Arumugham

6. Amplifiers & recorders, Diathermy (Microwave) structure & ultrasonic, Imaging system (X-ray, MRI & ultrasonic), Lasers in medicine. **Lecture : 8**

Text Books :

1. "Handbook for Biomedical instrumentation" by Khandpur.
2. "Medical Instrumentation" by Rajarao.
3. "Medical Instrumentation (application & design)" by Webster.
4. "Medical Instrumentation" by Carr & Brown.

7. Antennas for biomedical application & Applicator, Biomedical DSP (elementary idea). Biomedical micro-electro-mechanical system (Introductory idea) **Lecture : 6**

Text Books :

1. Antenna Theory & Practice by R. Chatterjee
2. Biomedical digital signal processing by Wills J. Tompkin.

04 1x69 RADIO ASTRONOMY

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction :** Brief history of radio astronomy and an overview of cosmic radio emission.
2. **Radio source mechanisms :** Very brief review of electrodynamics, radiative transfer, thermodynamics, atomic and molecular spectra. Thermal and non-thermal continuum mechanisms, thermal line emission and absorption, non-equilibrium line emission.
3. **Solar system radio sources :** Earth, Moon, Venus, Sun, Jupiter, artificial satellites, radio frequency interference (RFI)**.**
4. **Galactic radio sources :** Supernova remnants (SNR), diffuse non-thermal galactic emission, galactic HI, HII regions, interstellar and circumstellar masers, pulsars, active photospheres and accretion disks.
5. **Extra-galactic radio sources :** Cosmic microwave background radiation (CMBR), normal galaxies, radio galaxies, quasars, era of reionization (EoR).
6. **Radio telescope antennas :** Fourier optics, aperture illumination, beam polar pattern, descriptive parameters.
7. **Radio telescope receivers :** Noise temperature, low noise amplifiers (LNAs), filters, waveguide components, mixers and heterodyne systems.
8. **Radiometry :** Continuum radiometers, pulsar radiometers, polarimeters, spectrometers.
9. **Interferometry and aperture synthesis :** Mutual coherence function, van Cittert-Zernike theorem, two-element interferometers, aperture synthesis.

04 1x70 EMBEDDED SYSTEM DESIGN

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction :** Embedded Systems Overview, Processor technology-General purpose processor (Software), Single purpose processors (Hardware), Application- Specific processors; IC Technology – Full - Custom / VLSI, Semicustom ASCI (Gate Array and standard cell), PLD, etc. **Lecture : 5**
2. **Basic Concepts of Computer Architecture :** Concepts, Memory, Input / Output, DMA, Parallel and Distributed computers, Embedded Computer Architecture, etc. **Lecture : 7**
3. **Embedded Processors & Systems :** The PIC Micro-controllers- A Table of two Processors, Starting Example using Minimal PIC 12C508 Computer and PIC 16C73 Processor, The AVR Microcontrollers- The Atmel At tiny 15 AVR Processor and Architecture, Downloading code; The Bigger AT 90S835 Processor and support Components, Bus interfacing, AT 90S8515 Memory Cycle and Bus Signals, Memory Maps & address decoding, programmable logic (PALs, LCAs or PLDs), Timing Analysis and memory management. **Lecture : 10**
4. **MC 68000 Series Computer :** A simple 68000 architecture**;** a simple 68000- based computer- reset circuit, Address decoder I/O (Multifunction Peripheral), Memory Interfacing to SRAM and EPROMs, Wait-state generator, etc. **Lecture : 4**
5. **DSP- Based controller :** DSP 56800 programmer's model, A DSP 56805- based computer **–** DSP 56805 block Diagram, crystal oscillator circuit and module, reset and interrupts, External memory, interfacing to program, SRAM and data SRAM, Shared program and data memory, address decoder for two 32K SRAMs and Eight peripherals, JTAG. **Lecture : 5**

6 & 7. Peripherals and interfacing : Adding peripherals and interfacing – serial peripherals and interfacing - serial peripheral interface (SPI), Inter Integrated circuit (I^2C), adding a real time clock with I^2C), adding a small display

with I²C, Serial ports – UARTs, Error detection, RS – 232C & RS – 422, Infrared communication, USB, Networks – RS – 485, Controller area network (CAN), Ethernet, Analog sensors – Interfacing external ADC, Temperature Sensor, Light Sensor, Accelerometer, Pressure sensor, Magnetic field sensor, DAC, PWM, Embedded system applications – Motor control and switching big loads. **Lecture : 14**

Text Books/Reference Books :

1. Designing Embedded Hardware by Catsoulis, John, Shroff Publishers and Distributors Pvt. Ltd. New Delhi.
2. Embedded system design – A unified Hardware/Software Introduction by Vahid, Frank & Givargis, Tony, John Wiley & Sons, Replika press Delhi.

04 1x71 VLSI – DESIGN

L-T-P : 3-1-0 **Credit : 4**

THEORY

1. **Introduction to CMOS circuits :** MOS transistors, MOS transistor switches, CMOS logic, the inverter combinational logic, NAND gate, NOT gate, COMPOUND gates, multiplexers, memory-latches and registers circuit and system representation: Behavioral representation, structural representation and physical representation. CMOS processing technology: silicon semiconductor technology-An overview. Wafer processing. Oxidation, epitaxy deposition, lon-implemation and diffusion, The silicon gate process-basic CMOS technology, Basic n-well CMOS process, p-well CMOS process, twin tub process, silicon on insulator, CMOS process enhancement-interconnect, Circuit elements 3-D CMOS.
2. **Layout Design Rule :** Layer Representations, CMOS n-well Rules, Design rule of background scribe line, Layer assignment, SOI rule, Latch up, Physical origin of latch up, Latch up triggering, Latch prevention, Internal latch up prevention techniques, I/O latch up preventions.
3. **Switching Characteristics :** Analysis delay models, Empirical delay model, Gate delay, Power dissipation: static dissipation, Dynamic dissipation, Short-circuit dissipation, Total power dissipation, CMOS design methods, Design strategies, Hierarchy, Regularity, Locality.
4. **Programmable logic,** Programmable logic structure, Programmable interconnect and reprogrammable gate array : Xilinx programmable gate array, Algortomix,. Concurrent logic, Gate array design, Full custom mask design.
5. **Design method behavioural synthesis,** RTL synthesis, placement, Routing, Layout synthesis, Design capture tools, HDL design schematic, Layout design, Floorplanning, Chip composition, design verification, Simulation, Liming verifier, Netlist comparisons.

Text Books :

1 Principles of CMOS VLSI design: a system perspective by Neil H.E. Weste and Kamran Eshraghian; Addision Wesley pub.
2 Digital integrated circuits by Demassa & Ciccone. Wiley pub.
3 Modern VLSI Design system on silicon by Wayne Wolf: Addision Wesley Longman Publisher.
4 Basic VLSI Design by Douglas A Pucknell & Kamran Eshranghian; PHI
5 Digital Integrated Circuits: A Design Perspective by Jan M Rabaey; PHI

04 1x72 ALGORITHM DEVELOPMENT

L-T-P : 3-1-0 **Credit : 4**

1. **BASIC TOOLS ON DESIGNING ALGORITHMS :** What is an Algorithm? Algorithm specification and performance analysis, randomized algorithms.
2. **DIVIDE & CONQUER :** The general method, Application to binary search, Finding the maximum and minimum, Merge Sort, Quick sort, The problem of selection and Strassen's matrix multiplication.
3. **THE GREEDY METHOD :** The general method, Application to optimal storage on tapes, Job sequencing with deadlines, optimal merge patterns and minimum weight spanning trees.
4. **DYNAMIC PROGRAMMING :** The general method, Application to multistage graphs, all pairs shortest paths, optimal binary search trees, 0/1 Knapsack and travelling salesman problem, Flow Shop Scheduling.

5. **BACKTRACKING :** The general method, Application to 8- Puzzle problem, 8- Queen problem and sum of subsets.
6. **BRANCH & BOUND:** The method, Application to 0/1 Knapsack and travelling salesman problem and efficiency considerations.
7. **NP – HARD AND NP – COMPLETE PROBLEMS:** Introduction and basic concepts, non deterministic Turing machine, the classes of P and NP, NP – Hard Graph Problems, NP – Completeness of the satisfiability problem and Polynomial – space bounded problem.

Text Book :

1. Fundamentals of computer algorithms by E. Horowitz et. Al., Galgotia publication, New Delhi.

Reference Books :

1. Algorithm Design by J. Kleinberg & E. Tardos, Pearson Education, New Delhi.
2. Fundamentals of Algorithm by G. Brassard & P. Bratley, PHI, New Delhi.
3. Introduction to Algorithms by T.H. Cormen et. Al., PHI, New Delhi.
4. Algorithms by S. Dasgupta et. Al., TMH, New Delhi.

04 1x73 BIOMEDICAL SYSTEMS AND ITS APPLICATIONS

L-T-P : 3-1-0 **Credit : 4**

1. **Production of X-Rays**, X-Ray generator, properties of X-Ray, basic interaction between X-Ray and matter, types of machines and their control, filters, X-Ray beam restrictors and grids, X-Ray image control, detection of X-Ray, X-Ray films and their processing, radiographic image. **Lecture : 8**
2. **Fluoroscopic imaging**, intensifying screen and scattered radiation, image intensifier, basic concept and instruments of the catheterization laboratory, ballooning and angioplasty techniques, digital subtraction technique, xeroradiography. **Lecture : 4**
3. **Characteristics of ultrasound**, ultrasound transducers, different mode of operation, characteristics of ultrasonic beam, interactions between ultrasound and matter, Design and application of real time ultrasound machine, Doppler techniques, Doppler transducer and modes of operation, color Doppler, Arrays, 3-D ultrasonography. **Lecture : 5**
4. **Computed Tomography (CT)**, basic principle, generations of CT scan machine, spiral CT, data accumulation, data handling system, components of CT scan machine, algorithms of image reconstruction, factors affecting image quality. **Lecture : 4**
5. **Principles of Magnetic Resonance** Imaging (MRI), elementary physics at MRI, nuclear magnetic resonance, imaging of magnetization, Bloch equation, magnetic field gradient, receiver-transmitter and different RF coils for MRI machine. **Lecture : 5**
6. **Instrumentation and principle of operation** of Gamma camera, Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET), system performance and image reconstruction. **Lecture : 5**
7. **Radiation biohazards**, ionizing and non ionizing radiation hazards, radiation detecting equipment. **Lecture : 3**
8. **Instrumentation of Endoscope** and its attachments, Types of Endoscopes, cold light source, techniques applied in different type of endoscope for imaging. **Lecture : 3**
9. **Fundamentals of Digital Image Processing.** **Lecture : 5**

Text Books :

1. Introduction to Biomedical Engineering by Endrele, Blanchard, Bronzino
2. Handbook of Biomedical Instrumentation by R. S. Khandpur
3. Physics of Diagnostic Radiology by T. S. Curry, J. E. Dowdey & R. C. Murry
4. Nuclear Diagnostic Imaging Practical Clinical Application by E. Edmund Kim & Thomas P. Haynie

04 1x74 DIGITAL COMMUNICATION AND TELECOMMUNICATION MANAGEMENT

L-T-P: 3-0-3 **Credit : 5**

Theory

1. **Comparison between Digital and Analog system :** Numbering systems, Baudet Code and ASII code; Line encoding Formats **Lecture : 3**
2. **Information Theorem :** Information and Entropy, Hartley Shannon Theorem, Discrete channel with discrete noise, channel capacity and BW efficiency; Inter-symbol Interference (ISI) AND Equalizer, Communication through Fading Media. **Lecture : 9**
3. **Nyquist Sampling Theorem :** ADC, PCM, COMPANDING & RECONSTRUCTION; Source Encoding, Channel Encoding. **Lecture : 12**
4. **Digital Modulation Scheme :** Binary Shift Keying and M-ary keying. **Lecture : 6**
5. **Secure Communication :** Spread spectrum communication & Cryptography. **Lecture : 6**
6. **Special topics :** Various Switching System, protocol ISDN, LAN, ARPANET, ALOHA Ethernet, Internet. **Lecture : 6**
7. **Practical**

   As per syllabus experiments are to be conducted by the department.

Text books :

1. Telecommunication topics and applications of functions and probabilities in electronic communication by E. Brya. Prentice Hall:

Reference books :

1. Data communication and networking by Forouzan, TMH.
2. Data and computer communication by Satalling Pearson .
3. Computer networking by Tenenbaum, Pearson.
4. Internet working with TCP IP, Vol-1 Principles protocols and architecture by Douglas E. Corner, PHI
5. Internet working with TCP IP, Vol-II DESIGN , IMPLEMENTATION AND INTERNALS BY Douglous E. Corner& David stevens, PHI
6. Internet working with TCP IP, Vol-III, CLIENT – SERVER Programming and application by Douglas e. Corner & David I. Stevens , PHI.

04 1x75 SOFT COMPUTING TECHNIQUES AND ITS APPLICATIONS

L-T-P : 3-1-0 **Credit : 4**

1. **FUZZY SET THEORY :** Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parametrization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling. **Lecture : 10**
2. **OPTIMIZATION :** Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search. **Lecture : 8**
3. **NEURAL NETWORKS :** Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Multilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning. **Lecture : 10**
3. **NEURO FUZZY MODELING :** Adaptive Neuro-Fuzzy Inference Systems Architecture, Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum. **Lecture : 9**
4. **APPLICATIONS OF COMPUTATIONAL INTELLIGENCE :** Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction. **Lecture : 8**

Text Book :

1. "Neuro-Fuzzy and Soft Computing" by J.S.R.Jang, C.T.Sun and E.Mizutani, PHI, 2004, Pearson Education 2004.

References :

1. "Fuzzy Logic with Engineering Applications" by Timothy J.Ross, McGraw-Hill, 1997.

2. "Genetic Algorithms : Search, Optimization and Machine Learning" by Davis E.Goldberg, Addison Wesley, N.Y., 1989.
3. "Neural Networks, Fuzzy Logic and Genetic Algorithms" by S. Rajasekaran and G.A.V.Pai, PHI, 2003.
4. "Computational Intelligence -PC Tools" by R.Eberhart, P.Simpson and R.Dobbins, AP Professional, Boston, 1996.

04 1x76 IC ARCHITECTURE AND FABRICATION

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction :** The IC fabrication general process flow diagram, Process modules (brief overview), Features of IC fabrication process, Modern clean rooms, Limitations of fabrication techniques. **Lecture : 5**
2. **IC fabrication process :** Simplified CMOS IC process flow and fabrication steps (brief overview), Lithography as a basic method of fabrication process, Comparative analysis of lithographic methods, Resolution and accuracy, Photolithography, Typical operations, Photo masks and fabrication methods, Advanced lithography, Technological equipment. **Lecture : 10**
3. **Integrated circuits packaging :** The role of IC package. Packages classification and materials, Packaging methods and technology, Thermal consideration in packaging, Interconnect levels (wire bonding, TAB process, flip-chip technique), High-performance packages. **Lecture : 8**
4. **Fabrication constraints on layout :** Common design rules, Scalable and micron design rules, Resolution constraints and alignment/overlap constraints, Design rules the interface between designer and process engineer. **Lecture : 6**
5. **IC testing and yield analysis :** Measurements and control for IC characterization, Accelerated tests, Defects and yield analysis of chips, Reliability and degradation of IC, The features of statistical process control for IC fabrication, Role of models in microelectronics technology. **Lecture : 7**

04 1x77 NANOTECHNOLOGY & ITS APPLICATIONS

L-T-P: 3-1-0 **Credit : 4**

1. **General Introduction :** Basics of Quantum Mechanics, Harmonic oscillator, magnetic Phenomena, band structure in solids, Mossbauer and Spectroscopy, optical phenomena bonding in solids, Anisotropy.
2. **Silicon Carbide :**Application of Silicon carbide, Nano materials preparation, Sintering of SiC, X-ray Diffraction data, Electron microscopy sintering of Nano particles, Nano particles of Alumina and Zirconia: Nano materials preparation, Characterization, Wear materials and Nano composites
3. **Mechanical properties :** Strength of nano crystalline SiC, Preparation for strength measurements, Mechanical properties, Magnetic properties.
4. **Electrical properties :** Switching glasses with nanoparticles, Electronic conduction with nano particles, Optical properties: Optical properties, special properties and the coloured glasses.
5. **Process of synthesis of nano powders, Electro deposition, Important nano materials.**
6. **Investigating** and manipulating materials in the nanoscale: Electron microscopics, scanning probe microscopics, optical microscopics for nano science and technology, X-ray diffraction.
7. **Nanobiology :** Interaction between biomolecules and nanoparticle surface, Different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, Application of nano in biology, nanoprobes for Analytical Applications-A new Methodology in medical diagnostics and Biotechnology, Current status of nano Biotechnology, Future perspectives of Nanobiology, Nanosensors.
8. **NanoMedicines :** Developing of Nanomedicines, Nanosystems in use,Protocols for nanodrug Administration, Nanotechnology in Diagnostics applications, materials for used in Diagnostics and Therapeutic applications, Molecular Nanomechanics, Molecular devices, Nanotribology, studying tribology at nanoscale, Nanotribology applications.

Text Books :

1. Nano Materials by A.K.Bandyopadhyay/ New Age Publishers.
2. Nano Essentials by T.Pradeep/TMH

04 1x78 FIBER OPTICS AND NETWORKING TECHNOLOGY

L-T-P: 3-1-0

Credit : 4

1. **Introduction :** Generations of optical communication, Advantages, Elements of an optical fiber transmission link . **Lecture : 2**
2. **Optical Fiber :** Classification of Fibers, Fiber materials and fabrication methods, Ray optics representation & Wave optics representation for step Index and Graded Index fibers, Modes, Phase & Group velocity, Goos-Hanchen Shift, Power flow in Step Index Fibers. **Lecture : 10**
3. **Attenuation and Dispersion in optical fiber :** Signal attenuation and distortion in optical fibers, Dispersion effects in optical fibers. **Lecture : 5**
4. **Optical Sources :** Structure and materials of LED and LD sources operating characteristics and modulation capabilities of the LED and LD sources. **Lecture : 9**
   Source to Fiber Power launching and coupling, Lensing schemes for coupling improvement, Fiber to fiber couplings and alignment methods, Splicing techniques, Fiber Connectors.
5. **Optical Receiver :** Optical receiver configuration and performance, Pre-amplifier design for optical receiver, Analog and Digital receiver. **Lecture : 3**
   Point to point transmission links, Wavelength division multiplexing, Optical data buses, Link power and rise time budget, Optical Amplifier. **Lecture : 5**
6. **Optical Networking :** Fiber optics in LAN, MAN, SAN, WAN, FDDI architecture, SONET/SDH architecture, SONET/SDH network elements. **Lecture : 5**
7. **Potential applications and future prospects of optical fibers**, multimode intensity sensors and single mode, Interferometric sensors. **Lecture : 3**

Text Books :

1. "Fundamentals of Fiber optics in telecommunication and sensor systems" by B.P.Pal, New Age International (P) Ltd., Publishers, 2001

Reference Books :

1. "Optical Fiber Communication" by G. Keiser, McGraw Hill, 3rd Ed.
2. "Optical Networking and WDM" by Walter Goralski, Tata McGraw-Hill
3. "Optical Fiber Communications" by J. M. Senior, PHI, 2nd Ed.
4. "Introduction to fiber Optics" by Ghatak & Thyagarajan, Cambridge University press.
5. "Optical Communications" by J.H.Franz & V.K.Jain, Narosa Publishing House.
6. "Fibre Optics Communication" by Harold Kolimbirls, Pearson Education.

04 1x79 EMBEDDED SYSTEMS (REAL TIME SYSTEMS)

L-T-P: 3-1-0 **Credit : 4**

1. **Basic Real Time Concepts :** Terminology, Real - Time System Design Issues, Example real - time systems, common misconceptions, brief history.
2. **Hardware Considerations : Basic Architecture, Hardware interfacing, Central Processing Unit, Memory, Input/output, Enhancing performance, other special devices, Non–Von Neumann Architectures.**
3. **Real Time Operating Systems :** Real Time Kernels, Theoretical foundations of Real – Time Operating Systems, Inter task Communication and Synchronization, Memory Management, case study: POSIX.
4. **Software Requirements Engineering :** Requirements engineering process, Types of Requirements, Requirement specification for Real – Time Systems, Formal methods in software specification, Structured analysis and design, Object – Oriented analysis and the unified modeling language, Organizing the requirements document, Organizing and writing requirements, Requirements validation and review.
5. **Software System Design :** Properties of Software, Basic software engineering principles, The design activity, Procedural - Oriented Design, Object - Oriented Design, Appendix: Case study in software requirements specification for four – traffic intersection, Traffic light controller system.
6. **Programming Language & The Software Production Process :** Introduction, Assembly Language, Procedural Languages, Object – Oriented Languages.
7. **Performance Analysis & Optimization :** Theoretical preliminaries, Performance analysis, Application of queuing theory, I/O Performance, Performance optimization.

Text Book :

1. Real-time Systems: Design & Analysis by Phillip A. Laplante, John Wiley – India Edition.

Reference Books :

1. Real-Time Systems, Theory and practice by Rajib Mall, Pearson Edition, New Delhi.
2. Real-Time Systems by J.W.S. Liu Pearson Education, New Delhi – 2004.
3. Real-Time Systems by C.M. Krishna & K.G. Shiv, McGraw Hill – 1997.

04 1x80 MOBILE COMPUTING

L-T-P: 3-1-0 **Credit : 4**

1. **Wireless Communication Systems & Standards :** Evolution of Mobile Radio Communications, Different generations (1G to 4G) of Cellular Network, GSM, UMTS, GPRS, EDGE, Cellular telephone systems, WLAN, WLL, Bluetooth, PAN. **Lecture : 5**
2. **Propagation & Fading :** Propagation path loss, Free-space propagation model, Outdoor propagation models (Okumura model & Hata model), Indoor propagation models (Partition Losses in the same flow and between floors), Multipath fading, time dispersive and frequency dispersive channels, delay spread and coherence bandwidth, LCR and ADF. **Lecture : 8**
3. **Diversity & combining Techniques :** diversity Schemes (Space, frequency, field and polarization diversities) and combining techniques. **Lecture : 4**
4. **Mobile Radio Interferences & System Capacity :** Co-channel Interference and System Capacity, Channel planning for Wireless Systems, Adjacent channel interferences, Power control for reducing interference, Near-end-to-far-end Interference, Inter-symbol and Simulcast interference, False alarm rate and word error rate. **Lecture : 6**
5. **The Cellular Concept :** Frequency Assignment and Channel Assignment, Frequency Reuse, Handoff, sectoring, Repeaters for range extension, Microcell zone, Spectral efficiency, DS-SS, FH-SS. **Lecture : 6**
6. **Antenna Design Parameters :** Antennas used for Mobile Communications, Radiation patterns, Smart antenna (basic concept), Antenna location, Spacing and height in the base station and at the mobile unit. **Lecture : 4**
7. **Multiple Access Techniques :** FDMA, TDMA, CDMA, SDMA, OFDM, DS-CDMA, TH-CDMA, Capacity of Cellular Systems, Capacity of Cellular CDMA, WCDMA. **Lecture : 7**

Text Books :

(1) "Wireless Communications : Principles and Practice" by T. S. Rappaport, Prentice Hall.
(2) "Wireless Communication Technology" by Roy Blake, Thomson – Delmar.
(2) "Mobile Cellular Telecommunications Systems" by W. C. Y. Lee.

04 1x81 MOBILE AND SATELLITE COMMUNICATIONS

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction for wireless communication system :** Evolution of mobile radio communications, mobile radio systems around the world. Radio communication systems – paging systems, Cordless telephone systems, cellular telephone systems, comparison of common wireless communications, trends in cellular radio and personal communication, Different generations (1G to 4 G) of Cellular Networks, UMTS, Introduction to radio wave propagation, free space propagation model, channels, Fading. **Lecture : 6**
2. **Basics of Mobile Communication :** Limitations of conventional mobile system, mobile cellular communication - Introduction concept of frequency reuse, cluster size, cellular system architecture – mobile station, base station, MSC, Channel planning for wireless systems, Channel assignment strategies, call handover strategies, interference and system capacity, improving capacity in cellular systems – cell splitting, sectoring, repeaters for range extension, microcell zone concept. **Lecture : 8**
3. **Global system for mobile communication :** GSM services and features, system architecture, GSM radio subsystem, GSM channel types, Location updating and call setup, introduction to CDMA digital cellular standard, comparison between GSM and CDMA. **Lecture : 6**
4. **Diversity & combining techniques and antenna design :** Diversity schemes and combining techniques, Basic concept - Antennas used for mobile communication, smart antenna. **Lecture : 4**

5. **Multiple access techniques :** FDMA, TDMA, SDMA, CDMA, OFDM, capacity of cellular systems, spectral efficiency. **Lecture : 4**

6. **Wireless networking :** Wireless LAN standards – IEEE .802.11, layered protocol architecture, technology – RF and IR wireless LAN, advantages and applications of wireless LAN, introduction to Wi-Fi, Bluetooth, WLL, WAP. **Lecture : 5**

7. **Introduction to satellite communication :** Brief history and overview of satellite communication, Equations of the orbit, Satellite launching and launch vehicles, satellite subsystems - communication subsystem(transponder model), telemetry, tracking and command subsystem, Attitude & Orbit control subsystem, Electrical power supply subsystem, Satellite link design - Basic transmission theory, System noise temperature and G/T ratio for earth stations, Design of uplink and downlink, Earth station – description, Satellite applications. **Lecture : 12**

Textbooks

1. Wireless communication principles and practice . 2nd ed. by T.S.Rappaport., PHI
2. Wireless communications and networks 2nd ed. by William Stallings, Pearson
3. Mobile cellular telecommunications systems by W.C.Y. Lee., TMH
4. Satellite communication by T. Pratt & C.W. Bostian., John Wiley & Sons.

Reference books

1. Mobile communication systems by schiller, Pearson.
2. Satellite communication systems Engg. by Pritchard, Pearson
3. Wireless communication Technology by Roy Black, Thomson.

DEPARTMENT OF ELECTRICAL ENGINEERING

03 1x01 BASIC ELECTRICAL ENGINEERING

L-T-P : 3-0-3 **Credit : 5**

1. **Introduction :** Electrical Elements and their Classification, KCL, KVL equation and node voltage method, D.C circuits steady state analysis with independent and dependent sources, Series and parallel circuits, Star delta conversion, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer Theorem. **Lecture : 12**
2. **A.C Circuits :** Common signals and their waveform, R.M.S and Average value, form factor and Peak factor of sinusoidal wave. Impedance of series and parallel circuits, Phasor diagram, Power, Power factor, Power triangle, Coupled circuits. Resonance and Q-factor, Superposition, Thevenin's and Norton's, Maximum power transfer theorem for A.C circuits **Lecture : 12**
3. **A.C Circuits :** Phase Star delta, line and phase relation, Power relation, Analysis of balanced and unbalanced 3-phase circuits. **Lecture : 8**
4. **Magnetic circuits :** Introduction, Series & Parallel magnetic circuits. Analysis of Linear and non linear magnetic circuits. Energy storage, A.C. excitation. Eddy current and hysteresis losses. **Lecture : 5**
5. **Basic indicating instruments** for measurements Current Voltage, Power, Energy Insulation resistance. **Lecture : 5**

Text Book:

1. Basic Electrical Engineering by Fitzerald, et al, Tata McGraw Hill

Reference Books:Tata Fitzerald

1. Fundamental of Electrical Engg. By Leonard S. Bobrow, Oxford
2. Fundamentals of Electrical Engg. By R. Prasad, PHI Publication

03 1x02 ELECTRICAL POWER GENERATION AND ECONOMICS

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction :** Overview of power generation scenario from thermal, hydro, nuclear and non conventional sources. **Lecture : 2**
2. **Thermal station :** Selection of site, layout, main components(boiler, economizer, air preheater, super heater. **Lecture : 4**
3. **Coal handling plants,** water treatment plant, ash handling plant. **Lecture : 2**
4. **Types of boilers** and their characteristic, steam turbines and their characteristics. governing system for thermal power station. **Lecture : 4**
5. **Hydro electric station :** Selection of site, layout, classification of hydro plants, general arrangement and operation of a hydro plant. Governing system for hydro plants, types of turbines. **Lecture : 8**
6. **Nuclear power station :** Nuclear reaction for nuclear power. Nuclear fuels, feasibility of a nuclear power station layout. Main part of a nuclear station, nuclear reactor classification, control system for nuclear power station **Lecture : 8**
7. **Diesel electronic station :** Site selection, layout, main components, choice and characteristics of diesel engine. Diesel plant efficiency and heat balance, maintenance. **Lecture : 4**
8. **Gas turbine plant :** Plant layout, a simple gas turbine plant, IO methods to improve thermal efficiency of a gas turbine plant, fuel for gas turbine plant, Combined gas turbine cycle, advantages of gas turbine plants over steam plants. **Lecture : 4**
9. **Non conventional sources of energy :** Wind, Tidal and Solar and MHD generation. **Lecture : 2**
10. **Power operation economy :** Load factor, diversity factor, plant capacity factor, different types of tariff and their calculation. **Lecture : 4**

Text Book :

1. Electrical power generation & distribution by S.N. Singh, PHI

Reference Book :

1. A text book on power system engineering by A. Chakarvarty, M.L. Soni, Gupta and Bhatnagar, Dhanpat rai & Sons.
2. A course in Electrical power by J.B. Gupta, S.K.Kataria and Sons.

03 1x03 ELECTRICAL MACHINES-II

L-T-P : 3-0-3 **Credit : 5**

1. **Synchronous Generator :** Principle, construction and types of synchronous machines, Methods of excitation, Armature windings, EMF equation of Alternator, Armature reaction, testing(OC and SC test) Voltage regulation, Phasor diagram. **Lecture : 9**
2. **Two reaction :** Theory Modified Phasor diagram, Power angle characteristics, Parallel operation. Effect of change of fuel supply and excitation on alternator connected to infinite bus , Cooling of synchronous Generator. **Lecture : 9**
3. **Synchronous Motor :** Principle of operation , equivalent circuit, effect of varying field current. V-curves, Inverted V-curves, Phasor diagram, starting of synchronous motors, hunting application. **Lecture : 8**
4. **Single phase induction motors :** Introduction, Working principle , double revolving field theory , Equivalent circuit, Starting method and Types of single phase Induction motors, Applications. **Lecture : 8**
5. **Special motors :** Single phase synchronous motors, Two phase AC Servo Motor, single phase series (universal) motor, stepper motor, Permanent magnet DC motor, etc, Applications. **Lecture : 8**

Text Books :

1. Electrical machines by Nagrath I.J. and Kothari D.P. TMH
2. Electrical machinery by Fitzgerald A.E. & Kingsley: TMH

Reference Books:

1. Electrical Machines by P.S. Bimbra , Khanna Publication.
2. Electrical machines by Samarjit Ghosh, Pearson Education Pvt. Ltd.

03 1x04 POWER SYSTEM - I

L-T-P:3-1-0 **Credit : 4**

1. **Distribution :** Effect of system voltage on transmission efficiency, Single phase AC, 3 phase AC System, Choice of Conductor's Size, Choice of voltage, Radial and ring Feeders: Calculation of voltage drop in AC, Radial and ring system. **Lecture : 6**
2. **Electrical Design :** Calculation of inductance of conductor due to internal and external flux, Inductance of Single Phase System; Kin and proximity effects/ GMR of solid conductor, GMR of standard conductor, Mutual GMD Inductance of opposite conductor lines, Inductance of 3-phase lines single circuit and double circuit, symmetrical spacing and unsymmetrical spacing, Inductance of bundled conductor system, Calculation of capacitance of single phase and 3-phase system, symmetrical and unsymmetrical spacing, single circuit and double circuit bundled conductor system, effect of earth on capacitance of line. **Lecture : 12**
3. **Mechanical Design :** Types of supports cross arms and conductors, Calculation of sag and tension, cases of unequal height of supports, Stringing chart, earth clearance of live conductors, vibration, dampers. . **Lecture : 6**
4. **Performance of Lines :** Short, medium and long lines, A.B.C.D, constants: regulations nominal and T equivalent pie and T representation, surge impedance, surge impedance loading of line, universal power circle diagram, Lossless line. **Lecture : 10**
5. **Underground Cables :** Types, insulating materials, sed. Stress in isolation and capacitance inter sheath and capacitance grading, PF in cables capacitance of 3-core cables. Instantaneous and long time breakdown strength, dielectric losses, lionization, deterioration, Heat production, Sheath current, Thermal characteristics. **Lecture : 10**

Textbooks:

1. Elements of Power System Analysis by Stevenson (McGraw Hill)
2. Modern Power System by N J Nagrath & Kothari (TMH)
3. Elective Power System by Soni, Bhatnagar & Gupta

Reference Books:

1. A Course in Electrical Power by Soni, Bhatnagar & Gupta

03 1x05 NETWORK THEORY

L-T-P:3-0-3 **Credit : 5**

1. **Transient response** of RC, RL, RLC circuits to various excitation signals such as step, ramp, impulse and sinusoidal excitations using Laplace transform. **Lecture : 7**
2. **Terminal pairs or ports**, Network functions for one-port and two-port networks, poles and zeros of network functions, Restrictions on pole and zero locations for driving point functions and transfer functions, Time domain behavior from the pole-zero plot. **Lecture : 5**
3. **Relationship of two-port variables**, short circuit Admittance parameters, open circuit impedance parameters, Transmission parameters, hybrid parameters, relationships between parameter sets, Inter-connection of two-port networks. **Lecture : 8**
4. **Principles of network topology**, graph matrices, network analysis using graph theory**.** **Lecture : 8**
5. **Filter fundamentals**, high-pass, low-pass, band-pass, and band-reject filters**.** **Lecture : 6**
6. **Positive real functions**, synthesis of one-port and two-port networks, elementary ideas of Active networks. **Lecture : 8**

Text Books:

1. Networks and Systems by D Roy Choudhury; New Age International
2. Network Analysis by Van Valkenburg; PHI
3. Introduction to Modern Network Synthesis by Van Valkenburg; John Wiley

Reference Books:

1. Basic circuit theory by Dasoer Kuh; (McGraw Hill)
2. A Course in Electrical Circuit Analysis by Soni & Gupta; Dhanpat Rai Publication.
3. Circuit Analysis by G K Mittal, Khanna Publication.

03 1x06 ELECTROMAGNETIC FIELD THEORY

L-T-P : 3-1-0 **Credits : 4**

1. **Introduction** of field co-ordinate systems **Lecture : 2**
2. **Electrostatics :** Coulomb's law, Gauss's law and its applications, the potential functions, Equipotential surface, Poisson's and Laplace's equation, Applications (solution for some simple cases), Capacitance, Electrostatics energy, Conductor properties and boundary conditions between dielectric and dielectric-conductor, Uniqueness Theorems. **Lecture : 8**
3. **Magneto statics :** Biot-savart law, Ampere's circuital law, Curl, Stroke's theorem, Magnetic flux and magnetic flux density, Energy stored In magnetic field, Ampere force law, Magnetic vector potential, Analogy between electric and magnetic field. **Lecture : 6**
4. **Maxwell's equations**, Equation of Continuity for time varying field . Inconsistency of ampere circuital law, Maxwell's equations in differential and integral form. **Lecture : 3**
5. **Electromagnetic wave :** Solution of wave equation in free space, Uniform plane wave propagation, Uniform plane waves, the wave equation for conducting medium, Wave propagation in lossless medium and inconductive medium, Conductors and dielectrics, Polarization. **Lecture : 4**
6. **Reflections and refractions :** reflection by a perfect conductor with normal as well as oblique incidence. Reflection and refraction by perfect dielectrics with normal and oblique incidence. Surface impedance. **Lecture : 7**
7. **Pointing vector :** Pointing theorem, instantaneous average and complex pointing vector, power loss in a plane conductor. **Lecture : 3**
8. Transmission Lines : Transmission lion theory, low loss radio-frequency and UHF transmission line. UHF line as a transformer, voltage step up of the quarter wave transformer. Transmission line chart (Smith Chart). **Lecture : 10**

Text Books :

1. Electromagnetic waves and radiating system by E.C.Jordan, K.G.Balmain, Pearson
2. Engineering Electromagnetics by W.H.Hyat, TMH.

03 1x07 ELECTRICAL INSTRUMENTS AND MEASUREMENTS

L-T-P: 3-0-3 **Credit : 5**

1. **Measurements** of Voltage, Current, Power and Power factor, Energy and frequency. **Lecture : 10**
2. **Range Extension** including current and potential transformer **Lecture : 4**
3. **Galvanometer :** Dynamics of D' Arsonval galvanometer, Vibration galvanometer , Ballistic galvanometer . **Lecture : 6**
4. **Bridges :** D.C bridge, Wheatstone bridge, sensitive and its application bridge .Type of bridge for measure **Lecture : 7**
5. **Standard** A.C and D.C potentiometer, Principle and standardization and application. **Lecture : 5**
6. **Magnetic measurements :** D.C and A.C .Testing of magnetic materials. **Lecture : 5**
7. **Digital measurements** . **Lecture : 5**

Text Books :

1. Electrical measurement and Measuring Instruments by E.W. Golding
2. Basic Electrical measurement by M.B. Stout. PH

Reference Book :

1. Measurement Systems : Application & Design by Doebelin (5^{th} Ed) TMH

03 1x08 POWER SYSTEM – II

L-T-P: 3-1-0 **Credit : 4**

1. **Power station and sub-station :** Hydro and power station: Site selection, Layout, calculation of available power classification, Salient features, Pumped hydro plants.
   Thermal power Station : Site selection, Layout, calculation of coal requirements, cooling water tower efficiency, co-ordination of hydro and thermal power stations. **Lecture : 10**
2. **Economy of power system :** Load curves, Load duration curves, Diversity Factor, Base and peak Load station, Cost allocation of power station- fixed cost, Two par Tariff and Evaluation. **Lecture : 10**
3. **Symmetrical three phase faults on synchronous machines :** Short circuit current and reactance of synchronous machines, Internal voltage of loaded machines under transient conditions. **Lecture : 4**
4. **Symmetrical components :** Synthesis of unsymmetrical phases from their symmetrical components operators, The symmetrical components of unsymmetrical phase, phase shift in transformer bank: power in terms of symmetrical components; unsymmetrical series impedances; sequence impedances and sequence networks; sequence networks of unbalanced generators; sequence impedance of circuit elements positive and negative sequence networks; zero sequence network. **Lecture : 6**
5. **Unsymmetrical Faults :** Signal line to ground fault, line to line fault, double line to ground fault on unloaded generator and power systems, Interpretation of inter guidance sequence networks. **Lecture : 6**
6. **Power System Stability :** Steady state power limit of cylindrical rotor and salient pole machines without saturation, Maximum power transmitted to a transmitting network, series capacitor, Transient stability power angel curve, Inertia clearance angel, equal swing equation, equal area criterion and its application. **Lecture : 6**

Text Books :

1. Elements of Power System Analysis 3^{rd} Edition by Stevenson, McGraw Hill
2. A Course of Electrical Power by Soni Bhatnagar and Gupta, Dhanpat Rai & Sons.
3. Modern Power System Analysis by Nagrath and Kothari, Tata McGraw Hill.

Reference Books :

1. Electrical Power System by C.L.Adhwa, Wiley Eastern

03 1x09 POWER ELECTRONICS

L-T-P: 3-0-3 **Credit : 5**

1. **Introduction to thyristor and control circuits :** terminal characteristic, rating and protection.

L **Lecture : 4**

2. **Thyristor firing circuit :** Triggering circuit suitable for 1 phase and 3 phase fully controlled converters. **Lecture : 6**
3. **Converters :** Uncontrolled three phase power rectifiers, 1 phase & 3 phase line commutated A.C to D.C converters. **Lecturer : 10**
4. **Inverters :** Basic Bridge inverter circuit 1 phase & 3 phase phase McMurray-Bedford method of communication,pulse width modulation inverters. Series inverter gating circuits. **Lecture : 8**
5. **Choppers :** Types of choppers, steady state analysis of type A chopper, communication methods, chopper control of D.C. Motor. **Lecture : 8**
6. **Other applications** A.C., voltage regulator, cyclo-converter. **Lecture : 4**
7. **Application** of thyristors for industrial drives. **Lecture : 2**

Text Books :

1. Power Electronics by Rashid, PHI
2 Power Electronics by Ned Mohan, John Wiley & Sons

Reference Books :

1. Thyristorised Power Controllers by G.K dubey, Wiley Eastern Ltd.
2. Power Semiconductor Circuits by Dewan & Strangten, John Wiley & Sons

03 1x10 SIGNALS & SYSTEM

L-T-P : 3-1-0 **Credit : 4**

1. **System and Signal :** Definition, classification of systems, standard test signal, properties of system, properties of liner system. **Lecture : 3**
2. **Analogous System :** Force voltage analogy, Force current analogy, Mechanical coupling devices, Electromechanical system. **Lecture : 5**
3. **Laplace transformation :** Laplace transform of some important function, shift theorem and its application, Laplace transform of periodic functional, analysis of response, initial & final values theorem, response to periodic sinusoidal excitation. **Lecture : 10**
4. **Analysis of Fourier Methods :** Fourier series expansion of periodic functional symmetry condition, exponential form of Fourier series, Fourier integral & Fourier transform, Analysis by Fourier methods, Fast Fourier transform. **Lecture : 15**
5. **Z transformation :** Z transform, Discrete time, LTI system, solution of difference equation, Application of Z transform to open loop system. **Lecture : 9**

Text Books :

1. Analysis of Linear System by D.K Cheng, Narosa pub. House
2. Modeling & Analysis of Liner System by J.P Tiwari. Dhanpat rai&Sons

Reference Books :

1. Signal & system by H.P Hus, Tata McGraw Hill
2. Signal & system by I.J. et. at., Tata McGraw Hill

03 1x11 MICRO PROCESSOR AND ITS APPLICATION

L-T-P : 3-0-3 **Credit : 5**

Intel 8085

1. **Introduction :** CPU, Register, memory, Buses, Memory addressing capacity of a CPU. **Lecture : 3**
2. **CPU Architecture,** Pin configuration, Instructions, Addressing modes, Instruction word size, Languages. **Lecture : 4**

3. **Timing Diagram :** Read cycle, write cycle, fetch cycle, Memory read, Memory write, I/O cycle. **Lecture : 3**

4. **Programming :** Simple programming : 8-bit addition &subtraction, 16-bit addition , Delay subroutine using register, finding lowest & highest no. in data array. **Lecture : 5**

5. **Data transfer** schemes, I/O port. **Lecture : 6**

6. **8255, 8251, 8253, 8257** chips, pin diagram, control word, operating modes. **Lecture : 6**

7. **Interfacing** to ADC, Analog multiplexer, simple & hold. **Lecture : 4**

Intel 8086

8. **Architecture :** BIU & Execution unit, pin diagram, function of different modes, Registers. **Lecture : 4**

9. **Addressing Modes**, Instruction **Lecture : 4**

10. **Programming.** **Lecture : 3**

Text Books :

1. Fundamental of Microprocessor & Microcomputer by B.Ram, Dhanpat Rai
2. Advance Microprocessor by B.Ram

Reference Books :

1. Microprocessor & Interfacing by D.V hall,TMH
2. Microprocessor Architecture by R.S Gaonkar
3. Microprocessor with Application in process control by S.I Ahson. TMH
4. Programming Microprocessor Interfaces by Michael Andrews, PHI
5. The Intel Microprocessor Architecture, Programming & Interfacing by B.Brey, PHI

03 1x12 LINEAR CONTROL THEORY

L-T-P : 3-0-3 **Credit : 5**

1. **Introduction :** The control system, servomechanism, servomotors, standard test signal. **Lecture : 4**

2. **Time response analysis :** Time response of second order system, design consideration for higher order system, stability relative stability. **Lecture : 6**

3. **The root locus technique :** Concept, construction of root loci root contours systems with transformation log. **Lecture : 8**

4. **Frequency response analysis :** Correlation between time and frequency response, bode plots, root locus and minimum phase system log magnetic vs phase plots , stability in frequency domain , polar plots. **Lecture : 8**

5. **Mathematics preliminaries**, Nyquest stability criteria, Assessment of relation stability using Nyquest criteria. **Lecture : 5**

6. **Closed loop frequency response.** **Lecture : 3**

7. **Compensation of control system :** Introduction, type compensation approach to compensation. **Lecture : 8**

Text Books :

1. Modern control system by Nagrath & Gopal

Reference Books :

1. Modern Control Engineering by K.Ogata, Pearson Education.
2. Control Engineering by Kuo.

03 1x13 PROTECTION OF POWER APPARATUS & SYSTEM

L-T-P : 3-0-3 **Credit : 5**

1 **Name and cause of faults.** **Lecture : 2**

2. **Schemes of protection :** Methods of fault discrimination. **Lecture : 3**

3. **Protective relays :** Construction and operating principle of over current relays, directional relays, Distance relays, Differential relays. **Lecture : 5**

4. **Protection of feeders :** Over current protection and distance protection **Lecture : 5**

5. **Protection of transformer** and generator. **Lecture : 5**

6. **Mechanism of are interruption**, Restriction voltage ,Recovery voltage, RRRV, factors affecting the performance of circuit breaker, current chopping. **Lecture : 6**

7. **Circuit breaker**, construction and operating principle of air blast,oil,SF_6 and vacuum circuit breaker. **Lecture : 7**

8. **Protection against over voltage :** cause of over voltage , lightning phenomenon, lightning arrestors, surge absorber , insulation co-ordination. **Lecture : 5**

9. **Grounding :** Advantage, solid, resistance and reactance grounding, Peterson coil. **Lecture : 4**

Text Books :

1. Power System Protection & switch Gear by B.Ram & D.N Vishwakarma, TMH
2. Power System Protection and switch gear by R & C

Reference Books :

1. Art & science Protection Relaying by Moson
2. Switch gear and Protection by Sunil S.Rao, Khanna Publication

03 1x14 POWER SYSTEM DESIGN

L-T-P : 1-0-3 **Credit : 3**

1. **Per unit system representation**, reactance diagram, impedance diagram. **Lecture : 5**

2. **Load flow Analysis**; Load flow problem, ybus, Formulation of problem, solution technique using Gauss seidel method **Lecture : 7**

3. **Symmetrical short circuits Analysis**; Short circuit of a Synchronous machine on no load, Short circuit of loaded synchronous machine, Thevenin's equivalent circuit approach for short circuit analysis **Lecture : 7**

4. **Symmetrical component**; Transformation, phase shift in star-delta transformer, sequence Impedance and sequence network of transmission line, Synchronous machine, Transformer and power system. **Lecture : 8**

5. **Unsymmetrical Short Circuits**; Symmetrical component analysis of unsymmetrical short Circuits, single line to ground fault, Double line to ground fault and line to line fault. **Lecture : 7**

6. **Power system stability problem**, Swing equation, System response to small disturbances, Power angle equation and diagram **Lecture : 6**

7. **Transient stability**, Equal area criterion, Measures for improving transient stability **Lecture : 5**

Text Books:

1. Power system Analysis by Stevenson and Grainger.
2. Electric Energy Systems Theory an Introduction, Olle I. Elgerd.

Reference Book

1. Nagrath- Kothari,Modern power system Analysis
2. C.L Wadhwa, Electrical power systems
3. B.R Gupta, power systems Analysis

03 1x15 MODERN CONTROL THEORY

L-T-P : 1-0-3 **Credit : 5**

1. **Development** of state space model, state and state equation, transfer function from state equation and state equation from transfer function. **Lecture : 5**

2. **State transient matrix**, solution of state equation transfer matrix. **Lecture : 5**

3. **Concept of controllability and absorbability.** **Lecture : 3**

4. **State variable** feedback, state observes. **Lecture : 3**
5. **Control system** design via pole placement. **Lecture : 3**
6. **Optimal control system :** Introduction, performance in device, transfer function approach, state variable approach, parameter optimization. **Lecture : 6**
7. **Non- liner system :** common non-liner stability system, method for studying non-liner system, linearization, describing function analysis. **Lecture : 8**
8. **The phase plane method :** Stability analysis using Lyapunov's direct method. **Lecture : 5**

Text Book :

1. Modern Control by Ogata, Pearson Education

Reference Book :

1. Control Engineering: Theory & Practice by Bandopadhya, PHI

03 1x16 UTILISATION OF ELECTRIC POWER

L-T-P : 3-1-0 **Credit : 4**

1. **Electric Traction introduction :** System of D.C and A.C traction train movement and energy consumption, Electric Traction motor, Their starting speed, control and braking, System of power supply in traction, Modern method of speed control and starting. **Lecture : 10**
2. **Electric Heating :** Introduction, different methods of heating, Resistance, Dielectric, Induction and arc heating, Heating and cooling of electric motors. **Lecture : 6**
3. **Cooling :** Method of cooling by air, hydrogen and water, forced and natural cooling. **Lecture : 4**
4. **Electric welding :** Introduction, various methods of welding, Resistance, Electric are, Ultrasonic and Laser welding, control of current flow in welding transformer. **Lecture : 5**
5. **Illumination:** Introduction, Nature of radiation, Definition, polar curves, laws of illumination, luminous efficiency, Sources of light, incandescent, vapor, Florescent, lighting calculation, Factory lighting, Flood lighting, Street lighting essential. **Lecture : 9**
6. **Estimating and Costing of Electric Installation :** Introduction, Type of wiring, Design of light light, fan, alarm circuit and drawing of panel board, Electric installation for building, hotels, offices, workshops, playground, street and road lighting, Estimation and costing of electrical installation, House wiring and workshop lighting. **Lecture : 8**

Text Books :

1. Utilization of Electric Power by C.L.Wadhwa
2. Utilization of Electrical Energy by E.Openshaw Taylor

Reference Books :

1. Utilization of Electrical Energy by H.Partap, Dhanpat Rai & Sons
2. Utilization of Electrical Energy by R.K Garg
3. Electric Traction by Dover

03 1x17 MICROPROCESSOR AND MICROCONTROLLERS

L-T-P : 3-0-3 **Credit : 5**

1. **The 8086 Architecture :** Pin diagram of 8086 and description of various signal. Architecture block diagram of 8086 & description of sub-block such as EU &BIU & of various register, Description of address computation & memory segmentation, program relocation, addressing modes, Instruction formats. **Lecture : 8**
2. **Installation set of 8086 :** Installation execution timing, Assembler installation format, data transfer installations. Arithmetic installations, Branch installations, looping installations, NOP & HLT installations, Flag manipulation installations, Logical installations, Shift &Rotate installations, Directives & operators, Simple example such as copying a block of data, finding maximum from an array of numbers, using look up table technique etc. **Lecture : 10**

3. **Micro-controllers :** Type**,** Processor architecture memory type, hardware features, 8051 processor architecture. **Lecture : 3**
4. **Addressing mode**, 8051 installation set-data movement, Installation, architecture installation, Logic installation, Branch group installation. **Lecture : 9**
5. **8051 software** and programming memory interfacing memory interfacing and address decoding, programming input/output timer, ADC/DAC, serial data communication controller and interrupts controller for different application with respect to installation & control. **Lecture : 10**

Text Books :

1. The Intel Microprocessor 8086-Pentium processor by Brey (PHI)
2. Advance Microprocessor and Interfacing by Badri Ram, TMH
3. The 8088 and 8086 Microprocessor-Programming, Interfacing, Hardware & Applications by Triekel & Singh, PHI
4. Microprocessor and interfacing by D.B.Hall, McGraw Hill
5. The 8051 Micro controller & Embedded System by M.A.Mazidi & J.G.Mazidi, Pearson Education.

Reference Books :

1. Microcomputer systems : the 8086 & 8088 Family : Architecture, Programming & Design : Yu-Change Liu & Glenn, A Gibson : PHI.
2. Microsoft MASM Reference Manual, Published by Microsoft Corporation (Soft copy of Document available with MASM Software).
3. Assembler Inside & Out by Harley Hahn Pub., Osborn McGraw Hill, Burkley USA.
4. 80xx Microprocessor Programming by Venugopal, BPB Publication.
5. Microprocessor Architecture, Programming & Applications with 8056/8086 A by Ramesh S. Gaonkar, Wiley Easter Ltd.
6. Programming Microprocessor Interfaces for control & instrumentation by Michael Andrews, Prentice Gakk Ubc,m Engle Wood Clifs, New Jersey.
7. Programming and Customizing the 8051 Microcontroller by Predko; TMH.
8. Design with PIC Micro controllers by John B.Peatman. Pearson.
9. Designing Embedded Hardware by John Catsoulis; SHROFF Pub. & Dist. ND.
10. Design with Micro controllers by John B.Peatman. MH

03 1x18 MODERN CONTROL THEORY

L-T-P : 3-1-0 **Credit : 4**

1. **Development of state model :** State and equation, transfer function from state equation and state equation from transfer function. **Lecture : 5**
2. **State transient matrix**, solution of equation transfer matrix. **Lecture : 5**
3. **Concepts of controllability** and absorbability. **Lecture : 3**
4. **State variable feedback**, State observers. **Lecture : 3**
5. **Control System** Design via Pole placement. **Lecture : 3**
6. **Optimal control system :** Introduction, Performance in devices, transfer function approach, state variable approach, parameter optimization. **Lecture : 6**
7. **Non liner System :** Common non-liner stability of non-liner system, method for studying non-liner system, linearization, describing function analysis. **Lecture : 8**
8. **The phase plane method**, stability, analysis using Lyapunov's direct method. **Lecture : 5**

Text Books :

1. Modern Control by K.Ogata, Pearson education.

Reference Books :

1. Control Engineering Theory & Practice by Bandopadhya. PHI

03 1x19 DIGITAL CONTROL SYSTEMS

L-T-P : 3-1-0 **Credit : : 4**

1. **Sampling and reconstruction :** Sampled data control system, Digital to analog conversion**,** analog to digital conversion, sample and hold operation. **Lecture : 8**
2. **Transform analysis of sampled data system :** Liner differential equation, solution of liner difference equations, pulse response, z transform, pulse transform function, block diagram analysis of sampled data system, stability analysis. **Lecture : 12**
3. **Application of z transform** to open loop system, application of z transform to closed loop system stability of sampled data feedback system. **Lecture : 10**
4. **State space analysis of sampled data system :** Discrete time state equation, simplicity transformation, The Cavlex Hamilton theorem, realization of pulse transfer function, state equation for sampled data system. **Lecture : 12**

Text Books :

1. Digital control and State Variable method by M. Gopal, TMH
2. Linear system Analysis by D.K.Cheng. Narosa Publication House.

03 1x20 SIMULATION LAB

L-T-P : 1-0-3 **Credit : 3**

Simulation of Electrical and Electronic circuits and systems; study of their performance under different input and parametric changes, time and frequency response using OrCAD and MatLAB – Simulink Software

03 1x21 COMPUTER AIDED POWER SYSTEMS ANALYSIS

L-T-P : 3-0-3 **Credit : 5**

1. **Algorithm** for formulation of bus, types of modifications, short-circuit studies: Single line to ground fault, Line to line fault, double line to ground fault and symmetrical fault, conditions of pre-fault current.
2. **Algorithm and flow-chart** for computer application to load flow studies using G-S method, Newton-Raphson method and fast decoupled flow methods.
3. **Algorithm and flow-chart** for computer application to economic load dispatch; neglecting losses, including losses, optimum generation schedule of hydro-thermal system.
4. **Aims and function of control centers**, set up, locations, central facilities, civil facilities, facilities in control room ,communication,telemetry, emergency control.
5. **Power System Management :** Load dispatch center, reporting and data management, load dispatcher in the consumer setup, load control center, computerized power system control, SCADA system and RTU.

Text Books :

1. Power system Analysis Operation & Control by Abhijit Chakrabarti & Sunita Halder, PHI
2. Power system Analysis by Hadi Saadat, TMH
3. Digital Power system Protection by R.P Singh. PHI

Reference Books :

1. Computer methods in power by G.W Stagg and A.H El-Abiad. MGH
2. Power System Engineering by I.J Nagrath & D.P Kothari. TMH

03 1x22 ADVANCED ELECTRICAL MACHINE

L-T-P : 3-1-0 **Credit : 4**

1. **Special Electrical Machines :** Hysteresis motor-construction feature, principle of operations, performance, characteristic and application, stepper motor: types constructional feature, principle of operation & switching operation, performance, characteristic & application, universal motor: conditional feature, working principle, phasor diagram, performance and application. **Lecture : 12**
2. **Repulsion motor-starting** performance and application, double cage induction motor: conditional feature, principle of operation, Equivalent circuits, torque speed characteristic and application. **Lecture : 8**

3. **Introduction** to generalized theory of electrical machines: Synchronous machines and induction machines. **Lecture : 7**
4. **Dynamics of Electrical machines**, general torque equation, inertia constant, analysis of synchronous machine under transient condition, stability affect of damping. **Lecture : 5**
5. **State variable model of electrical machines :** Unbalanced operation of two and three-phase induction motors. **Lecture : 5**
6. **New machines :** Brushless d.c. Machines, Microprocessor based speed control of motor using thyristors. **Lecture : 6**

03 1x23 COMPUTER AIDED NETWORK ANALYSIS

L-T-P : 3-1-0 **Credit : 4**

1. **Local Area Network :** Background, Topologies and Transmission Media, LAN standards IEEE 802 reference Model, Logical Link Control, Medium Access Control, IEEE 802.3 Medium Access Control, Ethernet, Fast Ethernet, Gigabit Ethernet, Token Ring and FDDI, Medium Access Control, IEEE 802.5 Transmission Medium Options, Fibre Channel Elements, Fibre Channel Protocol Architecture, Fibre Channel Physical Media and Topologies.
2. **Connecting devices and Backbone Networks :** Bridges, Functions of a Bridge, Bridge Protocol Architecture, Fixed routing, Spanning tree approach, Connecting devices like Repeaters, Hubs, Bridges, Two-layer switches, Routers and Three layer switches, Backbone Networks, Bus Backbone, Star backbone, Connecting remote LANs, wireless LANs, Applications, Architecture, IEEE 802.11, Architecture and Services, Medium Access Control, Physical layer.
3. **Internetworking :** Principles of Internetworking, Requirements, Architectural approaches, Connectionless Internetworking, Addressing, Routing techniques, Static versus Dynamic Routing, Internet Protocol (IP), Internet Control Message Protocol (ICMP), $_{IPv6}$ Structure, Header, Address and Header Formats, ICMPv6.
4. **Internet work Operations :** Unicast and Multicast routing, Autonomous Systems, Unicast routing protocol OSPF, Internet Group Management Protocol (IGMP), Border Gateway Protocol, Multicast Trees, Integrated Service Architecture, ISA Approach, Components, Services, Queuing Discipline, Resource Reservation Protocol (RSVP), Differentiated Services (DS).
5. **Transport Protocols :** Connection Oriented Transport Protocol Mechanisms, Reliable Sequencing network services, Unreliable network services, TCP Services, TCP Header Format, TCP Mechanisms, TCP Implementation policy options, TCP Congestion Control, Retransmission Timer Management, Window Management, Quality of Service, User Datagram Protocol (UDP).
6. **Network Security :** Passive and Active Attacks, Symmetric Encryption, Encryption Algorithms, Key Distribution, Traffic Padding, Message Authentication, Hash function, Secure Hash function, Public-key Encryption, Digital Signature, RSA Public Key Encryption algorithm, Key Management, Secure Socket Layer and Transport layer Security, SSL Architecture, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, handshake Protocol, IP level security IPSEC, Application layer security PGP, Firewall, Virtual Private Networks.
7. **Distributed Applications :** electronic Mail, Simple Transfer Protocol (SMTP), Multipurpose Internal Mail Extension (MIME), Client Server Model, Socket Interface, Socket Programming, File Transfer, Simple Network Management Protocol (SNMP) SNMP V_2 and SNMP V_3, Hypertext Transfer Protocol (HTTP) Overview Message Entities, World Wide Web (WWW), HTML, Common Gateway Interface (CGI).

(1) "Data and Computer Communication", 7/e. by William Stallings.
(2) "Data Communication and Networking", 3/e. by Behrouz A. Forouzan.

03 1x24 EHV POWER TRANSMISSION

L-T-P : 3-1-0 **Credit : 4**

1. **Maxwell's coefficients**, Sequence inductance, and capacitance, Charge Matrix, Effect of Ground wire. **Lecture : 6**
2. **Surface Voltage-gradient** on bundled conductors Mangoldt's formula, Gradient factors & their use, Ground level electrostatic field of EHV lines. **Lecture : 6**
3. **Power frequency** over-voltage control, Series and shunt compensation, Generalized Constants of Compensated line, Static Var Compensators (SVC/SVS). **Lecture : 7**
4. **Switching** over-voltage in EHV Systems **Lecture : 6**

5. **Six-pulse Bridge circuit :** Waveforms and relevant equations, Twelve-pulse converter, Advantages of higher pulse number, Bipolar to monopolar operation, Converter performance with phase control, Commutation and effects of reactance. **Lecture : 8**
6. **Introduction to HVDC system**, Economical advantages, Technical advantages, Critical distance, Submarine transmission. **Lecture : 5**
7. **Inverter**, Equivalent circuit of HVDC system, Schematics diagram, Reactive power consideration in HVDC system, Harmonics, Filters in HVDC System. **Lecture : 7**

Text Books:

1. Extra high Voltage AC Transmission Engineering (2nd Ed) by R.D. Begamudre, Wiley Eastern Ltd.
2. HVDC Power Transmission Systems by K. Padiyar, Wiley Eastern Ltd.

Reference Books:

1. EHV AC and HVDC Transmission Engineering and Practices by S.S. Rao, Khanna Publications.

03 1x25 CONTROL SYSTEM DESIGN

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction**, Design specifications Controller configuration, Fundamental Principals of design with PD controller time-domain interpretation of PI control, design with PI controller- Time-Domain interpretation of PI control, Frequency domain interpretation of PI controller, Summary of effects of Pi control. **Lecture : 8**
2. **Design with PID controller :** Design with phase lag controller- Time Domain i interpretation of phase lag control, Frequency domain interpretation of phase lag controller, summary of effects of phase lead control, Design with Phase lead controller, Time- Domain interpretation of phase lead control. Frequency domain interpretation of phase lead controller, summary of effects of phase lead control, Multistage phase lead controller. **Lecture : 8**
3. **Design with lag-lead controller**, Pole zero cancellation design, north filter, forward and feed forward controllers, Design of Robust control systems. **Lecture : 6**
4. **Hardware and software implementation of common compensator :** Physical realization of common compensator with active and passive elements, Tunable PID algorithms- Position and velocity algorithms, Ziegler-Nichols method for controller tuning. **Lecture : 6**
5. **State feedback control**, Pole placement design through state feedback, with integral control, Design of state observer. **Lecture : 8**
6. **Design of discrete data control system :** Introduction, Digital implementation of analog controller (PID) and lead-lad controllers, Digital controllers, design of discrete data control system in frequency domain and Z-plane. **Lecture : 4**
7. **Synthesis** through Pole zero configuration, Determinate of closed loop system functions from the specifications, Determination of open lop transfer function from the closed loop transfer function from the closed loop transfer function, Additional correlation between open loop and closed lop characteristics. **Lecture : 3**

Text Book :

1. B.C. Kuo,"Automatic Control System", 7th Edition PHI.
2. M. Gopal, "Control System Principal & Design", 2nd Edition. TMH.
3. K. Ogata, "Discrete Time Control system", 2nd Edition, Pearson edition.

Reference Books :

4. Norman Nice, "Control system engineering", 4th Edition.
5. M. Gopal, "Digital Control & System Variable Method", TMH
6. B.C. Kuo, "Digital Control System" , 2nd Edition, Oxford

03 1x26 COMPUTER BASED PROCESS CONTROL

L-T-P : 3-1-0 **Credit : 4**

1. **COMPUTER CONTROL :** Introduction – Review of Z – Transform, Modified Z – Transform and delta Transform, Relation between discrete and continuous transfer function – Poles and zeros of sampled data System (SDS) – Stability analysis in Z – Domain.

2. **INTRODUCTION TO PULSE TRANSFER FUNCTION :** Open loop and closed loop response of SDS design and Implementation of different digital control algorithm: dead beat, Dahlin, Smith predictor and internal model control algorithm with examples.
3. **DIFFERENT MODELS OF DISCRETE SYSTEMS :** LTI Systems – Family of discrete transfer function models – state space models – distributed parameter model. Models for time varying and non linear system: linear time varying models – non linear state space model – non linear black box models – Fuzzy models.
4. **PARAMETER ESTIMATION METHODS :** General principles, Minimizing prediction errors, Linear regression and the least square method, statistical framework for parameter estimation and the maximum likely hood method, Instrument variable method, recursive and weighted least square method.
5. **ADAPTIVE CONTROL :** Introduction, Deterministic self Tuning regulator**,** Indirect and direct self Tuning regulator, Model reference adaptive system: Design of MRAS using Lyapnov and MIT rule – Auto tuning and gain scheduling adaptive control design with examples.

Text Books :

1. System Identification Theory For the user by Lennart Ljung-PHI, Information and System sciences series, NJ.
2. Computer controlled system by P. Deshpande and Ash, ISA press, USA.
3. Digital control and estimation by Richard H. Middleton and Grahm C. Goodwin – A Unified approach, PHI.
4. Process dynamic and control by Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp – Wiley India.
5. Adaptive control by Astrom K.J, Bjorn Wittenmark – PHI, New Delhi.

03 1x27 COMPUTER AIDED MACHINE DESIGN

L-T-P : 3-1-0 **Credit : 4**

1. **INTRODUCTION :** Basic design principles and approaches, specification, Magnetic and electric loading, output equations and output coefficients, Main dimensions, Ratings, Heating cooling and temperature rise.
2. **TRANSFORMER :** Magnetic circuit, core construction and design, Winding types, Insulation, Loss allocation and estimation, Reactance, Temperature rise.
3. **D.C. MACHINE :** No. of poles and main dimensions, armature, Windings, Magnetic circuit and Magnetization curve, Commutator and brushes.
4. **INDUCTION MACHINE 3-PHASE :** Rating specification, standard frame size, Main dimensions specific loadings, Design of stator windings, Rotor design – Slots and Windings, Calculation of equivalent circuit parameter.
5. **SYNCHRONOUS MACHINE :** Main dimensions, Magnetization characteristic, field welding design, Computer assisted design of above machines.

Text & Reference Books :

1. A course in Electrical Machine Design by Sawhney A.K, Dhanpat Rai & Co., Clayton A.E.
2. The Performance & Design of Direct Current Machines, by Hancock N.N.,CBS Publishers and Distributors.

03 1x28 DIRECT ENERGY CONVERSION

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction :** Energy sources, Energy conversion chart, Direct Energy Conversion (DEC) devices, General representation of DEC devices **Lecture : 4**
2. **Thermoelectric Power Generation :** Introduction, Thermoelectric effects, Thermodynamic analysis of Thermoelectric generator, Maximum thermal efficiency and maximum power output, Single stage and multistage generators, Thermoelectric materials, Applications. **Lecture : 7**
3. **Fuel Cells :** Introduction, Principle of fuel-cell operation and different types of fuel-cells reactions, electrochemical thermo-dynamics, Relation of cell potential to thermodynamic variables, Cell efficiency, Polarization losses, Types of fuel cells, Performance characteristics, Applications. **Lecture : 7**
4. **Solar Cells :** Introduction, Basic theory of p-n junction photovoltaic converters, Characteristics of solar radiation, Typical schematic representation of a solar cell and the idealized equivalent circuit, Basic characteristics, power and efficiency, Materials for photovoltaic conversion and cell fabrication, Silicon, Cadmium Sulphide and Gallium Arsenide cells, Application, System design methodology. **Lecture : 7**

5. **MHD Generator :** Introduction, Gaseous conductors, Seeding, MHD equations, Operating range of an MHD duct, Different types of MHD generators, Thermodynamic analysis of linear constant velocity MHD generator, Electrical power output and efficiency, Adiabatic efficiency, Introduction to liquid MHD generator.
Lecture : 10

6. **Fusion Power :** Principles of fusion power production, Advantages of fusion power, Problems in achieving controlled thermonuclear reactions, Plasma confinement, heating and diagnostics, Fusion devices.
Lecture : 5

7. **Wind Power :** Introduction to Wind Power Generation. **Lecture : 5**

Text Books :

(1) "Direct Energy Conversion" by M.All Kettani, Addison-Wesley, 1970.
(2) "Direct Energy Conversion" by S.W.Angrist, Allyn & Bacon, Boston, 4th Edn., 1982.
(3) "Direct energy Conversion" by S.L.Soo, Prentice Hall, 1968. 3

03 1x29 MODERN POWER SYSTEM OPERATION AND CONTROL

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction :** Operating states, Preventive and emergency control, Megawatt-frequency and megavar-voltage interaction. **Lecture : 3**
2. **Load Frequency Control :** Introduction, Speed governing system and modeling, Turbine modeling, Generator-load modeling, Steady-state and dynamic response of ALFC loop, The secondary ALFC loop, Integral control.
Lecture : 8
3. **Multi Control Area System :** Introduction, Pool operation, Two area systems, Modelling of tie line, Static and dynamic response of two area system, Tie-line bias control, Tie-line control, digital electrohydraulic (DEH) control system, Implementation of DEH system. **Lecture : 10**
4. **Excitation System :** Introduction, Elements of an excitation system, Types of excitation system, Digital excitation system. **Lecture : 5**
5. **Reactive Power Control :** Introduction, Methods of voltage control, Power capacitors and its application to distribution and transmission system, Static var system. **Lecture : 6**
6. **Power System Security :** Introduction, Factors affecting power system security, Introduction to contingency analysis. **Lecture : 4**
7. **Power System Restructuring :** Introduction, Regulation vs. Deregulation, Competitive Market for Generation, The Advantages of Competitive Generation, Electric Supply Industry Structure Under Deregulation in India, restructuring Models. **Lecture : 6**

Text Books :

(1) Electric Energy Systems Theory an Introduction by Olle I. Elgerd
(2) Power Generation Operation and Control by A.J. Wood, B.F. Wollenberg
(3)

Reference Books :

(1) Power System Deregulation by Loi Lei Lal
(2) Power System Stability and Control by P. Kundur
(3) Electric Power Distribution System Engineering by T.Goneen

03 1x30 POWER SYSTEM DYNAMICS AND RELIABILITY

L-T-P : 3-1-0 **Credit : 4**

1. **Classification of Power System Stability :** Introduction to Power System Stability classification, Small signal and Transient stability, Rotor angle & Voltage Stability. **Lecture : 5**
2. **Synchronous Machine Modeling :** Synchronous Machine, Basic Equations, Generator operated as part of large power grid. **Lecture : 5**
3. **Small Signal (Steady State) Stability :** Small Signal (Steady State) Stability, Linearization, State matrix.
Lecture : 5

4. **Transient Stability Studies :** Transient Stability Studies, Network performance equations, alternate solution techniques – Runga Kutta and Trapezoidal, Methods of improvement of transient stability.

Lecture : 7

5. **The Basics of Power System Reliability :** Characteristics of component failure, the general reliability functions, the exponential distribution, mean time to failure, mean time to failure.

Lecture : 7

6. **Generation Reliability Model :** Two state Markov Model, Steady-state availability, Steady-state unavailability or forced outage rate (FOR), Capacity outage probability table (COPT), Recursive techniques, Loss of load probability (LOLP) and loss of energy expectation (LOLE) calculation. **Lecture : 10**
7. **Transmission system reliability evaluation and composite reliability evaluation :** Average interruption rate method, The frequency and duration method, Stormy and normal weather effect, The Markov process approach, Two plant single load composite system reliability analysis. **Lecture : 5**

Text Books :

(1) Power System Control & Stability by P. Kundur
(2) Power System Reliability Evaluation by Roy Billingtor.

Reference Books :

(1) Electric Energy System Theory by O.I. Elgerd
(2) Power System Analysis by Stevenson and Grainger
(3) Power System Planning by R. L. Sullivan
(4) Reliability Modelling in Electric Power Systems by J.Endrenyl

03 1x31 FUZZY LOGIC CONTROL

L-T-P : 3-0-3 **Credit : 5**

1. **Fuzzy control** from an industrial perspective, knowledge-based controllers, knowledge representation in KBC's, vagueness,fuzzy logic versus probability theory, fuzzy sets, their properties & operations on fuzzy sets, fuzzy relations & operations on fuzzy relation, the extension principle, fuzzy propositions, tile compositional rule of inference, different implications, representing a set of rules.
2. **The PKBC architecture**, choice of variables & content of rules, derivation of rules, choice of membership functions, choice of scaling factor , choice of fuzzification procedure, choice of defuzzification procedure, comparison and evaluation of defuzzification methods.
3. **The control problem**, The FKBC as a non-liner transfer element and type of FKBC such as pill-link FKBC, shding mode FKBC, sugeno FKBC.
4. **Approaches to design** such as membership function tuning using gradient decent, membership function tuning using performance criteria, the self-organizing controller, model-based controller.
5. **The state space approach**, stability and robustness Ll'ldices, input-output stability, circle criterion, the conicity criterion.

Text Book : An Introduction to Fuzzy Control by D.Driankov, H. Hellendoom & M. Reinfrank. Narosa

Reference Book : Fuzzy Control System by Abraham Kandel & Gideon Imngholz : Narosa

03 1x32 NEURAL NETWORKS SYSTEM

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction :** Brain & Machine, Biological Neurons & its mathematical model, Artificial Neural Networks, Benefits and Applications, Architectures, Learning Process (paradigms & algorithms), Correlation Matrix Memory, Adaptation. **Lecture : 6**
2. **Supervised Learning I :** Pattern space and Weight space, Linearly & non-Linearly separable classes, Decision Boundary, Hebbian learning & limitation, Perceptron, Perceptron convergence theorem, Logic Functions implementations. **Lecture : 6**
3. **LMS Algorithm :** Wiener-Hopf equations, Steepest Descent Search Method, LMS algorithms, Convergence consideration in mean &mean square, Adaline, Learning curve, Learning rate annealing schedules.

Lecture : 7

4. **Supervised Learning II :** Multilayer Perceptrons, Backpropagation algorithm, XOR Problem, Training modes, Optimum learning, Local minima, Network Pruning techniques. **Lecture : 7**
5. **Unsupervised Learning :** Clustering, Hamming Networks, Maxnet, Simple competitive learning, Winner-Take-All Networks, Learning Vector Quantizers, Counterpropagation Networks, Self Organising Maps (Kohonen Networks), Adaptive Resonance Theory. **Lecture : 6**
6. **Associate Models :** Hopfield Networks (Discrete and continuous), Storage capacity, Energy Function & minimization, Brain-State-in-a-Box Neural Network. **Lecture : 6**
7. **Applications of ANN & Matlab Simulation :** Character Recognition, Control Applications, Data compression, Self organizing semantic Maps. **Lecture : 7**

Text Books :

1. Neural Networks : A Comprehensive Foundation by Simon Haykin. (Pearson Education)
2. Elements of Artificial Neutral Networks by Kishan Mehrotra, Chilukuri K. Mohan, Sanjay Ranka. (Penram International Publishing, India)

Reference Book :

1. Neural Networks : A Classroom Approach by Satish Kumar, Tata McGraw Hill

03 1x33 SWITCH GEAR AND PROTECTION

L-T-P : 3-1-0 **Credit : 4**

1. **Circuit breakers :** arc voltage mechanism of arc interruption restriking voltage and recovery voltage, classification of CBs oil CBs Air CBs Vacuum, **Sf6** CBs HVDC CBs, Rating and Resting of CBs.
2. **Protective Relaying :** Introduction to protective relaying, thermal relay, over current relay, Directional relay, Differential really.
3. **Transmission Line and Feeder Protection:** Over Current and directional relay applications distance Protection using impedance relay, reactance relay, MHO relay.
4. **Generator Protection :** Protection against stator and rotor faults and abnormal operating conditions such as unbalanced loading, loss excitation, over speeding.
5. **Transformer Protection :** Types of faults, over current protection, differential protection, Differential relay with harmonic restraint, Protection against high resistance ground faults, interturn faults, Bucholz relay.
6. **Introduction Motor Protection :** Production against phase fault, ground fault and abnormal operating conditions such as single phasing, Phase reversal and overloading.
7. Introduction to carrier-aided protection and numerical protection

Text Books:

1. Power System Protection & Switch Gear by Badriram and Vishwakarma, TMH Publication.
2. Switch Gear and Protection by Sunil S. Rao, Khanna Publications

Reference Books:

1. Power System Protection & Switch Gear by Ravindranath & Chander, New Age Publications
2. The Art and Science of Protective Relaying by C. Russel Mason, Wiley Western Ltd.

03 1x34 ELECTRICAL MACHINE MODELING AND ANALYSIS

L-T-P : 3-1-0 **Credit : 4**

1. **Modelling and Analysis :** Unified machine theory, generalized torque equation, performance and speed control of d.c. machine, induction machine and synchronous machine using generalized theory, Transformation methods (stationary, rotor and synchronous frames) and corresponding equivalent circuits, Park's transformations, drives and control techniques, concept of space vector. **Lecture : 10**
2. **CAD of electrical apparatus :** Review of design process of transformers, rotating machines, electromagnets etc., Basic design methodology and engineering consideration, flow charts for design and design optimization of transformers, rotating machines, electromagnets etc., Finite element method of design, FE techniques and their applications for designing transformers, rotating machines, electromagnets etc, CAD programming using "C" language and MATLAB. **Lecture : 12**

3. **Control of Electric Drives :** DC Motor Drive , Induction Motor Drive, direct and indirect field oriented control of induction motor, direct torque control, closed loop drive using sensor and sensorless operation Switched Reluctance Motor Drive, Sensor and sensorless control of SRM, Vector control of the PMSM drive, Direct torque control of PMSM drive, Sensor and sensorless control of PMBLDC and PMSM drives.

Lecture : 14

03 1x35 MICROCONTROLLERS AND ITS APPLICATION

L-T-P : 3-0-3 **Credit : 5**

1. **Microcomputers :** Type, Processor architecture memory type, hardwares, 8051 processor architecture.
2. **Addressing modes**, 8051, installation set- data movement installation, arithmetic installation, Logic instruction, Branch group instruction.
3. **8051 software and programming** memory interfacing and address decoding, programming Input/Output port/timer ADC'/DAC, serial data communication controller and interrupts controller for difference application with respect to instrumentation & control.
4. **Embedded System**, Hardware, Embedded system software, introduction to embedded development tolls like cross assembler, simulator, HLL cross compiler & in circuit emulator for system development.
5. **Introduction** to advanced embedded controllers with built in multichannel ADC,PWM, watch dog timer, multi tasking and trends, Real time operating system, basic design using real time operating system.

Reference Books :

1. The 8051 Micro controller & embedded system by M.A.Mazidi & J.G. Mazidi. Pearson Education
2. An Embedded Software Pioneer by David E. Simon. Pearson Education
3. Programming & customizing 8051 micro controller by Myke Predko. TMH
4. Design with Micro controllers by John B. Pittman. MH

03 1x36 HIGH VOLTAGE ENGINEERING

L-T-P : 3-1-0 **Credit : 4**

1. **Generation** of high voltages and current, AC voltage : cascade transformers-series response circuits DC voltages, voltage doubler cascade circuit electrostatic machines, impulse voltage: single stage and multistage circuits wave shaping tripping and control of impulse generators generation of switching surge voltage and impulse currents.
2. **Measurement of high voltage and currant :** DC, AC and impulse voltages and currents – DSO – electrostatic and peak voltmeters - sphere, gaps-factors affecting measurements – potential divider (capacitance and resistive) - series impedance ammeters - Rogowski coils- Hall effect generators.
3. **High voltage testing of materials and apparatus :** Preventative and diagnostic tests-dielectric loss measurement-Schering bridge-inductively coupled ratio arm bridge-partial discharge and radio interference measurement-testing of circuit breakers and surge diverting.
4. **Insulation materials and system :** Insulation system in practice, dielectric losses, ageing and life expectancy.
5. **Outdoor insulation :** materials, ageing, diagnostic, polymeric materials (EPDM,SIR), semi conducting ceramic, glazes.
6. **Breakdown in gas and gas mixtures**-breakdown in uniform, in non-uniform field-Paschens law-Lownsends criterion-streamer mechanism-corona discharge-breakdown in elector negative gases.
7. **Breakdown in liquid dielectrics**-suspended particle mechanism.
8. **Breakdown in solid dielectrics**-intrinsic, streamer, thermal breakdown.

Reference Books :

1. High Voltage Test Technique by Kind & Feser.SBA Publication.
2. High Voltage Engineering. M.S. Nandu & V.Kamraj. TMH

03 1x37 INDUSTRIAL DRIVES AND CONTROL

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction :** Electrical Drives & their advantages parts of electrical drives, D.C &A.C drives.

Lecture : 3

2. **Dynamics of Electrical Drives :** Torque equations, Multiquadrant operation, load torque & their types, calculation of time and energy loss in transient operation, Steady state stability, load equalization.
Lecture : 5
3. **Selection of Motor & its power rating :** Types of motors & their enclosures, thermal model of motor for heating & cooling, classes of motor duty, rate of motor. **Lecture : 5**
4. **Control of Electrical Drives :** Introduction, Mode of operation, speed controls and drive classification closed loop control of drives, speed and current sensing, manual, semi automatic and automatic control, magnetic and static control, power circuit & control circuit and their development, inter locking and sequential operation.
Lecture : 15
5. **D.C. Motor Drives :** Performance characteristics of DC Motors and their modifications, starting and design of starting circuit, braking, speed control, converter – controlled DC drives, chopper controlled DC drives.
Lecturer : 8
6. **Induction Motor Drives :** Performance characteristic of three phase induction motors and their modifications.
Lecturer : 6

Text Books :

1. Fundamental of Electric Drives by G.K Dubey. NPH
2. Power Semiconductor Controlled drives by G.K.Dubey. PHI
3. Power Electronics and AC Drives by B.K Boss. PHI

Reference Books :

1. Solid State Drives by K. Malarvizhi, scitech publication
2. A first course in Electric Drives by S.K.pillai. Wiley Eastern

03 1x38 INDUSTRIAL TRAINING

The curricula for all B.Tech. would include compulsory industrial training for 6 weeks carrying 2 credits to be carried out in the summer vacation at end of the sixth semester.

The six-week industrial training undergone by the student in the summer vacation after the sixth semester would be assessed within five weeks after commencement of the seventh semester. The students are required to submit a report on the training received and give a seminar on the basis of which a grade would be awarded. The students are also required to submit to Head of department a completion certificate in the prescribed form the competent authority of the organization where the training was received without which he/she would not be assessed.

03 1x39 PROJECT (MINOR)

03 1x40 SEMINAR

03 1x41 PROJECT (MAJOR)

L-T-P : 0-0-12 **Credit : 8**

03 1342 ELECTRICAL MACHINES – 1

L-T-P: 3-0-3 **Credit: 5**

1. **DC Generator :** Constructional Feature and types of D.C. Machines, Types of armature winding, Action of Commutator, Principle of D.C. generator, Induced EMF, Armature reaction, Commutation, Compensating Winding and Inter Poles, External & Internal Characteristics of D.C. Generator, Critical Resistance, Critical Speed. **Lecture : 8**
2. **D.C. Motor :** Principle of D.C. Motors , Back EMF, Torque and Speed of D.C. Motors, Losses and Efficiency, Characteristics, Starting and Speed Control of Various types of D.C. Motors **Lecture : 6**

3. **Single Phase Transformer :** Basic Principle, Types and Construction of Single Phase Transformer, EMF equation, Equivalent Circuits, Phasor Diagram, Losses and efficiency Testing, Voltage Regulation, per unit system, Losses and Efficiency, Parallel Operation of Single Phase Transformer. **Lecture : 10**
4. **Auto Transformer :** Working Principle, Saving of Conductor, Advantage and Disadvantage of Auto Transformer. **Lecture : 2**
5. **Three Phase Transformer :** Introduction, Types, Phasor Group, Parallel Operation of three Phase Transformer, Cooling of Transformer. **Lecture : 5**
6. **Three Phase Induction Motor :** Construction, Types and Principle of three Phase Induction Motors, Production of rotating field, slip, Equivalent Circuit and Phasor Diagram, Mechanical Power Developed, Maximum torque, Torque-Slip Characteristics, Losses and efficiency, Starting, Testing and speed control of Induction Motor. **Lecture : 11**

Text Book :

1. Electrical Machine by Samarjit Ghosh, Pearson Education Pvt. Ltd.
2. Electrical Machine by P.S Bimbra, Khanna Publication.
3. Electrical Machine by Nagrath, I . J and Kothari D.P. TMH.

Reference Book:

1. Electrical Machinery by Fitzgerald A.E & Kingsley TMH
2. Direct Current Machine by E.W.Daws.

DEPARTMENT OF INFORMATION TECHNOLOGY

06 1x01 FUNDAMENTAL OF INFORMATION TECHNOLOGY

L-T-P : 3-0-2 **Credit : 4**

Theory :

1. **Computer Basics :** Evolution of Computers, Generation and Classification of Computers Application of Computers and etc. **Lecture : 2**
2. **Computer Memory and Storage :** Memory Hierarchy, RAM, ROM, Types of Secondary Storage Devices and etc. **Lecture : 2**
3. **Information Technology Basics :** Information, Technology, Role of Information Technology, Information Technology and Internet and etc. **Lecture : 2**
4. **The Internet and its Tools :** Introduction, Evolution of Internet, Basic Internet Terms, Getting Connected to Internet, Internet Applications, Data over Internet, Web Browser, Browsing Internet Using Internet Explorer, E-mail, search Engines, Instant Messaging. **Lecture : 3**
5. **Emerging Trends in IT :** E-Commerce, Electronic Data Interchange, Smart Cards, Mobile Communication and etc. **Lecture : 3**
6. **Computer Programming and Languages :** algorithm, Flow Chart, Pseudo Code, Program Control Structures, Programming Languages, Generation of Programming Languages and etc. **Lecture : 4**
7. **C Language :** Basics, Constants, Variables and Data Types, Operators and Expressions, Input & output operations. **Lecture : 8**
8. **Control Structures :** Decision Making & Branching, decision Making & Looping. **Lecture : 9**
9. **Arrays :** One & Two dimensional Array. **Lecture : 3**
10. **Functions :** User defined functions, concept of recursion. **Lecture : 6**

Text Books :

1. Introductory to Information Technology, by ITL Education solution Ltd., Pearson Education.
2. Programming in ANSI-C by E. Balagurusamy 4th Ed.

Reference Books :

1. Fundamental of Computer & IT by A. Jaiswal (Wiley India).
2. Programming in ANSI-C by Ashok N.Kamthane.
3. The C Programming Language, 2e, by Brian W. Kernighan & Dennis M. Ritchie, PHI/Pearson Education.
4. Programming with C by Gottifried. Tata McGraw Hill (Schaum's series).
5. Mastering C by K. R. Venugopal & S. R. Prasad, Tata McGraw.

Practical : Working in windows environment, Internet, C Programming based on above syllabus.

06 1x02 WEB TECHNOLOGY

L-T-P : 3-0-3

Credit : 5

1. **Web Introduction :** Domain name, IP Address concepts, World Wide Web.
2. **HTML & CSS :** Introduction to HTML, Tags, Commands, Formatting web page, Font Tag, Links and Listings, Images and its Mapping, Tables, Frameset Definition, Forms, Cascading Style Sheet (CSS).
3. **Java Script :** Introduction, Data Types, Variables, Operators, Array Objective, Date Objective, String Objects, Document Object Model, Image Object, Event Handling, Browser Object, Window Object, Location Object, History Object, Submit Event and Data Validation.
4. **Dynamic Hypertext Markup Language (DHTML) :** Introduction to DHTML, Dragging and Dropping Data, Working Layers.
5. **Java Fundamental :** Introduction to Java, Java and the Internet, Data Type, Variables, Operators, Strings, Input and Output, Control Flow, Arrays, Object and Classes, Member of Classes, Inheritance, Interfaces.

6. **Graphics and Applet programming in JAVA :** Introduction to Abstract Window Toolkit (AWT) and Swing, Event Handling, Working with Text input, Choice components, Menus, Dialogue Boxes, Applets and Developing Applets with HTMO, Jar Files, Exception Handling, Introduction to Multi Threading and Java
7. **Database Programming :** JDBC API

Text Books :

(1) HTML Black Book by Steven Hoizner (Wiley India)
(2) JAVA – How to Program by Deitel & Deitel (Pearson)

Reference Books :

(1) HTML, CSS, Java Script, Perl, Python & PHP (Web Standard Programming Reference) (Wiley India)
(2) JAVA – The Complete Reference, J2SE, 5/e by Schildt (TMH)
(3) Web Programming by Bates, Wiley.
(4) Core Java TM Volume I & II by Cay S. Horstmann & Gary Cornell (Pearson)
(5) Internet & WWW - How to program by Deitel & Deitel (Pearson)
(6) HTML & DHTML- The Complete Reference by Powell (TMH)

Practical : Programming based on above syllabus.

06 1x03 OPERATING SYSTEM

L-T-P : 3-0-3 **Credit : 5**

1. **Introduction :** Introduction to OS, Operating system functions, evaluation of O.S., Different types of O.S., Batch multi programmed, Time-sharing, Real-time, Distributed, Parallel.
2. **Process :** Concept of processes, process scheduling, operations on processes, inter-process communication, communication in Client-Server-Systems, overview & benefits of threads.
3. **Process Scheduling :** Scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms.
4. **Process Synchronization :** Background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.
5. **Deadlocks :** System model deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.
6. **Memory Management :** Background, logical vs. physical address space, swapping contiguous memory allocation paging segmentation.
7. **Virtual Memory :** Background, demand paging, page replacement, page replacement algorithms, allocation of frames, thrashing.
8. **File Systems :** File concept, access methods, directory structure.
9. **Disk Management :** Disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN)

Text Books :

(1) Operating System Principles by Silberschatz A and Peterson J. L. Wiley.
(2) Operating System by Dhamdhere, TMH.

Reference Books :

(1) Operating System by Deitel, Deitel & Choffnes.
(2) Operating System by Stalling, Pearson.

Practical : Familiarization with UNIX/Linux and Windows Operating Systems.

06 1x04 VISUAL PROGRAMMING

L-T-P : 3-0-3 **Credit : 5**

1. **Introduction :** Introduction to NET Architecture, Features of Visual Studio.NET.
2. **C# :** Introduction to C#, C# Program Outline, Variables and Expressions, Flow Control, Functions, Debugging and Error Handling, Object-Oriented Programming in C#, Classes & Objects, Defining Class Members.

Collection, Comparisons, Conversions, Generics, OOP including Inheritance, Overloading, Overriding, delegates and other Language Keywords.

3. **Windows Programming :** Windows Programming Overview, Windows Forms, Menus, Common Dialogs & other Basic Control for UI Design, Deploying Windows Applications.
4. **Data Access :** File System Data, XML, Database and ADO.NET, Data Binding.
5. **Web Programming :** MS Web programming model, Using ASP.NET Objects session, application, request, response for accepting user input, session tracking & other fundamental operations, Advanced Web Programming with database handling, Introduction to Web Services, Deploying Web Applications, NET Assemblies Attributes, XML Documentation, Networking, Introduction to GDI+.

Text Books :

(1) Beginning Visual C# 2005 by Karli Watson, Christian Negal, Wiley India.
(2) Microsoft Visual C# .NET STEP by STEP by SHARP & JAGGER Microsoft/PHI

Reference Books :

(1) Professional C# 2005 by Christian Nagel, Bill Evgen, Wiley India.
(2) The Complete Reference C# 2.0 by Schildt, TMH

06 1x05 INFORMATION SECURITY

L-T-P : 3-0-0 **Credit : 3**

1. **Introduction, CRYPTO BASICS :** Classic Crypto, Simple Substitution Cipher,, Cryptanalysis of a simple substitution, Double Transposition Cipher, One-time Pad, Project VENONA, Codebook Cipher.
2. **SYMMETRIC KEY CRYPTO :** Stream Ciphers, A5/1, RC4, Block Ciphers, Fiestel Cipher, DES, Triple DES, AES.
3. **PUBLIC KEY CRYPTO :** Knapsack, RSA, Diffie-Hellman, Uses for Public Key Crypto.
4. **HASH FUNCTION :**
   AUTHENTICATION : Authentication Methods, Keys versus Passwords, Biometrics, Two-Factor Authentication.
   AUTHORIZATION : Access Control Matrix, Multilevel Security Models, Firewalls, Intrusion Detection.
5. **SOFTWARE FLAWS AND MALWARE :** Software Flaws, Malware, Miscellaneous Software-Based Attacks.
6. **OPERATING SYSTEM AND SECURITY :** Operating System Security Functions, Trusted Operating System, Next Generation Secure Computing Base.

Text Book :

(1) Information Security Principles & Practices by Mark Stamp, Wiley.

Reference Books :

(1) Introduction to Computer Security by Bishop and Venkatramanayya, Pearson Education.
(2) Cryptography and Network Security : Principles and Practice by Stallings, PHI.

06 1x06 DATA MINING & WAREHOUSING

L-T-P : 3-0-0 **Credit : 3**

1. **Fundamentals :** Three concept view, Supervised learning, Unsupervised clustering, Data Mining or Data Query, Expert System or Data Mining? A simple data Mining Process Model, Data Mining Strategies, Supervised Data, Mining Techniques, Association Rules, Clustering Techniques, Evaluating Performance.
2. **Basic Data Mining Technique :** Decision Trees, Generating Association Rules, K-Means Algorithm, Genetic learning, Choosing Technology.
3. **An Excel-based Data Mining Tool :** iData Analyzer.
4. **Knowledge Discovery in Databases :** KDD process model, Noisy data, Missing data, Data Transformation, CRISP-DM process model.
5. **Data Warehousing :** Operational Database, Data Warehouse design, OLAP, Excel Pivot Tables for data analysis.
6. **Formal Evaluation Techniques :** Evaluation criteria, Tools, Computing Test Set Confidence Intervals. Comparing Supervised Learner Models, Attribute Evaluation, Unsupervised Evaluation Techniques.

7. **Neural Networks :** Feed – Forward Neural Networks, NN Training, Building Neural Network with iDA.
8. **Statistical Techniques :** Linear Regression Analysis, Logistic Regression, Bayes Classifier, clustering Algorithm, query and Visualization Techniques, Machine Learning and Statistical Techniques.
9. **Specialized Techniques :** Time Series Analysis, Mining the Web, Mining Textual Data, Improving Performance.

Text Books :

(1) Data Mining : A tutorial-based Primer, by Richard J. Roiger, Michael W. Geatz, Pearson Education.
(2) Data Mining : Introductory & Advanced topic, by Margaret H. Dunham, Pearson Education.

Reference Books :

(1) Data Warehousing, Data Mining & OLAP by Berson/Smith, TMH
(2) The Microsoft Data Warehouse Toolkit : With SQL server 2005 and the Microsoft business Intelligence toolset by Ralph Kimball, Wiley India.
(3) Building the Data warehousing by W. H. Inmon, Wiley India.
(4) Data Warehousing : Design, Development and best practices by Soumendra Mohanty, Tata McGraw Hill.

06 1x07 DISTRIBUTED COMPUTING & ITS APPLICATION

L-T-P : 3-0-3 **Credit : 5**

1. **Introduction to Distributed Computing Systems :** Different forms of Computing Distributed Computing Programming.
2. **Java & Distributed Computing :** Socket API (TCP and UDP based Sockets), Remote Method Invocation (RMI), Introduction to Remote procedure Call, RPC implementation in Java using RMI, Concept of CORBA.
3. **Understanding Servlet Programming :** Using Servlets, its life cycle, Deploying Servlets on Web Server, Working with Request and Response Object, Understanding Servlet Sessions, Session tracking mechanism.
4. **Understanding of JSP :** Understanding the web page life cycle in JSP, JSP Documents, its Elements, JSP Tab extensions, Tag libraries and its validation.
5. **Working with Enterprise Java beans :** EJB Overview, Client, view of a Session Bean, Session Bean Component Contract. Session Bean Lifecycle, Client view of an Entity, Component Contract for Container-Managed Persistence (CMP), CMP Entity Bean Lifecycle, Entity Beans, EJB-QL, Message-Driven Bean Component Contract, Transaction, Exceptions, Enterprise Bean Environment, Security Management.

Text Books :

(1) Distributed Computing – Principles and Applications by M.L.Liu (Pearson Education)
(2) Java – How to Programme by Deitel & Deitel
(3) J2EE 1.4 Bible by Megovern (Wiley India)

Reference Books :

(1) Java Server Programming (Black Book) (Dreamtech Press)
(2) The J2EE tutorial 2/e by Bodoff, (Sun-Pearson Education Asia)

06 1x08 INTRUSION DETECTION

L-T-P : 3-0-0 **Credit : 3**

1. **Basics :** Understanding Intrusion Detection, Unauthorized activity, TCP Dump.
2. **Architecture :** IDS and IPS architecture, IDS and IPS internals.
3. **Implementation and Deployment :** Internet Security System's Real Source, Snort, NFR Security.
4. **Security and IDS Management :** Data Correlation, Incident Response, Policy and Procedures, Law, Standards and organizations, Security Business issues, Future of Intrusion Detection and Prevention.

Text Book :

(1) Intrusion Detection & Prevention by Carl Endorf, Eugene Schultz and Jim Mellander, TMH.

Reference Books :

(1) Implementing Intrusion Detection systems by Tim Crothers, Wiley.

06 1x09 XML WEB SERVICES

L-T-P : 3-0-3 **Credit : 5**

1. **XML :** Introduction to XML, DTD, CSS, Namespace, Schema, XSD, XSL.
2. **Introduction to Web Services :** The Web Services Type System, Data Type Mappings.
3. **SOAP :** Communication on the Web
4. **WSDL :** Describing Web Services.
5. **SOAP Tools :** SOAP Toolkit, components and architecture, exposing and invoke Web services.
6. **Developing Web Services :** Using ASP.Net application using c# programming environment.
7. **Web Services :** Working with WSDL and invoking them using .NET client/Java Client through the code.
8. **SOAP Header :** Managing the risks of Web Service, Interface-Based Web Service.
9. **Development of Interface-based Programming :** WSDL bindings, Reusable Web Services Infrastructure.
10. **UDDI :** A Web Service, Framework & Sample Applications.
11. **SOAP Toolkit Interoperability**

Text Books :

(1) XML 1.1 Bible, Edition by Elliotte Rusty Harold (Wiley)

(2) XML Web Services & Data Revolution by Coyle (Pearson Education Asia)

Reference Books :

(1) Beginning XML by David Hunter, Andrew Watt (Wrox Publication)

(2) Professional ASP.NET 2.0 by Thiru Thangarathinam (Wrox Publication)

06 1x10 MULTIMEDIA TECHNOLOGY AND APPLICATION

L-T-P : 3-0-0 **Credit : 3**

1. **Introduction :** Multimedia today, Impact of Multimedia, Multimedia Systems, Components and its Applications.
2. **Text and Audio :** Text: Types of Text, Ways to Present Text, Aspects of Text Design, Character, Character Set, Codes, Unicode, Encryption; Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI.
3. **Image and Video :** Image: Formats, Image Colour Scheme, Image Enhancement; Video: Analogue and Digital Video, Recording formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture and Computer based Animation.
4. **Synchronization :** Temporal relationships, synchronization accuracy specification factors, quality of service.
5. **Storage models and Access Techniques :** Magnetic media, optical media, file systems (traditional, multimedia)
6. **Multimedia devices :** Output devices, CD-ROM, DVD, Scanner, CCD
7. **Image and Video Database :** Image representation, segmentation, similarity based retrieval, image retrieval by colour, shape and texture: Indexing k-d trees, R-trees, Quad trees; Case Studies : QBIC, Virage, Video Content querying, video segmentation, indexing.
8. **Document Architecture and Content Management :** Content Design and Development, general Design Principles.
9. **Hypertext :** Concept, Open Document Architecture (ODA), Multimedia and Hypermedia Coding Expert Group (MHEG), Standard Generalized Markup Language (SGML), Document type Definition (DTD), Hypertext Markup Language (HTML) in Web Publishing, Case study of Application.
10. **Multimedia Application :** Interactive television, Video-on-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, media editors.

Text Books :

1. Multimedia : Computing, Communications & Applications by Ralf Steinmetz and Klara Nahrstedt, Pearson Ed.
2. Multimedia Systems Design by Prabhat K. Andleigh & Kiran Thakrar, PHI.
3. Principles of Multimedia by Parekh, TMH.

Reference Books :

1. Multimedia Literacy by Fred Hoffsteller, McGraw Hill.
2. Multimedia Fundamentals : Vol. 1-Media Coding and Content Processing by Ralf Steinmetz and Klara Hahrstedt, PHI.
3. Multimedia in Practice : Technology and Application by J. Jeffcoate, PHI.
4. Multimedia Communications by Fred Halsall, Pearson Ed.

06 1x11 WIRELESS & MOBILE COMMUNICATION

L-T-P : 3-0-0 **Credit : 3**

1. **Wireless Transmission :** History, Overview, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread Spectrum.
2. **Media Access Control :** MAC, SDMA, TDMA, CDMA, Spread Aloha Multiple Access.
3. **Telecommunication System :** GSM, DECT, TETRA.
4. **Wireless LAN :** Infrared Vs Radio Transmission, IEEE 802.11 standard, Concept of HIPERLAN and Bluetooth technology.
5. **Mobile Technology :** Mobile-IP, Mobile transport layer, Mobile TCP, Concept of WAP and WML.
6. **J2ME :** Overview, Small computing technology. Its architecture and development environment, Lifecycle, MIDP, Commands, Items and Event processing, High level display screen and low level display screen.

Text Books :

(1) Mobile Communication 2/e by Schiller (Pearson Education).
(2) J2ME : The Complete Reference by Keogh (Tata McGraw-Hill).
(3) Beginning J2ME from Novice to Professional by Singli Jonathan (Wiley India)

Reference Books :

(1) Wireless Communications & Network by Stallings (Pearson Education)
(2) Wireless and Mobile All – IP Networks by Lin & Pang (Wiley India).
(3) Core J2ME Technology and MIDP Muchow (Pearson Education Asia – Sun)
(4) Beginning Mobile Phone Game Programming Morrison (Pearson Education).

06 1x12 INTRODUCTION TO INFORMATION TECHNOLOGY

L-T-P : 2-0-1 **Credit : 3**

Theory :

1. **Computer Basic :** Evolution of Computers, Generation and classification of Computers Application of Computers and etc.
2. **Computer Memory and Storage :** Memory Hierarchy, RAM, ROM, Types of Secondary Storage Devices and etc.
3. **Information Technology Basics :** Information, Technology, Role of Information Technology, Information Technology and Internet and etc.
4. **The Internet and its Tools :** Introduction, Basic Internet Terms, getting Connected to Internet, Internet Applications, Data over Internet, web Browser, Browsing Internet Using Internet Explorer, E-mail, Search engines.
5. **Emerging Trends in IT :** E-Commerce, Electronic Data Interchange, Smart Cards, Mobile Communication and etc.
6. **C Language :** flow Chart, Constants, Variables and Data Types, Operators and expressions, Input & output operations.
7. **Control Structures :** Decision Making & Branching, Decision Making & Looping.
8. **Arrays :** One & Two dimensional Array.

Text Books :

1. Introduction to Information Technology, by ITL Education Solution Ltd., Pearson Education.
2. Programming in ANSI C by E. Balagurusamy 4th Ed.

Reference Books :

1. Fundamental of Computer & IT by A. Jaiswal (Wiley India)
2. The C Programming Language, 2e, by Brain W. Kernighan & Dennis M. Ritchie, PHI/Pearson Education.
3. Mastering C by K.R.Venugopal & S.R.Prasad, Tata McGraw Hill

Practical : Working in Windows environment, Internet, C programming based on above syllabus.

06 1x13 BIOMETRIC SECURITY

L-T-P : 3-0-0 **Credit : 3**

Theory

1. Introduction – Benefits of biometric security – Verification and identification – Basic working of biometric matching – Accuracy – False match rate – False non-match rate – Failure to enroll rate – Derived metrics – Layered biometric solutions.
2. Finger scan – Features – Components – Operation (Steps) – Competing finger Scan technologies – Strength and weakness. Types of algorithms used for interpretation.
3. Facial Scan - Features – Components – Operation (Steps) – Competing facial Scan technologies – Strength and weakness.
4. Iris Scan - Features – Components – Operation (Steps) – Competing iris Scan technologies – Strength and weakness.
5. Voice Scan - Features – Components – Operation (Steps) – Competing voice Scan (facial) technologies – Strength and weakness.
6. Other physiological biometrics – Hand scan – Retina scan – AFIS (Automatic Finger Print Identification Systems) – Behavioral Biometrics – Signature scan- keystroke scan.
7. Biometrics Application – Biometric Solution Matrix – Bio privacy – Comparison of privacy factor in different biometrics technologies – Designing privacy sympathetic biometric systems. Biometric standards – (BioAPI , BAPI) – Biometric middleware
8. Biometrics for Network Security, Statistical measures of Biometrics, Biometric Transactions.

Text Books :

1. Biometrics – Identity Verification in a Networked World by Samir Nanavati, Michael Thieme, Raj Nanavati, WILEY- Dream Tech
2. Biometrics for Network Security by Paul Reid, Pearson Education.

Reference :

1. Biometrics- The Ultimate Reference by John D. Woodward, Jr. Wiley Dreamtech.

06 1x14 NETWORK SECURITY

L-T-P : 3-0-0 **Credit : 3**

1. **Information system Security Principles :** Key Principles of Network Security, Formal Processes, Risk Management.
2. **Information System Security Management :** Security Policies, Security Awareness, Managing the Technical Effort, configuration Management, Business Continuity and Disaster Recovery Planning Physical Security, Legal and Liability Issues.
3. **Access Control Considerations :** Control Models, types of Access Control Implementations, Identification and Authentication, Remote Access.
4. **Operating System and Applications :** Introduction to Windows Security, UNIX and Linux Security.
5. **Web Browser and Client Security :** Web Browser and Client Security, Working of Web Browser, Web Browser Attacks, Web Browser Configurations.
6. **Web Security :** HTTP and its working, Server Content, Client Content, state, Attacking Web Servers, E-Commerce Design.
7. **E-mail Security :** The E-mail Risk, E-mail Protocols, E-mail Authentication.
8. **Domain Name system :** Purpose, Security Issues.
9. **Server Security :** General Server Risks, Operating Servers Safely.

10. **Network Security Fundamentals :** Network Protocols, Wireless Security, Network Architecture Fundamentals.
11. **Communications :** Secret Communication, Covert Communication, Applications of Secure/Covert Communication.
12. **Intrusion Detection and Response :** Review of Common attacks, Intrusion detection Mechanism, Honeypots, Incident Handling.
13. **Security Assessment, Testing and Evaluation :** Information Assurances Approaches and Methodologies, Certification and Accreditation, Penetration testing, auditing and Monitoring.

Text Book : Network Security Bible by Cole, Krutz and Conley, Wiley dreamtech
Reference Book : Network Security PRIVATE Communication in a PUBLIC World by Kaufman, Perlman and speciner, Pearson.

06 1x15 INTERACTIVE COMPUTER GRAPHICS

L-T-P : 3-0-0 **Credit : 3**

1. **A Survey of Computer Graphics :** computer-Aided Design, Presentation Graphics, computer Art, entertainment, Education and Training, visualization, Image Processing, Graphical User Interfaces.
2. **Overview of Graphics systems :** Application of Computer Graphics, Video Display Devices, refresh Cathode-Ray Tubes Raster-Scan Display, Random-Scan displays Colour CRT Monitors, Direct-View Storage Tubes, Flat-Panel displays, Three-Dimensional Viewing Devices, Stereoscopic and Virtual-Reality Systems, Raster-Scan Systems, Random-Scan systems, Graphics Monitors and Workstations, Input Devices, Hard-copy devices, Graphics Software.
3. **Output Primitives :** Points and Lines, Line-Drawing Algorithms, DDA Algorithm, Bresenham's Line Algorithms, Parallel Line Algorithms, Loading and Frame Buffer, Line Function, Circle-Generating Algorithms, Pixel Addressing, Filled-Area Primitives, Fill-Area Function, Cell array, Character Generation.
4. **Attributes of Output Primitives :** Line Attributes, Curve Attributes Colour and Grayscale Levels, Area-Fill Attributes, Character Attributes, Bundled Attributes, Inquiry functions, Antialiasing.
5. **Two dimensional Geometric Transformations :** Basic Transformations, Matrix Representations and Homogeneous Coordinates Composite Transformations, Other Transformation : Reflection, shear, Transformation Between Coordinate Systems, Affine transformations, Transformation Functions, raster Methods for Transformations.
6. **Two Dimensional Viewing :** The Viewing Pipeline, Viewing Coordinate Reference Frame, Window-to-Viewport Coordinate transformation, Two-dimensional Viewing functions, Clipping Operations, Point Clipping, Line Clipping, Polygon Clipping, Curve Clipping, Text Clipping, Exterior Clipping.
7. **Three-Dimensional Concepts :** Three-Dimensional display Methods, parallel Projection, Perspective Projection, Depth cueing visible Line and Surface, Identification, Surface Rendering, Exploded and Cutaway Views, Three-Dimensional and Stereoscopic Views, Three-Dimensional Graphics Packages.
8. **Three-Dimensional Object Representations :** Polygon Surface, Curved Lines and Surfaces, Quadric Surfaces, Super Quadrics, Blobby Objects, Spline Representations, Cubic Spline Interpolation Methods, Bezier Curves and Surfaces, Bezier Curves, Properties of Bezier Curves, Design Techniques Using Bezier Curves, Cubic Bezier Curves, Bezier Surfaces, B-Spline Curves and Surfaces, B-Spline Curves, Uniform, Periodic B-Splines, Cubic, Periodic B-Splines, Open Uniform B-Splines, B-Spline Surfaces, Beta-Splines, Beta Spline Continuity Conditions, Cubic, Periodic Beta-Spline Matrix Representation, Rational Splines.
9. **Three-Dimensional Geometric and Modeling Transformation :** Translation, Rotation, Scaling, Other Transformations, Composite Transformation, Three-Dimensional Transformation Functions, Modeling and coordinate Transformations.
10. **Colour Models and Colour Applications :** Properties of light, Standard Primaries and the Chromaticity diagram, XYZ Colour Model, CIE Chromaticity diagram, Intuitive Colour Concepts, RGB Colour Model, YIQ Colour Model, CMY Colour Model, HSV Colour Model, Conversion between HSV and RGB Models, Colour Selection and Applications.
11. **Computer Animation :** Design of Animation Sequences, General Computer-Animation Functions, Raster Animations, Computer-Animation Languages, Key-Frame Systems, Morphing, Simulating Accelerations, Motion Specifications, Direct Motion Specification, Goal-Directed Systems, Kinematics and Dynamics.

Text Book : Computer Graphics, C Version by Donald Hearn & M.Pauline Baker, Pearson Education.

Reference Books :

1. Procedural elements in Computer Graphics by Rogers, MGH Computer.
2. Graphics-A Programming Approach by Harrington, MGH.

06 1x16 BIO-INFORMATICS

L-T-P : 3-0-0 **Credit : 3**

1. **Overview :** Information networks, Protein information resources, Genome information resources, DNA sequence analysis, Pairwise alignment techniques, Multiple sequence alignment, Secondary database searching, sequence search protocol, Analysis packages.
2. **Introduction :** The dawn of sequencing, bioinformatics concepts, The biological sequence/structure deficit, Genome projects, bioinformatics importance, Pattern recognition and prediction, Folding problem, Role of chaperones, Sequence analysis, Homology and analogy.
3. **Information Networks :** European Molecular Biology network-EMBnet, National Centre for Biotechnology Information – NCBI, Bioinformatics programme in India, Virtual tourism.
4. **Protein information resources :** Introduction, Biological databases, Primary Sequence Database, Composite protein pattern databases, Secondary databases, Composite protein pattern databases, Structure classification databases.
5. **Genome information resources :** Introduction, DNA sequence database, Specialised genomic resources.
6. **DNA sequence analysis :** Introduction, Importance, Gene structure and DNA sequences, Features of DNA sequence analysis, Issues in the interpretation of EST searches, Two approaches to gene hunting, The expression profile of a cell, cDNA libraries and ESTs. Different approaches to EST analysis, Effects of EST data on DNA databases.
7. **Pairwise alignment techniques :** Introduction, Database searching, Alphabets and complexity, Algorithms and programs, Comparing Two sequences, Sub-sequences, Identity and similarity, The dotplot, Local and global similarity, Global alignment : the Needleman and wunsch algorithm, Local alignment : the smith-Waterman algorithm, Dynamic programming, Pair wise database searching.
8. **Multiple sequence alignment :** Introduction, Goal, Definition, Consensus, Computational complexity, Manual methods, Simultaneous methods, Progressive methods, Database of multiple alignment, Searching database with multiple alignments.
9. **Secondary database searching :** Introduction, Secondary database searches, Secondary database contents.
10. **Building a sequence search protocol :** Introduction, Practical approach, When to believe a result, Structural and functional interpretation.
11. **Analysis packages :** Introduction, Commercial database, Commercial software, Comprehensive packages, Packages specializing in DNA analysis, Intranet Packages, Internet Packages, Laboratory Information Management System (LIMS).
12. **Probability and statistics :** Introduction, Beginning of modern probability theory, Chance and risk, Degrees of certainty, The death of concept of the rational person, The end of the concept of the mathematically credible judgment, concept of the average person, Post-script : the non-average person, Bayesian logic.

Text Books :

1. Introduction to bioinformatics by T.K.Attwood/Smith/Phukan, Pearson Education.
2. Bioinformatics Methods and Applications by S.C.Rastogi, PHI.

Reference Books :

1. Bioinformatics-A Beginner's Guide by Claverie and Notredame, Wiley.
2. Textbook of Bio-Technology by H.K.Das, Wiley India.

06 1x17 INTERNET AND INTRANET ENGINEERING

L-T-P : 3-0-0 **Credit : 3**

Internet Structure, Protocol and Access with an eye to Intranet, Router Technology, Internet & Intranet Web Server Technology, Access & Protocol. Browsing system for the web, the internet & intranet, building web sites : issues on server side & application s/w, on-line services (application, technology), Broadband communication for internet & intranet, virtual reality application on the internet & intranet.

Text Book : Internet and Intranet Engineering by Daniel Minoli, Tata-McGraw Hill.

Reference Books :

1. Computer Networks and Internets by Douglas E.comer; PE.
2. Internet working with TCP/IP by Douglas E.comer; PE.
3. TCP/IP protocol suite by Forouzan Behrouz A; TMH.
4. Computer Networks by Andrew S.Tanenbaum; PHI.
5. Data and Computer Communication by William Stallings; PHI

06 1x18 E-COMMERCE & ERP

L-T-P : 3-0-0 **Credit : 3**

1. **Electronic Commerce :** Overview, Definitions, Advantages & disadvantages of E-Commerce, Indian Readiness for E-commerce, E-transition, Challenges for Indian Corporate, The Information Technology Act 2000.
2. **Business Models of e-commerce :** Model Based on Transaction Party – B2C, B2B, C2C, C2B, Model Based on Transaction Type.
3. **E-Marketing :** Identifying Web Presence Goals, The Browsing Behaviour Model, Online Marketing, E-Advertising, Internet Marketing Trends, E-Branding, Marketing Strategies.
4. **E-Security :** Security on the Internet, E-Business Risk Management Issues, Firewall.
5. **E-Payment System :** Digital Payment requirement, Digital token Based E-Payment Systems, E-Cash, Risk, Designing E-Payment Systems, Digital Signature, Online Financial Services in India.
6. **E-Supply Chain Management :** Overview, Benefits, Components, Architecture, Major trends.
7. **E-Strategy :** The Virtual Value Chain, Seven Dimensions, Planning the E-Commerce Project, Knowledge Management.
8. **Mobile Commerce :** Growth, Wireless Applications, Origins, Wireless Technologies, Generations, Security Issues, Indian context.
9. **ERP :** Concept, Origin, Evolution & Structure, Best Practices, ERP Vendor Analysis Basic Functional Modules in ERP

Text Books :

1. E-Commerce An Indian Perspective by P.T.Joseph, PHI.
2. Enterprise Resource Planning Theory & Practice by Rahul V.Altekar, PHI.

Reference Books :

1. Introduction to E-Commerce by Rayport & Jaworski, TMP.
2. Frontiers of Electronic Commerce by Kalakota & Whinston, Pearson Education.
3. E-Commerce : Strategy Technologies & Applications by David Whiteley, TMH.

06 1x19 IMAGE PROCESSING & GIS

L-T-P : 3-0-0 **Credit : 3**

1. **Introduction :** Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing – Image Acquisition, Storage, Processing, Communication, Display.
2. **Digital Image Formation :** A Simple Image Model, Geometric Model – Basic Transformation (Translation, Scaling, Rotating), Perspective Projection, Sampling & Quantization – Uniform & Non uniform.
3. **Mathematical Preliminaries :** Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of the Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.
4. **Image Enhancement :** Spatial Domain Method, Frequency domain Method, Contrast Enhancement–Linear & Nonlinear Stretching, Histogram Processing : Smoothing – Image Averaging, Mean Filter, Low-pass Filtering; Image sharpening, High-pass Filtering, High-boost filtering, Derivative Filtering, Homomorphic Filtering, Enhancement in the frequency domain – Low pass filtering, High pass filtering.
5. **Image Restoration :** Degradation Model, discrete Formulation, Algebraic Approach to Restoration –
6. **Unconstrained & constrained :** Constrained Least Square Restoration, Restoration by Homomorphic filtering, Geometric Transformation – Spatial Transformation, Gray Level Interpolation.
7. **Image Segmentation :** Point Detection, Line Detection, Edge detection, combined detection, Edge Linking & Boundary Detection – Local Processing, Global Processing via The Hough Transform; Thresholding –

Foundation, Simple Global Thresh holding Optimal Thresh holding; Region Oriented Segmentation – Basic formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.

8. **An Overview of GIS :** Definition of GIS, Features & Functions, GIS as an Information System, GIS & Cartography, GIS data feeds, Historical development of GIS.
9. **GIS Concepts & Spatial Data Model :** Automated Cartography versus GIS, Database, Remote Sensing, concept of Data model, Raster Data Model, Indexing & Hierarchical Data Structure, Vector Data Model, TIN Data Model.
10. **Remote Sensing :** Concepts, GPS Satellite Signals, GPS data, GPS surveying, GPS error source, Differential GPS Techniques & Concepts, Electromagnetic Spectrum, RS Platforms, Visual Interpretation.

Text & References :

1. Digital Image Processing by Gonzalez R.C. & Woods R.E.; Pearson.
2. Getting Started with GIS by Clarke Keith. C; PE.
3. Fundamental of Digital Image Processing by Jain A.K.; PHI/Pearson.
4. An Introduction to Geographical Information Systems by Heywood, Comelius, Carver, Pearson.
5. Introduction to Geographical Information Systems by Chang, TMH.
6. Concepts & Techniques of GIS by Lo C.P., Albert, Yeung K.W. – PHI

06 1x20 E-CUSTOMER RELATIONSHIP MANAGEMENT

L-T-P : 3-0-0 **Credit : 3**

1. **Introduction :** Business Process Models and Concept of CRM, CRM in E-Business Strategy (E-CRM), CRM's internal & external considerations.
2. **Foundations of Customer-Centric Business :** The importance of Organization, Internal & external processes and your customers, The benefits of keeping things simple.
3. **Preorder Customer Support Issues :** Online Visibility via Search Engines, Real-Time Access to product Information, Inventory Integration, International Business, Shipping and Order Tracking.
4. **Point-of-Order Customer-Support Issues :** Understanding Point-of-Order Issues, ensuring a Smooth Ordering Process, Personalizing the order process, providing an Intuitive site-navigation scheme, providing pricing information, Addressing customer security concerns.
5. **Post-order customer support issues :** Tracking Orders, Problems Resolution.
6. E-CRM Case Study of **Circuitcity.com**
   E-CRM Case Study of **Amazon.com**

Text Book : e-Business Customer Relationship Management Essentials by John W.Gosney and Thomas P.Boehm, PHI.

06 1x21 WEB PROGRAMMING

L-T-P : 3-0-0 **Credit : 3**

1. **Web Programming :** Concept of JDBC (Java Database Connectivity), Working with SQL, Stored Procedure, Security in Java, Class loader, Byte Code Verification, Security Manager and Permission, Digital signatures, Code Signing, encryption.
2. **Introduction to J2EE :** Its advantage, enterprise Architecture Types, Understanding EJB, its architecture, EJB Roles, Benefits and limitations of enterprise Beans, Session Beans : Stateful and Stateless Beans, Entity Beans, Beans Managed Persistence, Container Managed Persistence.
3. **Advanced Web Technology in J2Ee :** Understanding Directory Services and JNDI, Introduction to LDAP, LDAP operation, Working with LDAP Server, Introduction to Web Containers and Web Applications, Introduction to HTTP protocol, Web Application Life Cycle.
4. **Creating Web Application :** Understanding Servlet Programming, its Life-Cycle, Servlet Configuration, Understanding Servlet Sessions, Understanding of JSP and JSTL, JSP Documents, elements, Tax Extensions, tag Libraries, Validation, Translation, Time mechanism, Translation-time classes, Understanding Java Server Pages Standard Tag Library, Tags in JSTL, Core tag library, XML tag library, Using Internationalization Actions.

5. **Web Application Deployment and Authentication :** Enterprises Application Development Process, Deploying Web Application, Understanding CLASSPATH, Securing Web Applications, Basic authentication with JAXRPC Example, Client Certificate Authentication over HTTP/SSL

Text Books :

1. Java Server Programming J2EE 1.4 Edition Black Book (Dreamtech Press)
2. Core JavaTM Volume II by Cay S.Horstmann & Gary Comell (Pearson)

Reference Book : J2EE 1.4 Bible by McGovern (Wiley India)

06 1x22 MANAGEMENT INFORMATION SYSTEM

L-T-P : 3-0-0 Credit : 3

1. **Strategic View of Management Information System : Introduction to MIS :** Concept, definition, role, Impact etc., E-business Enterprise : Introduction, E-business, E-commerce, E-communication, e-collaboration, **Strategic Management of Business :** Corporate Planning, Strategic Planning, Development of Business Strategies, Types of Strategies, Short-Range Planning, MIS : Business Planning, Information Security Challenges in E-enterprises.
2. **Basics of Management Information Systems : Decision Making :** Concepts, Process, behavioural concepts, Organisational Decision Making, MIS and Decision Making Concepts,
   Information : Concepts, Classification, Methods of Collection, Value, Knowledge.
   Systems : Concepts, Control, Types, handling Complexity, Classes, General Model of MIS, Implementation Problems, MIS and System Concept.
   System Analysis & Design : Introduction, Need, System Development Model, Structured System Analysis & Design, Computer System Design, MIS and System Analysis.
   Development of MIS : Long Range Plans, Class of Information, Information Requirement, Implementation of MIS, Quality in the MIS, Organisation for development of the MIS, MIS : Development Process Model
   Business Process Re-Engineering : Business Process, Process Model, Value Stream Model, Relevance of IT, MIS and BPR.
3. **Applications of Management Information System to E-Business.**
4. **Application of MIS :** Application in Manufacturing Sector. Applications in Service Sector, Decision Support Systems, Enterprise Management Systems.
5. **Case Studies :** Tata Home Finance Ltd. and Engineering Product Limited.

Text Book : Management Information Systems by W. S. Jawadekar, TMH.

Reference Books :

1. Management Information Systems, Managing the digital firm by Laudon & Laudon, Pearson.
2. Management Information System by s. Sadagopan, PHI.

06 1x23 MINOR PROJECT

L-T-P : 0-0-3 Credit : 2

06 1x24 PROJECT – I

L-T-P : 0-0-6 Credit : 4

06 1x25 PROJECT – II

L-T-P : 0-0-9 Credit : 6

06 1x26 INDUSTRIAL TRAINING

L-T-P : 0-0-3 Credit : 2

Students need to do a project work which may be a continuation of the project work done in previous Semester.

DEPARTMENT OF MECHANICAL ENGINEERING

02 1x01 ELEMENTS OF MECHANICAL ENGINEERING

L-T-P : 3-0-2 **Credit : 4**

1 **ENERGY RESOURCES :** Renewable or non-conventional sources of energy, their origin forms – solar, wind, biogas and biomass energy, their merits & demerits, major applications. – Brief description. **Lecture : 4**
Non-renewable or conventional sources of energy, the fossil fuel, coal, petroleum and natural gas. **Lecture : 2**

2. **REVIEW OF BASIC CONCEPTS OF THERMODYNAMICS :** Thermodynamics system, properties, state, processes and cycles, Heat, work and internal energy. **Lecture : 4**
3. **STEAM GENERATORS :** Types of boilers, water-tube and fire-tube boilers – their merits and demerits, boiler mountings and accessories – simple description. **Lecture : 6**
4. **PRIME MOVERS:** Simple steam turbine, gas-turbine, IC engines (SI and CI), their brief description and principles of working. **Lecture : 8**
5. **POWER PLANT :** Principles of working of thermal, hydel and nuclear power plants, work output and efficiency. **Lecture : 6**
6. **BASIC CONCEPT OF REF. AND AIR CONDITIONING :** Principles of working of vapour compression, vapour absorption and air refrigeration; Principles of air conditioning systems. **Lecture : 6**
7. **ENGINEERING MATERIALS AND THEIR PROPERTIES :** Ferrous and non-ferrous metals : Mechanical properties e.g. strength, hardness, resilience etc. **Lecture : 4**
8. **HEAT TREATMENT OF STEEL :** Annealing, tempering, quenching, case-hardening etc. **Lecture : 2**

Text Book :

(1) Basic Mechanical Engineering by TJ Prabhu, V. Jaiganesh by Scitech.

02 1x02 ENGINEERING GRAPHICS

L-T-P : 2-0-4 **Credit : 5**

1. **Introduction**, drawing instruments, sheet layout, lines, lettering, dimensioning, engineering curves (ellipse, parabola, hyperbola, spiral). **Lecture : 3**
2. **Orthographic projection :** Projection of points, projection of straight line. **Lecture : 3**
3. **Projection of planes.** **Lecture : 2**
4. **Projection of solids** (Prism, Pyramid, Cone, Cylinder) Axis inclined to one reference plane. **Lecture : 3**
5. **Section of solid** (Prism, Pyramid, Cone, Cylinder) Axis inclined to one reference plane. **Lecture : 3**
6. **Development of surface.** **Lecture : 3**
7. **Intersection of surfaces :** Axes of both solids at right angles. **Lecture : 2**
8. **Isometric projection.** **Lecture : 3**
9. **Conversion** of pictorial view into orthographic view : Simple cases. **Lecture : 4**
10. **Introduction** to computer aided drawing. **Lecture : 2**

Practical

Understanding the AutoCAD windows and the drafting tools, drawing 2D objects.

Text Book :

1. Engineering Drawing by ND Bhatt
2. Engineering Drawing by KL Narayna & P. Kannaiah.

02 1x03 WORKSHOP

L-T-P : 0-0-6 **Credit : 4**

1. **Black smithy shop :** Introduction, Study & use of smithy forging tools, anvil, swage block, chisels, punches, hammers, sledge hammer, study of air blower M/c & sheering M/c
   Job making – (i) Eye Nail & Ring **Lecture : 7**
2. **Carpentry shop :** Introduction, study & use of various tools like cutting tools, planning tools, striking tools, drilling and boring tools, holding tools etc., Study of wood turning lather machine,
   Job making – (i) Half lap joint (ii) dovetail joint (iii) file handle **Lecture : 7**

3. **Fitting shop :** Introduction, study & use of different tools, cutting tools, marking tools, drill bit, die & tap & types of files
   Job making – (i) Matching gauge (ii) Chipping & filing. **Lecture : 7**
4. **Foundry shop :** Introduction, study & use of cupola furnace, various tools, pattern making moulding boxes.
   Job making – (i) Stuffing gland box (ii) Vee block. **Lecture : 7**

Text Book/Reference Book :

1. Workshop technology by Hazra Chaudhary
2. Workshop technology by Raghubansi
3. Manual on workshop Practice by Kannaiah
4. Workshop manual by Kannaiah

02 1x04 WORKSHOP PRACTICE – II

L-T-P : 0-0-6 **Credit : 4**

1. **Machine shop :** Introduction, study and use of lather machine, shaper machine including operations, holding devices and materials for cutting tools.
   Job making – (i) taper Stud (ii) angle block
2. **Welding shop :** Introduction, study and use of welding tools and devices, Study of electric arc welding machine.
   Job making – (i) Lab Joint (ii) Other joints
3. **Sheet Metal shop :** Introduction, study and use of various tools, soldering and brazing.
   Job making – Conical Funnel

02 1305 MATERIAL SCIENCE

L-T-P : 3-1-0 **Credit : 4**

1. Classification and application of engineering materials, recent development in metallic material – cermets. **Lecture : 4**
2. Phase rule, phase diagram, binary system, binary eutectic systems, eutectoid and peritectic reaction, The iron carbon system, the iron – iron carbide phase diagram. **Lecture : 10**
3. Phase transformation in metals – Isothermal transformation diagrams (or Time-Temperature-Transformation plots), Martensite, Continuous cooling transformation diagram – annealing, Normalizing, Tempered Martensite. **Lecture : 10**
4. Cast iron – grey cast iron, ductile (nodular) cast iron, white cast iron, malleable cast iron. **Lecture : 8**
5. Composite materials – Influence of fiber orientation and concentration, Continuous and aligned fiber composites, Tensile stress – strain behaviour – Longitudinal loading, Elastic behaviour – Longitudinal loading, Elastic behaviour – Transverse loading, Whiskers, Glass fiber – reinforced polymer (GFRP) composites. **Lecture : 10**

Text Book :

Material Science and Engineering : An Introduction by William D Callistor, Jr (Wiley India Edition)

02 1306 STRENGTH OF MATERIAL

L-T-P : 3-0-3 **Credit : 5**

1. **Introduction and fundamental concept :** Introduction, purpose & scope of the subject, basic assumption, types of forces (external & internal forces), classification of materials, st. venant's principles, principle of super position, generalized hook's law for isotropic & elastic material. Simple stresses & strain – Axial loads – safety concepts : general concepts; stress analysis of axially loaded base : axial strains and deformation in bars : Strains and deformation axially loaded bars – stress – strain relationship – Possion's ratio, analysis of bars of varying sections. Composite bars, thermal stresses, Relationship between elastic constants. **Lecture : 13**
2. **Torsion :** Torsion stress and deformation in circular member, design of circular member in torsion. **Lecture : 4**
3. **Shear force and bending moment diagram** of the transverse section of the beam. **Lecture : 4**

4. **Deflection of beams :** Deflection of integration, deflection by moments – area method.
Lecture : 5

5. **Two dimensional stress analysis :** Plane stress components on general plane at a point, Mohr's circle of stress. **Lecture : 5**

6. **Introduction to advance mechanics of solid :** thin cylinder, thick cylinder – radial and hoop stresses, application of compound stress theories, elastic strain energy and its application : Elastic strain energy of a rod under various kinds of loading elastic strain energy for various states of stress. Simple application, Castiglione theorem. **Lecture : 11**

Text Books :

(1) Strength of material by GH Ry der
(2) Mechanics of solids by Kazimi
(3) Mechanics of solids by LS Srinath
(4) Mechanics of solids by Singh & Jha

Reference Books :

(1) Mechanics of solids by Timoshinko & Gere
(2) Mechanics of solids by Popov

02 1307 THERMODYNAMICS

L-T-P : 3-1-0 **Credit : 4**

1. **Basic concept :** Thermodynamic system and their properties, thermodynamic equilibrium, quasi-static and non quasi-static process, zeroth law and temperature equilibrium concepts.
Lecture : 3

2. **First law of thermodynamics :** concept of heat and work, first law applied to closed and open system, internal energy and enthalpy, flow work, laws of perfect gas, specific heat, first law applied to flow & non flow process.
Lecture : 5

3. **Second law of thermodynamics :** concept of heat engine, refrigerator, heat pump and their range of working temperature, Kelvin-planck's and claussius' statements and their equivalence, Entropy, calculation of entropy change for processes, reversibility, entropy principles, in equality of claussius, available and unavailable energy.
Lecture : 8

4. **Properties of pure substances :** Properties of steam and process with steam, Use of steam tables and mollier charts. **Lecture : 4**

5. **Helmhotz and Hibb's function**, Maxwell's relation. **Lecture : 3**

6. **Ideal cycles :** Air standard cycles, Otto, Diesel, Dual and Brayton cycle, Comparison of Otto, Diesel and Dual cycle. **Lecture : 6**

7. **Vapour cycle :** Carnot and Rankine cycle, Regenerative and reheat cycle. **Lecture : 6**

8. **Non reacting mixture :** Mixture of two ideal gases and their properties. **Lecture : 2**

9. **Psychometry :** Air and water-vapour mixture and their properties, adiabatic saturation, Use of psychrometry charts, Simple introduction to psychrometric process. **Lecture : 5**

Text Book/reference Book :

(1) Engineering Thermodynamics by PK Nag
(2) An introduction to thermodynamics by YVC Rao
(3) Fundamental of thermodynamics by Van wylem, Wiley India
(4) Thermodynamics by Cengel

02 1x08 KINEMATICS OF MACHINERY

L-T-P : 3-0-0 **Credit : 3**

1. **Velocity and acceleration in mechanism :**
   - Relative velocity method and instantaneous center method
   - Acceleration diagram : Coriolis component of acceleration. **Lecture : 8**

2. **Friction devices :**

- Belt drive
- Clutch
- Shoe brakes
- Bank and block brakes. **Lecture : 7**

3. **Fundamental law of gearing**, basic terminology of gears, arc of contact and path of contact of involute gears, minimum number of teeth on the pinion to avoid interference, Gear trains-simple, compound and planetary, tooth load and torque. **Lecture : 10**
4. **Balancing :** balancing of evolving masses in the same plane by a single revolving mass – Balancing of revolving masses in different planes by two revolving masses in suitable planes. **Lecture : 7**
5. **Governors :** Watt, Porter, Proel & hartnell Governors, Effect of friction, controlling force, governor effort and power, sensitivity and isochronisms. **Lecture : 10**

Text Books :

(1) Theory of Machine by Thomas Bevan
(2) Theory of Machine by RS Bansal
(3) Theory of Machine by Sadhu Singh

02 1x09 MANUFACTURING BY SHAPING AND JOINING

L-T-P : 3-0-3 **Credit : 5**

1. **Casting :** Principles of pattern making, allowances in patterns and core boxes, sand mould casting, constituents and properties of moulding sand and their tests, types of sand moulds, method and principles of gating, risering, use of cores and chills, cleaning of casting, defects in castings and their remedies, sand mould machines, melting and casting practices relating to cast iron, steel, aluminium and its allays, copper and its alloys. Cupola, crucible and electric furnaces, metal mould casting, gravity casting, die casting, centrifugal casting, non-metallic mould casting-shell mould casting, Investment casting, plaster of paris mould casting. **Lecture : 12**
2. **Mechanical working of metals :** Hot and cold working of metals, their comparison and limitation, Hot working process – forging, roll forging, rolling piercing, extrusion, cold working processes – rolling, spinning, roll forming, cold heating, swaging, thread rolling, tube and wire drawing, coining, embossing, tube rolling. **Lecture : 8**
3. **Power metallurgy :** Principles, method of producing power, pressing, sintering and finishing operation, applications. **Lecture : 4**
4. **Welding, Brazing and Soldering :** Comparison of the processes and their application, welding classification, Gas welding equipment, filler metal and fluxes, classification, oxy-acytelene welding – their applications. Electric arc welding – equipment, electrodes and fluxes, classification, carbon arc welding, shielded metal arc welding, submerged arc welding. Inert gas shielded arc welding. atomic – hydrogen welding – their application, new welding and laser beam welding, plastic welding, thermit welding, welding of cast iron, Aluminium and its alloys, copper and its alloys, Testing of weld destructive and non-destructive tests. Flange cutting, soldering – fluxes solder, equipments, type and applications. Brazing and braze welding fluxes, filler metals, types and application. **Lecture : 12**
5. **manufacturing of plastic components :** Plastic and its past, present and future uses, injection moulding, Extrusion of plastic section, welding of plastics, Future of plastic & its application. **Lecture : 6**

Text Books :

1. Production technology by RK Jain
2. Manufacturing technology by PN Rao

02 1x10 FLUID MACHINERY

L-T-P : 3-0-3 **Credit : 5**

1. Introduction – classification of fluid machinery. **Lecture : 1**
2. **Dynamic action of fluid jet** – Impact of fluid jet on fixed and moving flat places, impact of jet on fixed and moving curved vanes, flow over radial vanes, jet propulsions. **Lecture : 4**
3. **Euler's fundamental equation**, degree of reaction. **Lecture : 2**

4. **Hydraulic turbines, introduction**, classification, impulse turbine, construction details, velocity triangles, power and efficiency calculations, reaction turbines; constructional details, working principle, velocity triangles, power and efficiency calculations, draft tube, cavitation, governing. **Lecture : 10**
5. **Principle of similarity in fluid machinery**; unit and specific quantities, testing models and selection of hydraulic turbines. **Lecture : 3**
6. **Positive displacement pumps :** Reciprocating pump; working principle, classification, slip, indicator diagram, effect of friction and acceleration, theory of air vessel, performance characteristics gas gear oil pump and screw pump. **Lecture : 4**
7. **Rotodynamic pumps :** Introduction, classification, centrifugal pump; main components, working principle velocity triangle, effect of shape of blade specific speed, heats, power and efficiency, calculations minimum steering speed, multi stage pumps, performance characteristic, comparison with reprobating pump. **Lecture : 7**
8. **Air compressor :** Reciprocating compressor, introduction, P-V diagram, calculation of isothermal and adiabatic work and efficiency, free air delivery, slippage, volumetric efficiency, effect of clearance, multistage compression, inter cooling. **Lecture : 5**
9. **Rotary compressor :** Introduction fans, blower and compressor, state and total head, centrifugal compressor, velocity triangles, slip factor, losses and efficiencies, performance characteristic. **Lecture : 6**

Text Books :

1. Hydrantic Machine by Jagdish Lal
2. Hydraulics & Hydraulic Machines by Vasandari
3. Hydrantic Machine by RD Purohit

02 1x11 MACHINE DRAWING

L-T-P : 1-0-3 **Credit : 3**

1. **Introduction to full section**, Half section, revolved-section off-set section. **Lecture : 2**
2. **Nut Bolts**, Riveted joints, Thread profiles, Screw jack. **Lecture : 3**
3. **Bushed bearing**, pedestal, bearing, foot step bearing. **Lecture : 2**
4. **Flanged coupling**, flexible coupling, solid coupling. **Lecture : 2**
5. **Stuffing Box.** **Lecture : 1**
6. **Eccentric.** **Lecture : 1**
7. **Cross Head.** **Lecture : 1**
8. **Assembly of dissembled parts.** **Lecture : 1**
9. **Dissembly of assembly parts.** **Lecture : 1**

Text Books :

1. Engineering Drawing by ND Bhatt
2. Engineering Drawing by KL Narayna & Kannaiah

02 1x12 STEAM POWER SYSTEM

L-T-P : 3-0-3 **Credit : 5**

1. **Analysis of steam power cycle,** Reheat pressure and degree of regeneration process heat & power generation. **Lecture : 3**
2. **Boilers :** Classification, boiler mounting & accessories, draft system, chimney height calculation, induced & forced draft fans, Boiler energy balance. Constructional details of boiler furnace, waterwall, Pulverized fuel burning. Different types of furnaces for burning coal, fuel oil & gas. Circulation theory. Feed water treatments. **Lecture : 14**
3. **Steam nozzles :** Flow through nozzles shapes & flow area, Effect of friction supersaturated flow, Estimation of flow area, Effect of divergence. **Lecture : 5**
4. **Steam turbines :** Construction & working of steam turbines, Impulse & reaction inlet & outlet velocity diagram. Work output & efficiencies. Pressure & velocity compounding regenerative feed heating cycle reheat cycle, reheat factor, governing of turbine, back pressure & pass out turbine. **Lecture : 12**
5. **Steam condenses :** Types, cooling water requirement, air leakage & air pump capacity, vacuum & condenser, efficiency steam ejector, spray pond 7 cooling tower. **Lecture : 6**

6. **Instrumentation** in steam turbine plan. **Lecture : 2**

Text Books :

1. Thermal engineering by CP Gupta & R Prasad
2. Steam turbine theory & practice by WB Keaton
3. Heat Engines (Vol II) by R Yadav
4. Power Plant Engineering by PK Nag

02 1x13 DYNAMICS OF MACHINERY

L-T-P : 3-0-3 **Credit : 5**

1. **Force analysis of mechanism :** Dynamics of plane motion of a rigid body, dynamically equivalent two mass system, correction torque, forced in mechanism and machines. **Lecture : 3**
2. **Turning moment diagram :** Fluctuations of crankshaft speed and energy in a direct acting engine mechanism, flywheels. **Lecture : 3**
3. **Cams :** Classification of cams and followers, types of follower and retardation, cam profile and generation of concentric and offset radial cam profiles by graphical method. cams with specified contours tangent cam with roller follower, circular arc cam with flat follower. **Lecture : 8**
4. **Analysis of gyroscopic motion :** Principle of gyroscope, gyroscopic couple and gyroscopic reaction couple, Gyroscopic effects on the movement of ships, aeroplanes, two wheeled and four wheeled vehicles, gyrostabilizers. **Lecture : 7**
5. **Effects of inertia of reciprocating masses on engine frame :** Unbalanced primary and secondary forces and couples, balancing of primary and secondary forces, partial balancing of locomotives, balancing of multicylinder in line and radial engines, direct and reverse cranks methods for balancing of radial engines. **Lecture : 9**
6. **Mechanical vibrations :** Basic concepts degree of freedom, types of damping and viscous damping; natural free, damped free and damped forced vibrations of a single degree of freedom spring mass system, reciprocating and rotating unbalance, vibration isolation and transmissibility, whirling of shaft, elementary treatment of two degree of freedom systems torsional vibrations of single rotor and two rotor systems, transverse vibration of simply supported beam energy method, Rayleigh's and Dankerley method. **Lecture : 12**

Text Books :

1. theory of machines by Thomas Bevan
2. Theory of machines by Shah and Jadhwani
3. Mechanical Vibration by William Thompson

02 1x14 MACHINE TOOLS AND MACHINERY

L-T-P : 3-0-3 **Credit : 5**

1. **Metal cutting and Machine Tools :** Metal cutting : Mechanics of metal cutting, Geometry of tool and nomenclature, Tool materials, Orthogonal vs oblique cutting. Mechanics of chip formations, types of chips, tools angles, shear angle, Merchant's force circle diagram, Cutting forces, power required, Cutting fluids/lubricants, Tools wear and tool life. **Lecture : 12**
2. **Machine Tools :**
   (a) Lathe : Principle, types, operations, turret/capstan, semi/automatic, Tool layout.
   (b) Shaper, slotted, planer, operation, drive.
   (c) Milling, Milling cutter, up & down milling, dividing head indexing, Max chip thickness, power required.
   (d) Drilling and boring, reaming tools, Geometry of twist drill, Grinding, Grinding wheel, Abrasive, cutting action, grinding wheel specification, Grinding wheel wear, alterations, wear, fracture wear, dressing and trimming. Max chip thickness and guest criteria, Flat and cylindrical grinding, Centreless grinding, Super finishing, Honing lapping, Polishing. **Lecture : 12**
3. **Computer controlled manufacturing process :** NC, CNC, DNC, part programming, Introduction to computer aided manufacturing and robotics. **Lecture : 10**
4. **Metrology :** Tolerance and limit systems, limit gauges, Measurement of surface roughness, Inspection of gears and screw threads. **Lecture : 4**
5. **Jigs and Fixtures :** Locating elements, clamping devices, principles of Jigs and fixtures design.

Lecture : 4

Text Books :

1.Manufacturing technology by PN Rao

2. Production technology by RK Jain

02 1x15 DESIGN OF MACHINE ELEMENTS

L-T-P : 3-0-3 **Credit : 5**

1. **Introduction :** Engineering material and their properties, Manufacturing consideration in machine design, factor of safety. **Lecture : 4**
2. **Simple stresses in machine parts**, torsional and bending stresses, dynamic loads, stress concentration. **Lecture : 4**
3. **Design of riveted joints**, welded joints, bolted joint, cotter joint, knuckle joint, pressure vessels and pipe joints. **Lecture : 12**
4. **Design of keys**, couplings, shafts levers, columns, studs, power screw, belt drive, pulley **Lecture : 14**
5. **Springs**, clutches and brakes. **Lecture : 8**

Practical : Minimum six design problems pertaining to theory paper syllabus.

Text Books :

1. Design of machine elements by VB Bhandari (TMH)
2. Design of machine elements by Sharma & Purohit (PHI)
3. Design data book by Mahadevan
4. Design data book by PSG institute of technology, Coimbatore
5. Design data book by Suresh Verma, Jadon

Reference Books :

1. Mechanical Engineering Design by Shigley
2. Machine Design by Black & Adams
3. Machine Design by Maleev & Hartman
4. Machine design by Sharma & Agarwal (SK Kataria)

02 1x16 HEAT AND MASS TRANSFER

L-T-P : 3-0-3 **Credit : 5**

1. **Introduction :** Basic concepts and modes of heat transfer. **Lecture : 1**
2. **Conduction :** General three dimensional heat conduction equation; one dimensional steady heat conduction through composite plane walls; cylinders and spheres; critical radius of insulation. **Lecture : 6**
3. **Extended surface :** Heat transfer from extended surfaces of uniform cross section. **Lecture : 4**
4. **unsteady heat conduction :** one dimensional unsteady heat conduction, lumped system analysis; use of Heisler chart, periodic changes of surface temperature. **Lecture : 6**
5. **Convection :** Free and forced convection, hydrodynamic and thermal boundary layer equation over flat plate, laminar boundary layer analysis, fully developed heat transfer through smooth pipes, relation between fluid friction and heat transfer forced convection correlations, laminar free convection on a vertical flat plate, empirical co-relations, application of dimensional analysis. **Lecture : 10**
6. **Heat exchange :** Types, LMTD, effectiveness, NTU method, single and multipass. **Lecture : 5**
7. **Radiation :** Physical mechanism, radiation properties, black body radiation, grey body, kirchoff's law, Wien's displacement law, view factor, radiation exchange between infinite planes, radiation shields. **Lecture : 6**
8. **Mass transfer :** Fick's law, analogy between heat and mass transfer, equimolal counter diffusion, isothermal evaporation of water through stagnant air. **Lecture : 4**

Text Books :

1. Heat and mass transfer by Cengel
2. Heat and mass transfer by JP Holman
3. Heat transfer by SP Sukhatme

4. Heat and Mass Transfer Data Book by CP Kothandaraman

Reference Books :

1. Heat and mass transfer by PK Nag
2. Heat and mass transfer by Incorpera Dewit
3. Heat transfer by PS Ghosdastidar

02 1x17 NON CONVENTIONAL MANUFACTURING

L-T-P : 3-1-0 **Credit : 4**

1. **Introduction :** Limitation of conventional manufacturing processes, need of unconventional manufacturing process and its classification. **Lecture : 2**
2. **Unconventional machining process :** Principle and working and applications of unconventional machining process such as electro – discharge machining, electrochemical machining, ultrasonic machining, abrasive jet machining etc. **Lecture : 12**
3. **Unconventional welding process :** Principle and working and applications of unconventional welding processes such as laser beam welding, electron beam welding, ultrasonic welding, plasma arc welding. **Lecture : 12**
4. **Explosive welding**, cladding etc. under water welding, metallising. **Lecture : 4**
5. **Unconventional forming processes**, principle, working and applications of high energy forming processes such as explosive forming, electromagnetic forming, electro-discharge forming, water hammer forming, explosive compaction etc. **Lecture : 12**

Text Books :

1. Manufacturing Technology by P.N.Rao
2. Production Technology by R.K.Jain

02 1x18 COMPETITIVE MANUFACTURING STRATEGIES

L–T–P: 3–1–0 **Credit : 4**

1. **The competitive environment in the market :** The WTO agreement and its effect on Indian Industries, Manufacturing as a competitive strategy, Competitive Advantages and Disadvantages. **Lecture : 6**
2. **Product Variety :** Modular Design, Design for manufacturability, Selection of manufacturing Technologies, Vendor Development, Vendor rating, Just in time manufacturing, Kanban system, and Agile Manufacturing. **Lecture : 8**
3. **Reengineering :** TQM, MRP, ERP and simulation as tools for competitive manufacturing, Intelligent Manufacturing. **Lecture : 8**
4. **Selection of manufacturing systems for different manufacturing scenarios :** Dedicated manufacturing system, Flexible manufacturing system (FMS), cellular manufacturing system (CMS), and Re-configurable manufacturing system (RMS); Elementary of DMS, FMS, CMS, and RMS. **Lecture : 14**
5. **Concept :** of CIM, FOF, Network based manufacturing, and E-Manufacturing. **Lecture : 5**

Text Books :

1. Manufacturing Excellence in Global Markets by W. Euershelm
2. Manufacturing Systems Design & Analysis by B. Wa.
3. Computer Automation in Manufacturing by T.O.Boucher
4. Intelligent Manufacturing Planning by P. Gu.

02 1x19 INSTRUMENTATION AND MEASUREMENT

L–T–P: 3–1–0 **Credit: 4**

1. **Functional elements of a basic measuring system,** configuration of a measuring system, Methods for correction for interfering and modifying inputs. **Lecture : 6**
2. **Static characteristics like accuracy**, precision, error sensitivity etc. Dynamic characteristics terms, Concepts of mechanical loading, order of the systems, Response of zero, First and second order systems to step, ramp and sinusoidal inputs, transfer function method. **Lecture : 8**
3. **Classification of errors** and statistical analysis of experimental data. **Lecture : 4**

4. **Description of various types of transduction principles**, transducers based on variable resistance, variable induction, variable capacitance and piezo-electric effects, Displacement transducer. **Lecture : 10**
5. **Microprocessor systems**, codes, Binary mathematics, Logic circuits. **Lecture : 6**
6. **Data acquisition systems**, via-computers DAS hardware. **Lecture : 4**
7. **Techniques for signal analysis.** **Lecture : 4**

Text Book: As recommended in class.

02 1x20 REFRIGERATION & AIR CONDITIONING

L–T–P: 3–1–0 **Credit : 5**

1. **Air refrigeration system :** Refrigeration machine, heat pump, coefficient of performance, ideal refrigeration cycle, Bell – Coleman, refrigeration cycle, open and closed systems, application of air- refrigeration in air-crafts. **Lecture : 6**
2. **Various compression systems :** Simple vapour compression refrigeration cycle, merits and demerits of this system over air refrigeration system, factors affecting the performance of a vapour compression refrigeration system, sub cooling and superheating of vapour, wet and dry compression, multistage vapour compression system, intercooler, flash chamber, accumulator and heat exchanger. **Lecture : 8**
3. **Vapour absorption system :** Simple and modified vapour absorption refrigeration system, Electrolux refrigerator, COP of heat operated refrigeration system. **Lecture : 5**
4. **Special refrigeration system**, absorption, cascade, vortex, thermoelectric and steam jet refrigeration system. **Lecture : 4**
5. **Refrigerants :** classification and nomenclature of refrigerants, primary and secondary refrigerants, properties of some common refrigerants, physical, chemical and thermodynamics properties, selection of refrigerants, leakage of refrigerants and methods of detection. **Lecture : 3**
6. **Equipment :** Elementary discussion of refrigerating equipment, ice plant and cold storage. **Lecture : 1**
7. **Psychometry :** Properties of air vapour mixture, wet bulb, dew point & dry bulb temperatures, humidity, specific humidity, humidity ratio, degree of saturation, relative humidity, total heat psychrometric relation, psychometric charts and its uses, psychometric processes evaporative cooling. **Lecture : 5**
8. **Air conditioning :** General principle and requirement for comfort and air conditioning, thermodynamics of human body, estimation of heating and cooling loads, capacity of cooling coils, humidification and dehumidification unit and conditioner, central air conditioner, year around air condition, humidity and temperature control, industrial application of air conditioning system **Lecture : 10**

Text Book:

1. Refrigeration and air conditioning by C P Arora
2. Refrigeration and air conditioning by Manohar Prasad
3. Refrigeration and air conditioning by Jordon & Priester

Reference Book:

1. Refrigeration and air conditioning by Domkundwar
2. Refrigeration by Stoecker

02 1x21 MECHANICAL SYSTEM DESIGN

L–T–P: 3–1–3 **Credit : 5**

Design and IC Engine parts

1. Cylinder, trunk position, connecting rod, crank shaft, value gear. **Lecture : 15**
2. Design of centrifugal pump. **Lecture : 06**
3. Design of fly wheel. **Lecture : 02**
4. Design of hydraulic press. **Lecture : 02**
5. Bearing types, selection, design of journal, ball and roller bearing. **Lecture : 05**
6. Design of gears (spar and helical) & gear boxes. **Lecture : 07**
7. Chain drive and brackets. **Lecture : 05**

Text Book:

1. IC Engine by Maleev

2. Machine design by Maleev & Hartman
3. Design of M/C elements by V B Bhandari
4. Design of M/C elements by Sharma & Purohit
5. Design data book by PSG institute of Technology
6. Design data book by Kale
7. Machine design data book by Jordon, Suresh Verma

Reference Book:

1. Mechanical Engg. Design by Shigely
2. Machine Design by Black & Adams

02 1x22 INTERNAL COMBUSTION ENGINE AND GAS TURBINE

L–T–P: 3–0–3 **Credit : 5**

1. **Introduction :** classification : Two strokes, four stroke (SI and CI) engines, engines parts, engines working principle and valve timing diagram. **Lecture : 3**
2. **Engine performance-test :** purpose and types, measurement of power, Engine system & performance parameters evaluation. **Lecture : 3**
3. **Theory of combustion**, principle of combustion, S.I. & C. I. Engine combustion process & parameters their dependence on engine variables and operating parameters. **Lecture : 3**
4. **Adiabatic flame temperature**, combustion processes & combustion chamber for SI and CI engines pollutant formation and control, effect of engine variables on combustion processes, knowing in SI & CI engines. **Lecture : 5**
5. **Petroleum based fuel**, gasoline & diesel fuel and their properties. Chemically correct air-fuel ratio and load variation. **Lecture : 3**
6. **Carburetors & modern air fuel systems**, compensating devices, venture and jet dimension calculation, injection system. **Lecture : 6**
7. **Super charging**, engine lubrication and cooling. **Lecture : 2**
8. **Gas turbine :** Principle. Simple, open gas turbine cycle, effect of operating variables on thermal efficiency. **Lecture : 5**
9. **Regenerative reheat cycles**, gas turbine applications, closed cycle gas turbine. **Lecture : 5**
10. **Jet propulsion :** working principle, thrust power, propulsive force and efficiency. **Lecture : 4**
11. **Rocket engine :** theory of operation and its applications, propellant. **Lecture : 3**

Text Book:

1. Internal Combustion Engines by V Ganesan (Tata McGraw-Hill)
2. Internal Combustion Engines by Arcoumaris (Academic Press)
3. Internal Combustion Engines - Fundamentals by Heywood
4. Internal Combustion Engines by Theory and Practical – Taylor CF
5. Gas Turbine Theory by Cohen and Rogers
6. Fundamental of Gas Turbine by Bathie WW
7. Gas Turbine by V Ganesan (Tata McGraw-Hill)

02 1x23 OPERATION RESEARCH

L-T-P: 3-1-0 **Credit : 4**

1. Scope and application of operation research. **Lecture : 2**
2. Linear programming, graphical and simplex method. **Lecture : 4**
3. Transportation and assignment models. **Lecture : 4**
4. Simulation and Monte-Carlo techniques. **Lecture : 4**
5. Queuing theory (single and double channel). **Lecture : 4**
6. CPM and PERT and CPM-crashing networks. **Lecture : 4**
7. Dynamic programming. Sequencing model (n jobs-2 machines), Replacement problems and Reliability theory, Inventory models with probabilistic demands and area, quantity constraints, Game theory (competitive strategies). **Lecture : 12**

8. Non-Linear Programming (Kuhn and Tucker condition). **Lecture : 4**

Text Book : As recommended in class.

02 1x24 AUTOMOTIVE MECHANICS

L-T-P: 3-1-0 **Credit : 4**

1. **Description of power unit :** Fuel supply system and engine lubrication. **Lecture : 6**

2. **Transmission requirements**, Fluid and automatic transmission system along with their performance requirements, tractive resistance. **Lecture : 5**

3. **Different types of steering systems** and performance requirements, Stability of vehicles on level road and curve path. **Lecture : 4**

4. **General braking requirements**, weight transfer during braking, different types of brakes. **Lecture : 5**

5. **General consideration of strength** and stiffness of vehicle frame, various suspension systems, shock absorber and engine mountage, Tyre pavement interaction forces, tyre wear & SAE terminology. **Lecture : 6**

6. **Various types of ignition systems with wiring diagram** **Lecture : 4**

7. **Testing of vehicles and handling characteristics**. **Lecture : 4**

8. **Preventive maintenance**, trouble shooting & tuning of power unit **Lecture : 4**

9. **Pollution due to vehicles emission**, Effect of design and operating condition on pollution. **Lecture : 4**

Text Book:

1. Automative Mechanics by Crouse
2. Automobile Engineering by KM Gupta

Reference Books:

1. Automobile Engineering by Newton & Steeds

02 1x25 EXPERIMENTAL STRESS ANALYSIS

L-T-P:3-1-0 **Credit : 4**

1. **Introduction to the theory of elasticity**, General principles governing the approach to experimental stress analysis techniques, Whole field and point per point information- **Lecture : 10**

2. **Photo elasticity :** Light and optics as related to photo elasticity, Theory of photo elasticity, stress optic relations, model materials, analysis techniques. Three dimensional photo elasticity. **Lecture : 12**

3. **Strain- gauge techniques**, Various type of strain gauges; Electrical resistance, strain gauges and semiconductor gauges. **Lecture : 8**

4. **Parameters influencing the behaviours**, Rosette analysis strain gauge circuits and Recording instruments for static and dynamic applications. **Lecture : 08**

5. **Introduction to digital photo - elasticity.** **Lecture : 08**

Text Book : As recommended in class.

02 1x26 TOTAL PRODUCTIVITY MAINTENANCE & VALUE ENGINEERING

L-T-P- 3-1-0 **Credit : 4**

1. **Work study :** Method Study- flow process charts, motion economy, Threbligs, work measurement- time study, activity sampling, synthesis, analytical estimating and PMTS, advantages an limitations. **Lecture : 10**

2. **Production, Planning and control :** Production planning and production control, functions of PPC, inventory control – EOQ- and buffer stock, Types of production. **Lecture : 10**

3. **TPM :** Introduction to total productivity maintenance productivity- major losses, measurement of overall performance, pillars of TMP , continuous improvements (Kaizen), Safety and Hygiene, preventive maintenance, predictive maintenance and time based maintenance.

4. **Value Engineering :** Definition and concept of VE, Type of value, Cost vs. quality, FAST diagram, phases of VE, general phase, information's phase, junction phase, oration phase, evaluation phase, application and benefits of VE,

Test Books:

1. Production, Planning and inventory control by Mcleavey and Bullington (Prentice Hall)
2. Industrial Engineering by A.P. Verma (SK Kataria & sons)
3. Industrial Engineering hand book by KB Zandin (TMH)

02 1x27 INDUSTRIAL POLLUTION

L-T-P: 3-1-0 **Credit : 4**

1. **Introduction :** Environments and Human activities, Environments and Ecology, Consequences of population growth. Energy problem. **Lecture : 4**
2. **Population of Air**, water and land, Fossil fuel related pollutants in the environment- **Lecture : 4**
3. **Environmental Impacts of Hydro-electric**, Nuclear energy and chemicals forwards a solution. **Lecture : 4**
4. **Air Pollution :** Definitions and scales of concentration, classification and properties of air pollutants, Emission an sources and their classification. Air pollution laws and standards, Inversion Ambient air sampling, stack sampling, sampling system, analysis of air pollutants. Air pollution emission control, selection of a particulate: collector, control of gaseous emission, combustion- **Lecture : 10**
5. **Water Pollution :** Hydrologic cycle and water quality , origin of waste water and its composition, Type of water pollutants and their effects, water pollution laws: and standards, waste water sampling and analysis water quality standard, waste water treatment , Biological systems(Aerobic and Facultative ponds), Recovery of material from process effluents. **Lecture : 8**
6. **Noise pollution :** Different noise environments and their sources, measurement of noise and the equipments Noise pollution lows an, Vibration isolation and noise control in industries. **Lecture : 6**
7. **Solid waste management :** Sources and classification, Public health aspect, effluent treatment processes and solid waste management: sources and classification. Public health aspect, effluent treatment process and solid waste management, “Solid-Solid separation technique for recovery and reuse. **Lecture : 3**
8. **Case study :** Modern environmental assessment method, pollution control in steel plants and coal industries. **Lecture : 3**

Text Book :

1. Managing Industrial Pollution by SC Bhatia
2. Enviromental pollution by HM Dix
3. Chemistry for environmental engineering by SAWYER

02 1x28 HEAT EXCHANGER DESIGN

L-T-P : 3-1-0 **Credit : 4**

1. **Heat exchanger :** Types and construction **Lecture : 3**
2. **Heat and fluid flow** fundamental general design consideration and approaches. **Lecture : 6**
3. **Computer aided design**, cost estimation, optimum design, design of single phase, liquid to liquid, liquid to gas and gas to gas heat exchanges. **Lecture : 10**
4. **Design of steam** generators and condensers. **Lecture : 4**
5. **Design of heat exchangers** for liquid metal and molten salts. **Lecture : 4**
6. **Design cooling tower.** **Lecture : 6**

Text Book :

1. Process heat transfer by Kern
2. Process heat transfer by Dass
3. Heat exchanger design- Ozsik

02 1x29 FINITE ELEMENT METHOD & APPLICATIONS

L-T-P:3-1-0 **Credits : 4**

1. **Introduction to finite Elements Methods**, general descriptions, concept of finite elements: discretization and interpolation function, steps on finite element analysis’ procedure **Lecture : 10**
2. **Calculus of Variation :** Function and functional, euler language equation, Boundary conditions, determinations of functional for plane and axisymmetric elastic problems, **Lecture : 10**
3. **Finite elements :** One , two and three dimensional elements, axisymmrtric elements: generalize local and natural co-ordinate systems, isoprametric, Interpolation function, field variable model for displacement and temperature, Direct, Variational and Galerikan Methods. **Lecture : 10**
4. **Equation of single elements and solutions**, Application to plane and axisymmetric elastic problems, heat conduction, plates and shells problems. **Lecture : 12**

Text Book : As Recommended in class

02 1x30 COMPUTER AIDED DESIGN & MANUFACTURING

L-T-P: 3-0-3 **Credit : 4**

1. **Introduction** concept of CAD/CAM **Lecture : 4**
2. **Computer system**, Hardware in computer – Aided Design system, Product cycle Automation, part programming. **Lecture : 6**
3. **Computer aided design system software**, Transformation, geometric modeling, Drafting applications, **Lecture : 8**
4. **CAD/CAM technology** to finite element data preparation, concept of data structures- **Lecture : 6**
5. **NC, CNC, DNC programming.** L**ecture : 9**
6. **Introduction to AVG. Lecture : 9**

Text Books : As recommended in class

02 1x31 QUALITY ASSURANCE & RELIABILITY

L-T-P: 3-1-0 **Credit : 4**

1. **Probability and statistics** concept and application. **Lecture : 5**
2. **Production tolerance** , tolerance analysis and allocation process capability. **Lecture : 10**
3. **Statistical process control :** Economics of quality control, acceptance sampling, Plans and selection. Taguchi technique, Product reliability, reliability achievement, reliability evaluation, system assessment. **Lecture : 22**
4. **Quality circles ISO :** quality awards- **Lectures : 5**

Text Books :

1. Industrial Engg. And mngt by Dr. OP Khanna
2. Total quality management by S Raju SM
3. Industrial Engg. by AP Verma

02 1x32 ROBOTICS AND ROBOT APPLICATIONS

L-T-P: 3-1-0 **Credit : 4**

1. **History of development of industrial robots**, fields of application and future scope. **Lecture : 7**
2. **Anatomy and structural deigns of robot**, manipulation, arm geometry, drives and control(Hardware) for motions End effectors and grippers, pickups etc. **Lecture : 7**
3. **Matching robots to the working place and conditions :** interlock and sequence control. **Lecture : 7**
4. **Reliability maintenance and safety of robotic systems. Lecture : 4**
5. **Application studies in manufacturing processes**, e.g. casting, welding, painting, machine tools, machining, heat treatment and nuclear power stations etc. **Lecture : 10**
6. **Synthesis and evolution of geometry configurations**, robot economics, educations, educating, programming and control of robots. **Lecture : 7**

Text Book : As recommended in class.

02 1x33 MANUFACTURING PROCESS - I

L-T-P: 3-0-0 **Credit : 3**

1. **CASTING (Foundry) :** Principles of pattern- making, allowances in pattern and core boxes, sand mould casting, constituents and properties of moulding sand and their tests, types of sand moulds, methods and principles of gating, risering, use of cores and chills, cleaning of castings defects in castings and their remedies, sand mould machines, melting and casting practices relating to cast iron, steel, aluminium and its alloys, copper and its alloys. Cupla, crucible and electric furnaces, metal- mould casting, gravity casting die casting, centrifugal casting, Non- metallic mould casting- shell mould casting. Investment casting, Plasters of paris mould casting. **Lecture : 12**
2. **Mechanical working of Metals :** Hot and cold working of metals, their comparison and limitation. Hot working Processes. Rolling, spinning, Roll Forming, cold heading, Thread Rolling, Tube and wire drawing, coining, Embossing, Tube Rolling. **Lecture : 12**

3. **Power Metallurgy :** Principles, method of producing power, pressing, sintering and finishing operation, applications. **Lecture : 6**

4. **Welding, Brazing and Soldering :** Comparison of the processes and their application, welding classification, Gas welding equipment, filler metal and fluxes, classification, oxy- Acetylene welding – their applications, Electric and welding, equipment, Electrodes and fluxes, classification, Classification, Carbon Arc welding, shielded metal are welding, submerged are welding. Inset gas shielded arc welding, Ultrasonic welding,, Electroslag welding Electron beam welding and laser beam welding, plastic welding, Thermit welding, welding of cost iron, Aluminum and its alloys, Copper and its alloys, Testing of weld destructive and non- destructive tests. Flange cutting, soldering- fluxes solder, equipments, type and application. Brazing and braze welding fluxes, Filler metals, Types and application. **Lecture : 12**

Text Book : As referred by Teacher.

02 1x34 MANUFACTURING PROCESS – II

L-T-P : 3-0-3 **Credit : 5**

1. **Metal cutting and Machine Tools :** Metal cutting : Mechanics of metal cutting, Geometry of tool and nomenclature. Tool materials, Orthogonal vs oblique cutting, Mechanics of chip formations, types of chips, tools angles, shear angle, Merchant's force circle diagram. Cutting forces, power required, Cutting fluids/lubricants. Tools wear and tool life.

   Machine Tools :

   a. Lathe : Principle, types, operations, turret/capstan, semi/automatic, Tool layout.
   b. Shaper, slotted, planer, operation, drive.
   c. Milling, Milling cutter, up & down milling, dividing head indexing, Max chip thickness, power required.
   d. Drilling and boring, Drilling, boring, reaming tools, Geometry of twist drill.
   e. Grinding, Grinding wheel, Abrasive, cutting action, grinding wheel specification, Grinding wheel wear, alterations, wear, fracture wear, dressing and triuing. Max chip thickness and guest criteria. Flat and cylindrical grinding. Centreless grinding.
   f. Super finishing, Honing, Lapping, Polishing. **Lecture : 16**

2. **Non-conventional Machining process :** Benefits, application and survey of non-conventional machining process, Mechanics of metal removed, tooling and equipments, process parameters, working & applications of AJM, USM, EDM, ECM, ECG, EBM, LBM, PAM and chemical milling etc. **Lecture : 12**

3. **Metrology :** Tolerance and limit systems, limit gauges, Measurement of surface roughness, Inspection of gears and screw threads, Individual and commutative error measurement. **Lecture : 8**

4. **Jigs and Fixtures :** Locating elements, clamping devices, principles of jigs and fixtures design. **Lecture : 6**

02 1x35 SEMINAR

02 1x36 MINOR PROJECT

02 1x37 INDUSTRIAL TRAINING

02 1x38 CONTROL & MEASUREMENT

L-T-P: 3-0-3 **Credit : 5**

1. **Introduction concept of automatic controls** open loop and closed loop system- servomechanism block diagram transfer functions. **Lecture : 6**

2. **Representations of control component** and systems translational and rotational mechanical components electrical components. Series and parallel combinations comparator for rotational and linear motions integrating devices hydraulic servomotor temperature control, system response speed control system. **Lecture : 6**

3. **System response first and second order systems** response to step pulse ramp and sinusoidal input system with distance velocity lag. **Lecture : 4**

4. **Pressure use of monometers Bourdon gauge**, bellows type gauge, measurements of vacuum and pressure transducer, static and dynamics, response of pressure measuring instruments. **Lecture : 6**

5. **Flow use of obstruction type meters**, Variable and meters, Probes. Positive displacements type meters, How wire anemometry. **Lecture : 4**

6. **Temperature use of thermocouples**, resistance thermometer, pyrometer, thermistors static and dynamics response of temperature measuring instrumentation. Thermocouple errors and compensation. Neat flux measurements and meters. **Lecture : 6**
7. **Strain, use of strain gauge**, static and dynamic response, displacement, velocity, acceleration, Jerk linear and angular, piezoelectric pick /ups . inductive type pic/up. Force, torque, time, frequency and phase angle, use of CRO. Electronic counters, Density and viscosity of gauges and liquids, Calorific value of solid, liquid and gaseous fuels, noise, humidity flow visualization, demonstration of shadow and schlieren technique, introduction to metrology. **Lecture : 10**

Text Book : As referred by teacher:

02 1x39 INDUSTRIAL ENGINEERING & MANAGEMENT

L-T-P : 3-0-3 **Credit : 5**

1. **Material management inventory management**, inventory analysis and control- **Lecture : 3**
2. **Work study method study and work**, Measurement, work sampling, synthesis, analytical estimating predetermined motion and time system- **Lecture : 5**
3. **Production planning and control Batch sixe**, buffer stock, man machine chart, production control progressing feedback control charts. **Lecture : 4**
4. **Quality management SQC**, analysis of variance, OC CURVE, AOQL, PRODUCERS RISK , CONSUMERS RISK, LDPD Sampling plans ISO 9000 Series. **Lecture : 8**
5. **Elementary operation research industrial safety and pollution control :**
   - LPP graphical and simplex method, duality, TP and AP, queuing theory (single channel) **Lecture : 8**
   - Project management, CPM&PERT for small scale industry industry feasibility study, preparation of project report. **Lecture : 4**
   - Industrial safety – accidents, causes and costs, accident prevention , protective equipments **Lecture : 5**
   - Pollution control, air, water and land pollution, noise pollution, preventive, **Lecture : 5**

Text Book :

1. Industrial Engineering by AP Verma
2. Industrial Engineering & Management by Dr. OP Khanna
3. Industrial Engg, & Mgt by Dr. Ravi Shankar

02 1x40 PROJECT

L-T-P : 0-0-15 **Credit : 10**

07 1301 Theory & Practices of Preservation and Pre-Tanning Operations

Preservation of Hides and Skins :

Principles and practice involved in long and short term preservation techniques for hides and skin, Preservation, defects. **Lecture - 5**

Pertaining Processes :

Soaking :- Physico-chemical explanation of wetting, objectives materials, methods and different controls in soaking operation. **Lecture -4**

Liming :- Chemistry of Unhairing, Unhairing by different methods, Objectives of liming, Effects of liming in collagen, controls in liming operation to achieve different physical properties of leather. **Lecture- 6**

Deliming and Drenching :- Objectives, Principles and controls of deliming and drenching. **Lecture- 3**

Bating :- Chemistry of proteolytic enzymes used for bating, Necessity of bating, its necessity and controls for desired properties of leather. **Lecture- 5**

Pickling :- Acid binding capacity of collagen, use of organic acids or salts in pickling, its necessity and controls, concept of De-pickling. **Lecture- 4**

Degreasing :- Objectives and necessity of Degreasing, different degreasing systems and methods. **Lecture- 3**

CLEANER PROCESSING PRACTICES IN BEAM HOUSE

Salt free curing option, Sulfide free unhairing system, ammonia free deliming, salt free pickling system, eco friendly degreasing system, strategies to bring down BOD, COD and TDS of tannery effluents. **Lecture 10**

Suggested Books :-

1. Introduction to the Principles of Leather Manufacture. By – S. S. Dutta, 4th Edition, ILTA, Kolkata.
2. Chemistry & Technology of Leather. By – Roddy, O' Flahorty & Lollar, Vol – 2 &3, Robert E. Kreiger. Publishing Co., N.Y.
3. Theory & Practice of Leather Manufacture. By – K. T. Sarkar, Macmillan India Press, Chennai.
4. Fundamentals of Leather Manufacture. By- Eckent Hidem
5. Chemistry of Tanning Processes. By – K. H. Gustavson, Academic Press, N.Y.

07 1x02 Introduction to Leather Technology

Live stock population, animal mortality and availability of hides and skins in India. **05**

Statistical analysis of leather Industries, Leather, Leather products (National & International Scenario). **12**

Chemical constituents of hides and skins. **05**

General principles involved in raw hide and skin preservation, assortment and their processing, pre tanning, tanning and post tanning operations. **15**

Defects in leather, Microscopy & Bacteriology **05**

07 1x03 Bio-Chemistry of Proteins

Fundamentals of Biochemistry :-

The molecular logic of life, strong and weak interactions, introductory concept of cell, bio-molecules and water. **5**

Histology and fiber packing in commercially viable hides/skins. **3**

Amino acids, peptides and proteins :-

Chemistry, Classification determination of amino acids, Qualitative and Quantitative determinations, Structure of Various amino acids, formation of peptides, polypeptides and separation of proteins, covalent structure of proteins, Reaction of Proteins with acid, bases and salts. **8**

Polarity of amino acids and ionization of proteins, electro-phoresis, hydration, solubility of proteins, dielectric properties, intermolecular forces of proteins cross linking in collagen, Iso-electric point of collagen and its manipulation in various stages of leather manufacture. Acid and base binding capacity of collagen, reversible and irreversible acid and base binding capacity of collagen, Effects of anions, swelling (osmotic and lyotropic) and phase transition in collagen, helix-coil transition, Denaturation and melting of collagen. Glass transition of collagen, Shrinkage denaturation and optical birefrigence of collagen. **12**

Structure, function and chemical features of collagen reactive groups and Cross linking, Tropo collagen molecules, Sub-units of collagen, Types of collagen, Structure and function, Fibril formation, Precipitated forms of collagen, Electron microscopy of the collagen fibre, Bio-Synthesis. **9**

Structure and functional role of other skin proteins like keratin, Reticelin and Elastic, albumin, globulin and mucine etc. **6**

071x04 CHEMICAL ENGINEERING –I

1. **Fluid Mechanics :- Properties of fluids, Compressible, Incompressible fluid, Viscosity, Elasticity, Vapour pressure, Surface tension, Buoyancy and floatation. 10**
2. **Flow Measurement :-** Pitot tube, Venturi meter, Orifice meter, Pumps, Manometers. **08**
3. **Fluid Dynamics :-** Bernoulli's theorem, Continuity equation, Euler's equation, Energy and momentum equation, Basic concept of Newtonian and Non-Newtonian fluid. **08**
4. **Heat transfer :-** Heat transfer by conduction, convection and radiation, Conduction through plain and cylindrical surfaces, Natural and forced convection, Heat transfer coefficient. Log mean temp. difference. **09**
5. **Evaporation :-** Types of Evaporators, Operation of Evaporation unit, Different methods of feedings. **04**
6. **Size Separation :-** Screening, Mixing and agitation, floatation, **04**

Practical :-

1. To verify Bernoulli's theorem.
2. Study and calibration of venturimeter.
3. Study of pilot tube and to measure discharge through it.
4. Study of orifice meter and determination of Cv, Cd, Cc for free flow.
5. To study and draw various flow pattern of a fluid past body.
6. To find the metacentric height of a body.

071x05 CHEMICAL ENGINEERING –II

1.Nitration,Alkylation, Halogenation, Sulfonation. **10**

2. **Crystallization :-** Theory of crystallization, crystallization equipment for chemical processing. **08**

3. **Adsorption :-** Theory of adsorption, Industrial adsorbents adsorption equipments Decolourization of chemicals. **08**

4. Diffusion :- Binary diffusion Concept of mass transfer coefficients and interface mass transfer and stage wise contact. **09**

5. Absorption :- Theory of gas absorption, Design and operation of absorption towers, Humidity and its measurements. Adiabatic Saturation temp. Dry and wet bulb temp, Humidity chart. **08**

Practical :

1. To find out the Viscosity of a given fluid by ostwald Viscometer and by capillary tube viscometer.
2. To study about bomb calorimeter.
3. To find the calorific value of a given solid fuel.
4. To separate the mixture of Benzene and Toluene by simple distillation method.
5. Screen analysis by Taylor's method.

07 1x06 Principles of Inorganic Tannage

Tanning :- Theory, Chemistry, Factors and objectives of following inorganic tanning operations :- (a) Chrome Tannage (b) Aluminum Tannage (c) Iron Tannage (d) Zirconium Tannage (e) Titanium Tannage (f) Poly Phosphate Tannage and (g) Silica Tannage. 1**0**

Introduction to Co-ordination Chemistry, metal ion in tanning :-

Historical introduction to mineral tanning, Introduction of factors controlling molecular stability of transition metal complexes, Werner's theory of Co-ordination, Role of d and f orbitals, Definition of ligands, Ligand Bond in Collage, Chelation, Masking agent :- Their requirement for use in chrome tanning, Effect of masking on chrome tanned leather & as chrome liquor. **10**

Aqueous Chemistry of Chromium :-

Electric configuration, common oxidation states of chromium, stabilities of Chromium (IV) and Chromium (III) salt, Basicity, Olation, Oxolation and polymerization, complexity of chrome complexes. **07**

Factor Controlling Chrome tanning :-

Single and double bath chrome tannage and their relative merits and demerits, preperation of Basic chromium sulphate salt, Effects of float Volume, PH, basicity, Masking temperature, drum speed, ageing chrome tanned substrate. **07**

Mechanism of chrome tanning :-

Theories of chrome tanning, Absorption, Coating, Electrostatic and hydrogen bond interaction and co-ordinative forces involved in chrome tanning, hydro thermal stability of chrome-collagen compound.

07

Suggested Books :- Same as 07 1x02

07 1x07 Principles of Organic Tannage

Vegetable Tannins –

Classification of Vegetable tannins – Structural aspects, Analysis of Chemistry of Hydrolysable & Condensed tannins, Manufacture of vegetable tannin extract use of additive for product notification, Reactions of vegetable tannins with collagen, Principle of vegetable tanning, Factors affecting tannin diffusion & factors affecting tannin fixation with collagen, Principle of Rapid tanning methods.

12

Synthetic tannins –

Chemistry & Multifunctional properties of syntans, Nontans in synthetic tannins, General Manufacturing methods of Phenol, Formaldehyde Naphthalene, Formaldehyde and Naphthol, Formaldehyde condensates, Supra Syntans, Use of Syntans for the Manufacture of various Leathers & for chemical modifications for specific objectives, use of Lignosulfonic acids in Leather processing.

12

Resin Syntans –

Urea, Formaldehyde & Melamine, Formaldehyde condensates as tanning agents for leather, their chemistry & structure, Property, Relationship, Polyacrylates & Polyurethanes as Resin tanning agent Principles of their use.

08

Aldehydes as tannins –

Formaldehyde and other mono, difunctional aldehydes their chemistry, Structure and general properties, Reaction of aldehydes with different functional groups of protein. Tanning faculty at different pH reactions, oil, sulphony/chloride quinone tannage. **08**

Combination tannages –

Deficiencies of single tannage, Machanistic classification of tannages. All chrome based combination tannages, semi-chrome & semi – alum tannages

07 1x08 Practices of Leather Manufacturing – I

General Practices in vegetable and chrome tanning with quality control in manufacture of the following Industrial and heavy leathers. **02**

Traditional and Rapid methods of vegetable tannage of sole (Pit and Drum tanning). Chrome tanned sole and waxed chromed soles. Improvement of water resistance of vegetable tanned sole leathers.

06

Bag tanning of cattle and buffalo hides, different types of finished leather from bag tanned leathers, Belting harness, Saddlery and honing leathers. **05**

Picking band leathers, Apron leathers, Hydraulic pneumatic leathers such as water and air pump leathers for turbines, Oil seals, Gas meters etc. **08**

Sports goods leathers like Foot ball, Hokey ball, Volley ball, Cricket ball, Glove for wicket keepers and Boxing. Taxidermy. **03**

Manufacture of Kattai, Banwar and case hides from Buff cattles. **06**

07 1x09 Analytical Chemistry of Leather

1. Analysis of Lime

Principles underlying determination of following in lime

(a) Available lime

(b) Total based by titration method

(c) Iron by colorimetric method

03

2. Analysis of Na_2S

Principles underlying analysis of Na_2S by official international method.

02

3. Analysis of lime liquors (Fresh & used)

Principles underlying determination of following in line liquor :-

(a) Total Alkalinity (b) Total lime (c) Total nitrogen

(d) Hide substance (e) Amino acids

03

4. Analysis of limed pelt

Principles underlying determination of following in limed pelt

(a) Total Alkalinity (b) Total Ammonia (c) Hide Substance

03

5. Analysis of Boric acid

01

6. Analysis of deliming agent (Ammonium chloride and Ammonium sulfate)

01

7. Analysis of enzyme bates

02

8. Analysis of used pickle liquors for following :-

(a) Determination of acid

(b) Determination of salt

9. Analysis of Sodium formate

01

10. Analysis of Chrome liquor to determine

(a) Basic chromium (b) Basicity of chrome liquor

(c) Degree of Olation.

04

11. Analysis of basic chromium sulfate for following :-

(Power of Crystal)

(a) Moisture (b) Chromium

02

12. Analysis of acids & salts in vegetable tannin extracts by different methods.

02

13. Analysis of Zirconium and Alum. Tanning agents.

14. Analysis of Formaldehyde.

02

15. Analysis of chrome tanned leather for following :-

Moisture, ash, Chromic oxide content, Solvent extractable substances, Water soluble matter and difference figure.

03

16. Analysis of followings of Veg. tanned leather :-

Moisture, ash, Water soluble matter, Solvent extractable substances and difference figure, Degree of tannage.

03

17. Analysis of followings of Alum. Tanned leather moisture, total ash, Solvent extractable substances, Aluminium as Alumina.

01

18. Analysis of followings of Zirconium tanned leather :-

Moisture, Ash, Solvent extractable substances, Zirconium content.

01

19. Analysis of followings of combined tanned leather :-

Moisture, Ash, Solvent Extractable substances, Water soluble matter and difference figure, Chromic oxide content, Degree of tannage.

03

20. Analytical Chemistry of Post tanning and Finishing agent

Analysis of lipids for following :

(a) Acid value

(b) Saponification value by reflux method.

(c) Iodine value by Hanus method.

(d) Unsaponifiables by extraction method.

(e) Analysis of sulfated oils and ready made fat liquors.

05

21. Principles underlying examination and analysis of dyes used in leather manufacture

01

22. Principles underlying examination and analysis of readymade finishes and finishing materials used in leather manufacture.

02

Suggested Books :-

1. Analytical Chemistry of leather manufacture - P. K. Sarkar, ILTA, Kolkata.
2. The Chemistry and Technology of leather – F – O Flaharty, Roddy, Lollar. Krieger Publishing Co. Florida USA.
3. Official methods of Analysis SLTC, U.K.
4. Different standards issued by BIS from time to time.

07 1x10 Principles of Post-Tanning Operation

NEUTRALISATION :- Its objectives, necessities and control to achieve desired uptake of dyes and fat liquors.

03

BLEACHING :- Definition, Theory, Mechanism of chemical bleaching, classification and application of different methods of bleaching to leathers.

03

DYEING :- Classification of dyes based on their chemical nature and also according to their application, Theory of colour, Manual colour matching, Theory and mechanism of dyeing, Chemistry and application of dyeing auxiliaries such as levelling agents, wet ting agents, dispersing agents and dye fixative, Metal complex dye.

10

FAT LIQUORING :- Theory of stability of Emulsion (Surface tension theories and Electrical theories), Fatliquor based on natural oils, their chemistry and preparation, Oxidation, Sulphation, Sulphonation, Bisulphitation and their properties, Synthetic Fat liquor :- Preparation and Properties, Principles and objectives of fatliquoring, Differences between synthetic and natural fat & oils concept of curring.

10

RETANNING SYNTANS AND RETANNING :- Classification of retanning syntans, Tanning power of retanning syntan, Dipole theory of syntan tanning, General method of manufacture of aromatic syntans their general properties, Objective of retanage, Effect of different retanning agents on properties of leather principle of bondage of retanning material.

07

THEORY OF LEATHER DRYING :- principles of energy and mass transfer, Physio-Chemical aspect of leather drying, Different methods of drying followed in leather Industry

07

Suggested Books :- Same as 07 1x02

07 1x11 Leather Bio-Technology

Microbiology (Bacteria) :-

Morphology & fine structure of bacteria :- The size shape & arrangement of bacterial cells, Bacterial structures, Structure external to the cell wall, Flagella and motility, pili, capsules, sheaths & stalks.

The Cultivation reproduction & Growth :- Nutritional requirement, nutritional types of bacteria, Prototroph Chemotrophs autotrophs & hetrotrophs, obligate parasites.

10

Bacteriological media :- Types of media, preparation of media, Physical conditions required for growth.

02

Reproduction :- Modes of cell division, new cell formation .

02

Methods of isolating pure culture :- The streak plate technique, the power plate and spread techniques, micro manipulator techniques, the maintenance and preservation of pure culture, culture collection cultural characteristics colony characteristics, Characteristics of broth culture.

Characteristics, Classification of mold, Role of bacteria and mold in leather, uses of Bactericides and Fungicides in leather.

05

Enzyme, their Physico-chemical concept regulation of enzyme synthesis in microbes, classification, function methodology, Enzyme reaction mechanism : - Enzyme kinetics isolation and purification of enzymes.

Immobilization of enzymes in whole cell and enzyme reactors.

02

Cleaner Leather processing :- use of enzyme option in beam house operations – Soaking, Unhairing, Bating Degreasing, offal treatment, Types of enzymes – Proteases, Lipases, Properties and Production.

05

Fermentation :- Mechanism of alcoholic fermentation of carbohydrate, bacterial fermentation, fermentation by coliform organisms, fermentation of nitrogenous compound, vinegar.

04

Bacterial Genetics :- Biosynthesis of deoxyribonucleic acid (DNA)- Structure of DNA, Biosynthesis of nucleotides in DNA strands, Replication of the DNA molecule, Transcription & translation of genetic information in protein synthesis.

Bacterial mutation :- Types of mutation, How mutation occur, How mutation are repaired, Bacterial recombination, Bacterial conjugation, Bacterial transduction, Bacterial transformation, Recombiant DNA Technology, DNA Cloning.

04

Lisation of collagenous tissues for Biomedical and other application :-

Collagen and its application in food, cosmetic and medical fields.

05

Suggested Books :-

1. Microbiology – Michel J. Pelczar, JR, E.C.S Chan R, Krieg (Fifth edition).
2. Molecular Biology of gene-walson, Hopkins, Roberts Steitz Weiner (Fourth Edition)
3. Biological waste water treatment – Theory and application – C.P. Lertem Grady, Jr. Henry C. Um.
4. Stryer, L. Biochemistry 3/e W.H. Freeman and Co. 1989.
5. Lehninger A.L. Principles of Biochemistry Buttercoorth, 1982.

07 1x12 Leather Product Technology – I

1. Introduction

History of Footwear industry, Functions of footwear, Different parts of Footwear (Upper, Bottom and hidden components)

03

2. Anatomy of Human foot

Bones, Joints, Muscles, Ligaments, arches of skin of human foot, Internal and external changes of human foot from infant to adult stage, Analysis of human locomotion, Common foot abnormalities and their remedies. Foot comfort and foot care.

07

3. Last

Definition, Classification of last, Different parts of last, Seasoning of wood for wooden last, Last measurement, Comparison of last with human foot.

04

4. Shoe Sizes and Fittings

Relation between foot sizes and fittings and shoe, sizes and fittings, English, American, French, Continental and mondopoint shoe sizes and fittings system.

03

5. Designing

Introduction, Classification of Basic design, Elements of Design, Elements of Fashion design procedure, Concept of inside form, outside form and mean form, Making a basic shoe standard, pattern making allowances, Grading (Grading m/c)

10

6. Footwear materials

(a) Upper and Lining materials – Different natural and synthetic materials.

(b) Adhesive – Definition, Different types of adhesives use in footwear industry and their relative advantages and disadvantages.

(c) Sole, Insole, Toe, PUA, Shonic, Stiffner, Itec, Thread, Required properties of these materials, Different types of these materials.

09

7. Footwear Costing

Material, Labour and Overhead cost, Determining the material consumption, Leather consumption – One pair tracing insole consumption, Adhesive and thread consumption etc.

04

Suggested Books :-

1. Manual of Shoe making –Clark
2. The text book of Footwear menu – J. H. Throntin.
3. Principle of Footwear Manufacture – Somnath ganguly.

07 1x13 Principles of Material Testing

1. Introduction

Thumb tests, Necessity of Physical Testing, Classification, Sampling positions, Conditioning of test samples

05

2. Different Strengths of Leather

Determination of Tensile strength and percent elongation of break, Stitch tear strength, Tearing strength, Tongue tearing strength, Buckle tear strength, Split tear strength, Distension and strength of grain by Boll Burst test – (i) The Lastometer (ii) The Tensometer. **09**

3. Few more tests for upper and light leather

Flexing endurance test, air and water vapour permeability, Dynamic water proofness test, Dry and wet rub fastness test, Measurement of shrinkage temperature. **09**

4. Tests for Sole leather

Measurement of apparent and real density, Determination of Abrasive resistance of sole leather, Dynamic water proofness of sole leather (Kubelka method), Grain cracking in sole leather (Mandrel test)

09

5. Tests for Finish -film

Determination of bond strength between the leather surface and finish film, cold, crack resistance, Light fasters test.

05

6. Specification

Shoe upper, Sole, Lining Leather, Clothing, Glove, Technical leathers, Upholestry and fancy leather.

03

Suggested Books :-

1. An Introduction to the principles of physical testing of leather – Prof. S. S. Dutta, ILTA, Kolkata.
2. Technical Controls in Leather Manufacture – By Bangau Swami, CLRI.
3. The Chemistry and Technology of Leather – O' Flaherty, Roddy, Lollar, Robert E, Kvieger Publishin Co. N.Y.

07-1x14 CHEMICAL ENGINEERING - III

1. Distillation :- Vapour-liquid, Equilibra, Theory of distillation of Binary liquid mixture, Fraction, Design and operation of distillation column for separation of binary mixture by Mc. Cebe thiel method.

12

2. Filtration :- Theory and Mechanism of filtration, continuous and batch type filtration equipment.

10

3. Drying :- Drying characteristics of material, Theory and Mechanism of drying, estimation of drying rate. Type of dryers. **08**

4. Extraction:- Extraction, Types of extraction, liquid-liquid extraction liquid-solid extraction, operation of stagewise and differential contact extractors. **07**

5. Chemical Process :- Manufacture of Bleaching powder, Alkali Industries Sodium sulfide, Sodium dichromate Basic Chromium sulphate. **07**

07 1x15 Leather Finishing Materials and Auxiliaries

1. Pigments :-

Inorganic and Organic Pigments, Preparation of Pigments, Methods of Prepation of Pigments, Aqueous Pigment Paste, Properties required in Pigments. **08**

2. Principles of Finishing, Finish Formulation and their Application:-

Definition, Aim, Film- Formalation mechanism, Properties of films such as transparency, Gloss and resistance to heat, light and solvent, Role is dispersion and stability – Requirement in multiple coat technique- Single coat, Composition and methods of application like spraying, Curtain coating, Roller coating etc, Cationic finishes and their relative merits

06

3. Chemistry and Preparation of Nitrocellulose, lacquers, lacuuer emulsion, Coloured lacquers, Wax emulsions, Silicone emlsion. 06

4. Chemistry and Properties required of Synthetic Polymers, Impregnating agents, Binders, Chemistry of Polyurethane lacquers. **06**

5. Chemistry and Mechanism of Plasticization, Internal and External Plasticizers. **06**

6. Definition of Water proofing, Theory of water Proofing, Chemistry & Mechanism involved in water proofing.

06

7. Upgradation technologies in finishing.

General introduction to addition, condensation, Natural polymer, Caesin, Cellulose **06**

Suggested Books :-

1. Acrylics and their uses in leather manufacture. By Rajadesa, S. and Kula Sekhran, S. CLRI 3 Chennai –1956.

2. Chemistry of Tanning Process. By Gustavson, K.H. Academic Press, New York- 1956.

3. The Chemistry and Technology of Leather. By Fred O, Flaherty, Toddy T.W. and Hollar, R. M. Vol – II, Types of tannages, Rober E. Krieger, Publishing Co. New York – 1977.

07 1x16 ELECTIVE – I

(One Elective paper will be taken up out of the following four options with the consultation of H.O.D)

07 1x16 Animals & Tannery Byproducts Utilization (LTE 1.1)

1. An Overview :- Types of tannery available in India. Their nature and composition. Present methods of collection and utilization. Recovery of salt from the same. Its treatment and re-use. Theoretical and practical aspects of recovery of chrome, Protein and biogas from the tannery waste.

2. Beam-house Products :- Recovery of fat, proteins, chemicals and glue and their use. Pet Treats, finished split, gloves, washers etc.

3. Leather shavings and Trimmings :- Chemistry and Processing into hydrolysates, glue gelatin, syntans, fertrilizers, processing into leather and acoustic boards.

4. Nature of Tannery Hair :- Chemistry and processing into protein meal hydrolysates and their uses – Conversion into felts and other utility products.

5. Process Studies :- Glue and protein meal from tannery fleshing, Quality evaluation of glue and protein meal, pet treats limited stock recovery of salt from used salt – Analytical procedures of protein meals.

07 1x16 Polymer Science and Technology(LTE 1.2)

1. Science of Macromolecules: Basic concepts, molecular forces and chemical bonding in polymers, molecular weight and its distribution.
2. Step Reaction Polymerisation: Classification of polymers and polymerization mechanisms, mechanisms of step growth polymerisation, kinetics, polyfunctional step growth polymerisation.
03. Radical Chain polymerisation: Mechanism of venyl polymerisation, kinetics of chain growth polymerisation, molecular weight and its distribution,
04. Ionic and Co-ordination Chain Polymerisation: Similarity and contrasts in ionic polymerisation, mechanisms and kinetics of anionic, cationic and co-ordination polymerisations.
05. Copolymerisation: Kinetics of copolymerisation, composition of copolymers, mechanism of copolymerisation, blocks and graft polymers.
06. Polymerisation Conditions and polymer Reactions: Polymerisation in homogeneous and heterogeneous systems, polymerisation engineering, chemical reaction of polymers.
07. Polymer Solutions: Criteria for polymer solution, conformation of dissolved polymer chains, thermodynamics of polymer solution.
08. Measurement of Molecular Weight and Size: End group analysis, colligative properties measurement.
09. Structure–Property Relationship: Polymer folding, thermodynamic and kinetic flexibility, Crystalisation and melting of polymers and the factors responsible, glass transition and phase transition of polymers.
10. Determination of Thermal Behaviour of Polymers: Principles of DSC, DTA, TGA analyses.
11. Plasticization and Crosslinking of polymers: Theory and mechanisms of plasticization, kinds of plasticizers, crosslinking of polymers and its effect in the physical property of polymer network.

Suggested Books: -

1. Textbook of Polymer Science-Billmeyer, F.W. Jr. (1994), 3rd Edn. Wiley Interscience Publication N.Y.

2. Polymer Science and Technology of Plastics and Rubbers -Ghosh, P.M. (1990), 2nd Edn.Tata McGraw-Hill Publishing Co. N.D.

07 1x16 Co-ordination Chemistry. (LTE 1.3)

General characteristics of d block elements, Metallic character, Colour, Magnetic properties, Double salts, Tendency to form complexes, Coordination compounds, Coordination complexes and complex ions, Isomerism coordination number, important ligands, chelating ligands and chelates,

12

Postulates of werner's co-ordination theory, to explain the different oxidation states of Cr, Al, Zr, Pt, Ti, P As, Sb, Bi, Co etc. Explain the structure of Cr, Al, and Zr Ammines on the basis of Werner's Coordination theory, Experimental evidence in favour of Werner's theory, complex co-ordination, Molecular orbital and ligand field theories, Sidgwick's electronic concept of Co-ordination bond, limitations of sidgwick's electronic concept of Co-ordination bond, sidgwick's effective atomic number (EAN) Rule, Calculation of EAN of the central Metal atom in complex ions, Application of EAN Rule, Some typical Problems with Solutions, Metallurgy of Cr, Ti, Al, V, Co, Mn, Mo and Zr.

24

Chemistry of chromium salts and chrome tanning, factors affecting the formation and stability of different complexes like Al, Cr, Zr etc.

4

07 1x16 Organic Chemistry (LTE 1.4)

1. Carbohydrates :-

Introduction – Mono and Diaccharides, Trisacchrides , Polysacchrides, Strach and Cellulose, Derivatives of cellulose, Carboxy Methyl cellulose, Structural aspects of cellulose and starch.

2. Amino acids and Proteins :-

Classification of Proteins, Test of Proteins, Denaturation, Structural aspects of wool.

3. Oils, Fats and Waxes :-

Analysis of Oils, Fats and Waxes, Natural sources, General properties and reactions.

4. Dyes and Dyeing :-

Chemical classification of dyes, Synthesis of some important dyes, Synthesis of triphenyl methane dyes, Anthraquinone dyes, Phthalein dyes, Introduction to Natural and reactive dyes, Metal complex dyes.

5. Reaction of mechanism :-

Homolytic bond fission, free radicals, heterolytic bond fission, electrophiles, Carbonium ion, Nucleophiles, Acids and bases, Bronsted lowry concept lewis concept, Strength of acids and bases, substitutions reactions – S_{N1}, S_{N2}, S_{Ni}, Addition reactions, Elimination reactions, condensation, redox reactions.

07 1x17 Practices of Leather Manufacturing – II

Manufacture of different types of wet blue/wet white from raw Cow/Goat/Sheep/Buffalo hides/skins.

05

Modern practices in E.I. tanning, E.I. Kips and their dressing into upper, lining and leather for goods.

06

Semi chrome/Full chrome/Chrome retain hunting suede, Safety uppers burnishable upper leathers from cattle hides. Printed and shrunken grain leathers, Chrome tanned Buff uppers, Upholdstry and printed leathers. Vegetable and chrome tanned lining leathers.

20

Morocco leathers, Chamois leathers, book binding leathers and pleated leathers. **10**

07 1x18 Theory of Leather supplements & Synthetics

1. Chemistry of the most common Polymeric materials used in leather industry as supplements. **04**

2. Concept of a macromolecule, natural & synthetics polymer, modes of polymerization, radical, condensation, stereo regular polymerization, polymerization kinetics, mechanism, anionic and cationic polymerization.

10

3. Manufacture of industrially important polymer for plastics, fibres and elastomer, polyethylene, polypropylene, polyvinyl, chloride, polyvinyl, alcohol, polyacrylonitrile, polyurethane, fluoro – carbon polymer, epoxy resins, polyamides, polyesters, alkyd resin, silicon polymers, cellulosics, polyacrylates, polyurethanes and their common applications.

12

4. Testing of Polymers, Mechanical and thermal testing.

04

5. Polymer and Rubber industries in India.

04

6. Manufacture of Rubber and Synthetic rubber, Natural rubber processing and vulcanizing synthetic elastomers, butadiene copolymer, Polyisoprene, Polybutadiene, Thermosetting, Thermoplastic.

10

07 1x19 Instrumentation & Process control

AIM

To know the principle and importance of various analytical instruments used for the characterization of various materials.

2

OBJECTIVES

To have thorough understanding of theory, instrumentation and applications of analytical equipments used in Industries for testing quality of raw materials, intermediates and finished products.

Introduction to spectroscopical methods of Analysis

Electromagnetic Radiation :- Vavious ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance & transmittance and their relationship, Permitted energy levels for the electrons of an atom and simple molecules, Classification of instrumental methods based on physical properties.

10

Quantitative Spectroscopy :- Beer-Lambert's law, Limitations, Deviations (Real, Chemical, Instrumental), Extimation of inorganic ions such as Fe, Ni and estimation of Nitrate using Beer-Lambert's Law.

UV – Vis Spectrophotometry :- Determination of spectra of some known organic compounds and identification of molecular transitions and functional groups in single beam spectrophotometer, quantitative estimation of various compounds in single beam spectrophotometers , estimation of Cr^{6+}, Fe^{3+}, NO_3, PO_4^{3-}, COD in spectrophotometer.

07

Atomic Absorption Spectrophotometry :- Determination of some heavy metal concentrations (like total Cr, Fe, Zn, Pb, Zr etc.) from solution, leather ,effluent, soil/sludge, plant and fish tissues.

06

IR, RAMAN AND ATOMIC SPECTROSCOPY :-

Theory of IR spectroscopy, Various stretching and vibration modes for diatomic and triatomic molecules both linear and nonlinear), various ranges of Ir (Near, Mid, Finger print and Far) and their usefulness, Instrumentation (Only the sources and detectors used in different regions), sample preparation techniques, Applications.

Raman spectroscopy : Theory, Differences Between IR and Raman.

Atomic Absorption spectrophotometry :- Principle, Instrumentation (Types of burners, Types of fuels, Hollow cathode lamp, Chopper only) and Applications, various interferences observed in AAS (Chemical, radiation and excitation).

Flame photometry :- Principle, Instrumentation, quantitative analysis (Standard addition method and internal standard method) and applications.

08

CHROMATOGRAPHIC METHODS :-

Classification of chromatographic methods, Column, Thin layer, Paper, Gas, High Performance Liquid Chromatographical methods (Principle, mode of separation and Technique). Separation of organic compounds by column and Thin layer, mixure of Cu, Co and Ni by Paper, separation of amino acids by paper, estimation of organic compounds by GC and HPLC.

06

Controls in leather processing :-

Concept continous processes, material and energy optimization, conventional and computer assisted control strategies, case studies.

06

07 1x20 Leather Product Technology – II

1. Clicking

Characteristics and variations in leather, Material selection, Clicking of upper linings, Socks and fabrics.

2. Preparation (Pre – Closing)

(a) Identification making, stitch making, Punching, Perforating and embossing.

(b) Skiving – Objectives, different types skiving.

(c) Reinforcements.

(d) Topline and edge treatments.

06

3. Closing operations

(a) Stitching – Types of stitching m/c, Types of stitch, Different types of seam.

(b) Eyeleting , lasting, etc

05

4. Construction

Assembly, Definition of construction, Types of Construction, Flowchart of different construction., Details of cemented construction – Methods,

Details of moulded construction – DVP construction, Direct PVC moulded construction, Direct PU moulded construction, Veldtschoen construction, Machine welted construction. Slip – lasted construction, string lasted shoes.

16

5. Treeing Department (Shoe-room operations)

Shoe-room operations for grain, leather and suede leather uppers.

03

6. Quality control in footwear industry, Marketing of footwear, Hand tools and fittings for footwear industry.

05

Suggested Books :-

1. Manual of Shoe – making – Clark.
2. Text book of Footwear Manufacture – J. H. Thronton.
3. Principle of Footwear Manufacture – Dr. Somnath Ganguly.

07 1x21 ELECTIVE – II

(One Elective paper will be taken up out of the following four options with the consultation of H.O.D)

07 1x21 Fashion styling and Computer added design of leather product (LTE 2.5)

International Fashion Trends :

Historical evolution of footwear and garment styling, seasonal, cultural and geographical influences on foot wear and leather garments fashion, trends in fashion, concepts, colour and human psychology.

Colour characteristics :

Primary colours and colour scheming for aesthetics, colour blending and techniques for colour matching.

Decorative styling Techniques :

Decorative components, decorative techniques like batik, stitching, punching, printing, embossing, knitting etc.

CAD of Leather Product :

Introduction to general CAD, Input and output devices required for CAD and their working principles. Capabilities of CAD for styling purpose- colour, basic primitives etc. Design methods using CAD for leather products, Pattern assessment methods for inter locking and economic cutting.

Introduction to CAM :

Tools required in CAM, Possible application of CAM in leather products, Introduction of the commercial CAM systems for leather products.

07 1x21 Advance Leather Process Technology (LTE 2.6)

Anatomical structures of hides and skins, Retanning, dyeing and fat liquoring in light and heavy leathers composition of finishes, formulation and application of Leather auxiliaries like protein and resin binders, pigments, wax emulsions, lacquer and lacquer emulsions coloured lacquers, silicones and slip agents, pretanning and neutralizing syntans etc. in manufacture of above leathers.

Function of different finishing ingredients – Newer approaches in finishing, problems encountered in finishing and their solutions.

Novel finishing techniques :

Role of newer equipments like auto spray, roller coats, continous embossing machines, finiflex etc., Methods such as oil-pull-up, Waxy burnishable, antique, grain sueded, screen printing, roller coating, pearl finishing easy care and petent finishing.

Light leathers from heavy hides and skins :

Resin upper, glazed uppers, lining leathers shoe-suedes, garment suedes- sheep nappa, glove leathers, E.I.- Wet-blue, wet – white, etc – details of processing techniques split processing for shoe suede, garment sued, grain finished and specialty finishes.

Upgradation through processing technologies and finishing techniques specially suited for the purpose like selection and use of retannage systems, Embossing-special effects by screen and block printing, roller coating, gravure printing, Tie and Dye leather.

07 1x21 Applied Statistics and Quality Control (LTE 2.7)

Definition of Probability and Related basic concept :

Discrete and continous probability distributions (Binomial, Poisson, uniform, normal, Gamma and exponential), Basic concept of statistical population and sampling, Sampling design, random sampling, Mean variance and co-variance, correlation coefficient, Moments. Basic concepts of testing of hypothesis, Analysis of variance and Co-variance.

15

Basic concept of statistical Quality control (S & C) :

Development of various quality control and quality assurance concepts, Concept of product quality, Concept of quality control system, Nature of control limits, purposes of control charts, control charts for variables, control charts for attributes, cusum control chart.

15

Application of computers to quality systems.

4

Introduction to ISO 9000 and TQM :
ISO 9000 genesis, advantages, documentation, procedures. ISO 9000 VS classical quality control concepts. System evaluation, system development, system implementation, and maintenance, ISO 9000 and ISO 14000 standards **8**

07 1x21 Surface and colloid chemistry (LTE 2.8)
Colloidal State :
Introduction to colloidal state, Distinction among true solutions, colloids, Suspensions classification of colloids based on (physical state, Nature of interaction, Type of particles) Study of different phases (micellar, liquid crystalline and microemulsions) as well as aggregates such as vesicles, Purification of colloidal solutions, General physical properties of Colloidal solutions (colligative, Mechanical and electrical properties of colloidal solutions), Protective colloids and Gold number. **24**

Application of colloids, stability of emulsions, electrophoresis, dialysis, coagulation and flocculation and their characteristics summary of surface chemistry. **8**

Adsorption Physisorption and chemisorption and their characteristics, factors affecting adsorption of gases on solids – Freudlich and Langmuir adsorption, Isotherms, Adsorption from solutions.
8

07 1x22 ELECTIVE – III

(One Elective paper will be taken up out of the following four options with the consultation of H.O.D)

07 1x22 Computer application for Leather Technology(LTE 3.9)

1. Computer Programming Languages Operating System :- An overview of operating systems – DOS, UNIX, OS/2, MS-WINDOWS Review of Programming Languages – Basic, C & Fortran.
2. Data Processing :- Introduction to spread sheets, Analysis of data, Graphical representation.
3. Office Automation & Presentation Softwares :- Word Processing, Presentation Softwares, Professional Report generation using the above., Audio visual presentations using Multimedia.
4. Database and its Application :- Basic structures Retrieval of data for Reports, query and other formats and their export to other applications.
5. Cad Systems for Leather & Leather Products :-

Pattern Grading & Cutting for Footwear and Garments.
Design & Development of Leather Products.
Computerised colour maching system –its Principle & application.

07 1x22 Profession Ethics (LTE 3.10)
1. **Engineering Ethics :-** Senses of Engineering Ethics Variety of moral issue- types of inquiry – moral dilemmas- moral autonomy kolberg's theory – consensus and controversy professions and professionalism – professional ideals and virtues – theories about right action – self – interest – customs and religion – uses of ethical theories.
2. **Engineering as social experimentation :-** Engineering as experimentation – engineers as responsible experimenters-codes of ethics-a balanced outlook on law-the challenger case study.

3. **Engineer's responsibility for safety :-** Safety and risk – assessment of stabety and risk benefit analysis-reducing risk-the three mile island and chernobyl case studies.

4. **Responsibilities and rights :-** Collegiality and loyalty – respect for authority – collective bargaining-confidentiality – conflicts of interest – occupational crime- professional right – employee rights – intellectual property rights (ipr) – discrimination.

5. **Global issues :-** Multination corporations –environmental ethics-computer ethics-weapons development-engineers as managers-consulting engineers as expert witnesses and advisors-moral leadership-sample code of conduct.

07 1x22 Entrepreneurship(LTE 3.11)

1. Introduction :

Productivity in India, Resources, Availability and mobilization, Land Labour and capital, Industrial Growth in five year plan period, Human resources development.

2. Technology and Investment :

Industrial climate in India, Technological investment, Transfer of Technology, Factors influencing technical investment, NRI, Capital market in India.

06

3. Technocrats :

Development of Technocrats, Role of educational institutions, Psychology of India technocrats, Technocrats as entrepreneur, Characteristics of an entrepreneur.

06

4. Leadership :

Attitudes and aptitudes, Qualities and development, Risk taking and decision making, Personal involvement.

04

5. Value Engineering Techniques :

Value added products, Value adding techniques, cost reduction techniques, Waste control, Alternate product application, Functional value of the product, Improvement and expansion.

06

6. Marketing :

Indian and International markets, Market surveys, Strategies and development of market, Need based marketing techniques.

06

7. Business Laws and Regulations :

Company law of India, Taxation Laws, Labour Laws, Factories Act., ESI Act., Workmen Compensation act., Licencing procedures of State and the Central Governments, Industrial subsidies.

08

8. Entrepreneurship Development and Government: Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants - Export Oriented Units - Fiscal and Tax concessions available. Women Entrepreneurs Reasons for low / no women Entrepreneurs their Role, Problems and Prospects.

05

References :

1. G. Meredith, R.E. Nelson, and P.A. Nech, The Practice of Entrepreneurship, I.L.O. Publishers, Geneva, 1982.
2. R. Dirk Larkran, Profit Improvement Technology, College Book publishing Company, Canada, 1981.
3. Sukumar Bhattacharya, Indian Direct Taxes, Wadhva and Co. 1983.
4. K.D. Shrivasthava, Commentaries on workmen compensation Act and ESI Act.
5. K.D. Shrivasthava, Factories Act. 1948.
6. How to start your own Industry-Circular by ITCOT and SIDCO Greams Road, Madras – 600006.

07 1x22 Total Quality Management(LTE 3.12)

1. Introduction

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic Concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Demin Philosophy, Barriers to TQM Implementation.

2. TQM Principles

customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, Sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

3. Statistical Process Control (SPC)

the seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

4. Total Quality Management Tools

Benchmarking – Reasons to Beanchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

5. Quality System

Need for ISO 9000 and other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

Suggested Books :-

2. Dale H. Besterfo;ed. et at., Total Quality Management, Person Education Asia, 1999. (Indian reprint 2002)

References :-

2. James R. Evans & William M. Lidsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN O –324-06680-5)
3. Feigenbaum. A.V. “Total Quality Management” M.cGraw-Hill, 1991.
4. Oakland.J.S. “Total Quality Management Butterworth” – Hcinemann Ltd., Oxford 1989.
5. Narayana V. and Sreenivasan, N.S. Quality Management –Concepts and Tasks, New Age International 1996.

6. Zeiri. " Total Quality Management for Engineers, Wood Head Publishers, 1991.

07 1x23 Tannery Waste Management

Water Pollution in General Perspectives: -

Leather industry attributed for water pollution. Types of water pollution – Physical, Chemical and Biological pollution. Hazardous effects of water pollution on land, Ground water, Surface water, Aquatic life and sea. Ecological system and water pollution.

10

Tannery Effluent :-

Types of tannery effluent, Characteristics of effluent from beam house processes, Tan yard processes and finishing processes their nature and pretreatment before disposal, Most toxic ingredients- Hazards of tannery effluent, Principles involved in removing their toxic effect from tannery effluent, Principles for estimation of TDS, SS, DO, COD, BOD, Sulphides, Chromium and non bio-degradable aromatic substances in waste water. **10**

Primary Treatment :-

Main object of primary treatment – Primary treatment units, Collection system of discharged waste water in tanneries, Screening, Equalisation of waste water. **05**

Secondary Treatment :-

Principles of secondary treatment – Different processes involved in secondary treatment system, Lagoon treatment, Aeration Treatment, Trikling filter, Systematic design of these systems. Lecture-05

Tertiary Treatment :-

Unit operation in controlling pollutant at tertiary stage. **03**

Standards and Specifications :-

Indian standards, International standards specifications for Industrial effluent discharge, Types of effluent disposal.

04

Recovery of Waste Water and Materials :-

Different processes in recovery and reuse of waste water & material in tanning industry, Economic feasibility of different processes. **04**

Suggested Book :-

Environmental & Tannery – M.C.C. Carre et. Al. center technique du cuir, Lyon, France.

07 1x24 Practices of Leather Manufacturing – III

General practices and techniques involved in manufacture of different types of light leathers.

02

Glove kin, Resin upper, Glazed uppers, Lining leathers, Shoe suedes, Garment Swedes, Grain garment leathers, Gloving leathers.

10

Sheep nappa, Suede garments, Uppers and safety uppers, Lining and diaphragm leathers.

10

Nubuck, Oil pull up leathers, Dressing of for skins and processing of reptiles.

10

Combination tanning, Embossing, Grain correction, Special effects by spray, Screen printing, Roller coating, Gravure printing, tie and dye leathers, imitation leathers.

10

07 1x25 Leather Product Technology – III

Historical evolution of Garment and Goods styling, Seasonal cultural and geographical influences on fashion, Friends in fashion concept, Colour and human psychology.

05

Classification of Leather Goods and Garments, Selection of materials, Grading and assortment of Leathers for leather goods and garments. Property requirement for leather and lining materials. Accessories for leather goods and garments comparison between manual and machine cutting, Maintenance of knives and tools, clicking machines mechanical, Hydraulic/Pneumatic pattern interlocking/nesting for material optimization Assembly and sticking (Closing).

09

Different types of sewing machines (Flat bed, inclined bed, special type machines), Feed mechanisms, Various types of assembly techniques for leather goods and garments.

09

Pattern Designing

Basic design development, Measurements/Sizing chart for Man, Women and Children, Adaptation of stages to basic blocks. Pattern development, grading. Application of CAD for leather goods and garments design and production. Feasibility reports for leather goods and garments production. Machinery requirement/plant layout, process scheduling and line balancing, Quality control measures. Packaging methods and practices. Costing, pricing and marketing procedures for domestic and international markets.

09

07 1x26 Project Work

A Comprehensive innovative project work will be taken up by individual student or a group of students related to Leather and allied subjects with consultation with H.O.D. or the Teacher concerned. At the end of the semester every students will submit project report for evaluation. There will be two pre-reviews before the final submission of the project report for internal assestment. These reviews will be conducted by A Board of two or three internal examiners (including guide/s)

B. PHARM

SEMESTER - I

09 1101 PHARMACEUTICS – I (Physical Pharmacy)
L-T-P : 3-0-0 Credit : 3

1. **Matter, Properties of Matter:** State of matter, change in the state of matter, latent heats and vapor pressure, sublimation-critical point, Eutectic mixtures, gases, aerosols-inhalers, relative humidity, liquid, complexes, liquid crystals, glassy state, solids-crystalline, amorphous and polymorphism.
2. **Micromeretic and Powder Rheology:** Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, Asieving, sedimentation, measurement, particle shape, specific surface, methods for determining surface area; permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.
3. **Surface and Interfacial Phenomenon:** Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, Spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid-gas and Solid - liquid interfaces, complex films and electrical properties of interface.
4. **Viscosity and Rheology:** Newtonian systems, Law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling ball, rotational viscometers.
5. **Dispersion Systems:** Colloidal Dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy; Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement" sedimentation of flocculated articles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations; Emulsions-types, theories, physical stability.
6. **Complexation:** Classification of complexes, methods of preparation and analysis, applications.
7. Kinetics and Drug Stability: General considerations & concepts, half-life determination, Influence of temperature, light, solvent, catalytic species and other factors, Accelerated stability study, expiration dating.
8. **Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.

09 1101P **PHARMACEUTICS – I (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Determination of latent heat, vapor pressure, critical point.
2. Studies on polymorphs, their identification and properties.
3. Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
4. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
5. Determination of surface/interfacial tension, HLB value and critical micellar concentration of surfactants.
6. Study of rheological properties of various types of systems using different Viscometers.
7. Studies of different types of colloids and their properties.
8. Preparation of various types of suspensions and determination of their sedimentation parameters.
9. Preparation and stability studies of emulsions.
10. Studies on different types of complexes and determination of their stability constants.
11. Determination of half-life, rate constant and order of reaction.
12. To study the influence of various factors on the rate of reaction.
13. Accelerated stability testing, shelf-life determination and expiration dating of pharmaceuticals.
14. Preparation of pharmaceutical buffers and determination of buffer capacity.
15. Experiments involving tonicity adjustments.

Recommended Books:

1. Martin's Physical Pharmaceutical Sciences by P. J. Sinko (Lippincott William and Wilkins, Baltimore).
2. Cooper and Gunn's Tutorial Pharmacy edited by S.J. Carter.
3. Bently's Textbook of Pharmaceutics edited by E.A. Rawlins.
4. Bahl & Tuli: "Essentials of Physical Chemistry," S. Chand & Co.
5. Gennaro et al., "Remington's The Science & Practice of Pharmacy" (Lippincott William and Wilkins, Baltimore).
6. Banker & Rhodes,. "Modern Pharmaceutics"
7. Aulton, "Pharmaceutics – The Science of Dosage Form Design"

09 1102 PHARMACEUTICAL ANALYSIS - I

L-T-P : 3-0-0 Credit : 3

1. Significance of quantitative analysis in quality control, Different techniques of analysis, Preliminaries and definitions, Significant figures, Rules for retaining significant digits, Types of errors, Mean deviation, Standard deviation, Statistical treatment of small data sets, Selection of sample, Precision and accuracy. Fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards.
2. **Acid Base Titrations:** Acid base concepts, Role of solvent, Relative strengths of acids and bases, Ionization, Law of mass action, Common-ion effect, Ionic product of water, pH, Hydrolysis of salts, Henderson-Hessel bach equation, Buffer solutions, Neutralization curves, Acid-base indicators. Theory of indicators, Choice of indicators, mixed indicators, Polyprotic system, Polyamine and amino acid systems, Amino acid titration, applications in assay of Hl04, NaOH, $CaC0_3$ etc. .
3. **Oxidation Reduction Titrations:** Concepts of oxidation and reduction, Redox reactions, Strengths and equivalent weights of oxidizing and reducing agents, Theory of redox titrations, Redox indicators, Cell representations, Measurement of electrode potential, Oxidation-reduction curves, Iodimetry and Iodometry, Titrations involving ceric sulphate, potassium iodate, potassium bromate, potassium permanganate; titanous chloride and Sodium 2, 6-dichlorophenol indophenol.
4. **Precipitation Titrations:** Precipitation reactions, Solubility products, Effect of acids, temperature and solvent upon the solubility of a precipitate. Argentometric titrations and titrations involving ammonium or potassium thiocyanate, mercuric nitrate, and barium sulphate, Indicators, Gay-Lussac method, Mohr's method, Volhard's method and Fajan's method.
5. **Gravimetric Analysis:** Precipitation techniques, Solubility products; The colloidal state, Supersaturation co-precipitation, Postprecipitation, Digestional washing of the precipitate, Filtration, Filter papers and crocibles, Ignition, Thermogravimetric curves, Specific examples like barium sulphate, aluminium as aluminium oxide, calcium as calcium oxalate and magnesium as magnesium pyrophosphate, Organic precipitants.

09 1102P **PHARMACEUTICAL ANALYSIS - I (LAB)**
L-T-P : 0-0-4 Credit : 2

The students should be introduced to the main analytical tools through demonstrations. They should have a clear understanding of a typical analytical balance, the requirements of a good balance, weights, care and use of balance, methods of weighing and errors in weighing. The students should also be acquainted with the general apparatus required in various analytical procedures.

1. Standardization of analytical weights and calibration of volumetric apparatus.
2. Acid Base Titrations : Preparation and standardization of acids and bases; some exercises related with determination of acids and bases separately or in mixture form, some official assay procedures e.g. boric acid should also be covered.
3. Oxidation Reduction Titrations: Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate etc. Some exercises related to determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving potassium iodate, potassium bromate, iodine solution, titanous chloride, sodium 2,6-dichlorophenol indophenol, and ceric ammonium sulphate.
4. Precipitation titrations: Preparation and standardization of titrants like silver nitrate and, ammonium thiocyanate, Titrations according to Mohr's, Volhard's and Fajan's methods.
5. Gravimetric Analysis: Preparation of gooch crucible for filtration and use of sintered glass crucible, Determination of water of hydration, some exercises related to gravimetric analysis should be covered.

Recommended Books:

1. Vogel's Text book of Quantitative Chemical Analysis (Person Education, Singapore).
2. Beckett & Stenlake: "Practical Pharmaceutical Chemistry," CBS Publishers & Distributors.
3. Garratt, "The Quantitative analysis of drugs".

09 1103 PHARMACEUTICAL CHEMISTRY - I (Inorganic Pharmaceutical Chemistry)
L-T-P : 3-0-0 Credit : 3

An outline of methods of preparation, uses, sources of impurities, tests for purity and identity, including limit tests for iron, arsenic, lead, heavy metals, chloride, sulphate and special tests if any, of the following classes of inorganic pharmaceuticals included in Indian Pharmacopoeia.

1. Acids and Bases: Buffers, Water.
2. Gastrointestinal Agents: Acidifying agents, Antacids, Protectives and Adsorbents, Cathartics.
3. Major Intra-and Extra-cellular Electrolytes: Physiological ions. Electrolytes used for replacement therapy, acid-base balance and combination therapy.
4. Essential and Trace Elements: Transition elements and their compounds of pharmaceutical importance, Iron and haematinics, mineral supplements.

5. Cationic and anionic components of inorganic drugs useful for systemic effects.
6. Topical Agents: Protectives, Astringents and Anti-infectives.
7. Gases and Vapours: Oxygen, Anesthetics and Respiratory stimulants.
8. Dental Products: Dentifrice, Anti-caries agents.
9. Complexing and chelating agents used in therapy
10. Miscellaneous Agents: Sclerosing agents, expectorants, emetics, poisons and antidotes, sedatives etc. Pharmaceutical Aids Used in Pharmaceutical Industry. Anti-oxidants, preservatives, filter aids, adsorbents, diluents, excipients, suspending agents, colorants etc.
11. Inorganic Radio Pharmaceuticals: Nuclear radio pharmaceuticals, Reactions, Nomenclature, Methods of obtaining their standards and units of activity, measurement of activity, clinical applications and dosage, hazards and precautions.

09 1103P **PHARMACEUTICAL CHEMISTRY - I (LAB)**
L-T-P : 0-0-4 Credit : 2

The background and systematic qualitative analysis of inorganic mixtures of up to four radicals. Six Mixtures to be analyzed, preferably by semimicro methods. At identification tests for pharmacopocial inorganic pharmaceuticals and qualitative tests for cations & anions should be covered.

Recommended Books:
1. Inorganic Medicinal and Pharmaceutical Chemistry by Block, Roche, Soine, Wilson
2. Bentley and Driver's Text Book of Pharmaceutical Chemistry.
3. Pharmaceutical Chemistry – Inorganic by G.R.Chatwal.

09 1104 PHARMACOGNOSY - I
L-T-P : 3-0-0 Credit : 3

1. Definition, history, scope and development of Pharmacognosy
2. Sources of drugs: Biological, marine, mineral and plant tissue cultures as sources of drugs
3. Classification of drugs: Alphabetical, morphological, taxonomical, chemical and pharmacological classification of drugs.
4. Plant taxonomy: study of the following families with special reference to medicinally important plants - Apocynacae, Solanaceae, Rutacease, Umbelliferae, Leguminosae, Rubiaceae, Liliaceae, Graminae, Labiatae, Cruciferae, Papaveraceae.
5. Cultivation, Collection, Processing and storage of crude drugs: Factors influencing cultivation of medicinal plants. Types of soils and fertilizers of common use. Pest management and natural pest control agents. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants.
6. Quality control of crude drugs: Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods and properties.
7. An introduction to active constituents of drugs: their isolation, classification and properties.
8. Systematic pharmacognostic study of following:
   a) Carbohydrates and derived products: agar, guar gum, acacia, Honey, Isabgol, pectin, Starch, sterculia and Tragacantyh.
   b) Lipids: Bees wax, Castor oil, Cocoa butter, Cod~liver oil, Hydnocarpus oil, Kokum butter, Lard, Linseed oil, Rice, Bran oil, Shark liver oil and Wool fat.

09 1104P **PHARMACOGNOSY – I (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Morphological characteristics of plant families mentioned in theory.
2. Microscopic measurements of cells and Cell contents: Starch grains, calcium oxalate crystals and phloem fibres.
3. Determination of leaf constants such as stomatal index, stomatal number, vein-islet number, vein-termination number and palisade ratio.
4. Identification of crude drugs belonging to carbohydrates and lipids.
5. Preparation of herbarium sheets.

Recommended Books:
1. Text Book of Pharmacognosy by Kokate C K, Purohit A P, Gokhale S B (Nirali Prakashan, Pune)
2. Trease G.E. and Evans W.C., Pharmacognosy (Balliene Tindall, Eastbourne)
3. Text Book of Pharmacognosy by T.E.Wallis.(CBS Publishers & Distributors, New Delhi)
4. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)

24 1105 COMMUNICATIVE ENGLISH

L-T-P : 3-1-0 Credit : 3

1. Basic Grammar: Structural pattern, single word substitution: Editing tenses of Verbs.
2. Common errors, comparison, Syntax.
3. Antonyms, Homonyms, Comprehension based on topics of Science & Technology
4. Precise, Paragraph Writing, Technical description.
5. Expansion (worked & phrase)
6. Official Correspondence, Memorandum, Circular letter.
7. Applying for a job, Resume
8. Business Correspondence, Report Writing, E-mail.
9. Phonetics (Symbol and Transcription), Pronunciation.
10. Reading –developing Reading skill.
11. Group Discussion.

Recommended Books:

1. English grammar and Effective Business Communication by M.A. Pink & S.E. Thomas – S.Chand & Company Ltd.
2. English grammar by Dr. D .Thakur
3. Comprehensive English grammar by C.J.Joseph & EG Myall – Inter Univ. Press.
4. Technical English by Sharon j Garson and Steve M Garson.
5. Gartside's Model Business Letters by Shirley Taylor – Pitman Publishing.
6. Communication in English for Technical Student by Orient Longman.
7. Business Correspondence and Report Writing by R. C. Sharma and Krishna Mohan - Tata McGraw Hill.
9. A Student's Grammar of the English Language by Sidney Greendaum & Randolph Quirk (Pearson Education)

09 1106 REMEDIAL MATHEMATICS

L-T-P : 3-1-0 Credit : 3

1. **Algebra:** Equations reducible to quadratics, simultaneous equations (linear and quadratic), Determinants, properties of solution of simultaneous equations by Cramer's rule, matrices, definition of special kinds of matrices, arithmetic operations on matrices, inverse of a matrix, solution of simultaneous equations by matrices, pharmaceutical applications of determinants and matrices. Evaluation of Enl, En2, and En3, mensuration and its pharmaceutical applications.
2. Measures of Central Value: Objectives and pre-requisites of an ideal, measure, mean, mode and median.
3. Trigonometry: Measurement of angle, T-ratios, addition, subtraction and transformation formulae, T-ratios of multiple, submultiple, allied and certain angles. Application of logarithms in pharmaceutical computations.
4. Analytical Plans Geometry: Certain co-ordinates, distance between two points, area of triangle, a locus of point, straight line, slope and intercept from, double - intercept form, normal (perpendicular form), slope-point and two point form, general equation of first degree.
5. Calculus:
   Differential**:** Limits and functions, definition of differential coefficient, differentiation of standard functions, including function of a function (Chain rule). Differentiation of implicit functions, logarithmic differentiation, parametric differentiation, successive differentiation.
   Integral**:** Integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, substitution and partial fractions, formal evaluation of definite integrals.

Recommended Books:

1. A Textbook of mathematics for XI-XII Students, NCERT Publications, vol. I-IV.
2. Sinha: "A Text Book of Algebra and Coordinate Geometry," Students Friends Publications.
3. Agarwal : "Senior Secondary School Mathematics," Bharti Bhawan Publications.
2. Boltons, Pharmaceutical Statistics. Practical and Clinical Applications, Meecel Dekker, N Y.
3. Daniel W W, Biostatistics. A Foundation for Analysis in Health Sciences, John Wiley, NY.

Or

09 1107 REMEDIAL BIOIOGY

L-T-P : 2-0-0 Credit : 2

1. Methods of classification of plants.
2. Plant cell, its structure and non-living inclusions; mitosis and meiosis; different types of plant tissues and their functions.

3. Morphology and histology of root, stem, bark, wood, leaf, flower, fruit and seed. Modification of root and stem.
4. General Survey of Animal Kingdom; Structure and life history of parasites as illustrated by amoeba, entamoeba, trypanosoma, plasmodium, taenia, ascaris, schistosoma, oxyuris, and ancylostoma.
5. General Structure and life history of insects like mosquito, housefly, mites and silkworm.
6. Cell & Tissue:
    - Structure of cell, its components and their functions.
    - Mechanism of transport through the cell membrane.

09 1107P **REMEDIAL BIOIOGY (LAB)**
L-T-P : 0-0-2 Credit : 1

l. Morphology of plant parts indicated in theory.
2. Care, use and type of microscopes.
3. Gross identification of slides of structure and life cycle of lower plants animals mentioned in theory.
4. Morphology of plant parts indicated in theory.
5. Preparation, microscopic examination of stem, root and leaf of monocot and dicot plants.
6. Structure of human parasites and insects mentioned in theory with the help of Specimens.

Recommended Books:

1. Dutta: “Text Book of Botany”.
2. Maheshwari: “Text Book of Botany”.
3. Truemans: “Elementary Biology”.
4. Vidyarathi:“Text Book of Biology”.
5. Gupta: “Genetics”.

SEMESTER - II

09 1201 PHARMACEUTICS - II (Unit Operations I, including Engg. Drawing)
L-T-P : 3-0-0 Credit : 3

1. Unit Operations: Introduction, basic laws.
2. Fluid Flow: Types of flow, Reynold's number, Viscosity, Concept of boundary layer, basic equations of fluid flow, valves, flow meters, manometers and measurement of flow and pressure.
3. Material Handling Systems:
    a. Liquid handling - Different types of pumps.
    b. Gas handling-Various types of fans, blowers and compressors.
    c. Solid handling-Bins, Bunkers, Conveyers, Air transport.
4. Filtration and Centrifugation: Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter etc. Factors affecting filtration, mathematical problems on filtration, optimum cleaning cycle in batch filters. Principles of centrifugation, industrial centrifugal filters and centrifugal sedimenters.
5. Crystallization: Characteristics of crystals like-purity, size, shape, geometry, habit, forms size and factors affecting them, Solubility curves and calculation of yields. Material and heat balances around Swenson Walker Crystallizer. Supersaturation theory and its limitations, Nucleation mechanisms, crystal growth. Study of various types of Crystallizer, tanks, agitated batch, Swenson Walker, Single vacuum, ciralating magma and crystal Crystallizer, Caking of crystals and its prevention. Numerical problems on yields.
6. Dehumidification and Humidity Control: Basic concepts and definition, wet bulb and adiabatic saturation temperatures, Psychrometric chart and measurement of humidity, application of humidity measurement in pharmacy, equipments for dehumidification operations.
7. Refrigeration and Air Conditioning: Principal and applications of refrigeration and air conditioning.
8. Material of Construction: General study of composition, corrosion, resistance, Properties and applications of the materials of construction with special reference to stainless steel and glass.
9. Industrial Hazards and Safety Precautions: Mechanical, Chemical, Electrical, fire and dust hazards. Industrial dermatitis, Accident records etc.

09 1201P **PHARMACEUTICS - II (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Measurement of flow of fluids and their pressure, determination Reynold's number and calculation of Frictional losses.
2. Evaluation of filter media, determination of rate of filtration and study of factors affecting filtration.
3. Experiments to demonstrate applications of centrifugation.

4. Thermometers and Psychrometric charts.
5. Determination of humidity - use of Dry Bulb and Wet Bulb.
6. Elementary Knowledge of Engineering Drawing - Concept of orthographic and isometric views of elevation and third angle projection. Notation and abbreviation used in engineering drawing.
7. Basic Engineering Drawing Practice - Bolts, nuts, rivetted fronts, screws, worn screws as per specification.
8. Drawing of simple pharmaceutical machinery parts.

Recommended Books:

1. Cooper and Gunn's Tutorial Pharmacy Edited by S.J.Carter (CBS Publishers, Delhi)
2. Pharmaceutical Engineering by K.Sanbamurty (New Age International, New Delhi)
3. Chamical Engineering by Badger and Banchero (Mc Graw Hill, New Delhi)
4. Pharmaceutical Dosage forms by Aulton.(Churchill Livingstone, Edinburg)

09 1202 PHARMACEUTICAL CHEMISTRY - II (Physical Chemistry)

L-T-P : 3-0-0 Credit : 3

1. Behaviour of Gases: Kinetic theory of gases, deviation from behaviours and explanation.
2. The Liquid State: Physical properties (surface tension, parachor, viscosity, refractive index, optical rotation, dipole moments and chemical constituents).
3. Solutions: Ideal and real solutions, solutions of gases in liquids, colligative properties, partition coefficient, conductance and its measurement, Debye Huckel theory.
4. There dynamics: First, second and third laws, Zeroth law, absolute temperature scale, thermochemical equations, phase equilibria and phase rule.
5. Adsorption: Freudlich and Gibbs adsorption, isotherms, Langmuir theory of adsorption.
6. Photochemistry: Consequences of light absorption, Jablenski diagram, Lambert-Beer Law, Quantum efficiency.
7. Chemical Kincties: Zero, first and second order reactions, complex reactions, theories of reaction kinetics, characteristics of homogeneous and heterogeneous catalysis, acid base and enzyme catalysis.
8. Quantum Mechanics: Postulates of quantum mechanics, operators in quantum mechanics, the Schrodinger wave equation.

09 1202P **PHARMACEUTICAL CHEMISTRY - II (LAB)**

L-T-P : 0-0-4 Credit : 2

1. To determine molar mass by Rast method and cryoscopic method.
2 To determine refractive index of given liquids and find out the contribution of carbon, hydrogen and oxygen in molar refraction of a compourld.
3. To determine molar mass of volatile liquids by Victor-Meyer method.
4. To determine the specific rotation of sucrose at various concentrations and determine the intrinsic rotation.
5. To determine the heat of solution, heat of hydration and heat of neutralization.
6. To determine the cell constant, verify Ostwald dilution law and perform conductometric titration,.
7. To determine rate constant of simple reaction.

Recommended Books:

1. Bahl & Tuli: "Essentials of Physical Chemistry" S. Chand & Co.
2. Atkins & de Poule, "Atkins Physical Chemistry" Oxford University Press.

09 1203 PHARMACEUTICAL CHEMISTRY - III (Organic Chemistry)

L-T-P : 3-0-0 Credit : 3

The subject of organic chemistry will be treated in its modem perspective keeping for the sake of convenience, the usual classification of organic compounds:

1. Structure and Properties**:** Atomic structure, Atomic orbitals, Molecular orbital theory, wave equation, Molecular orbitals, Bonding and Antibonding orbitals, Covalent bond, Hybrid orbitals, Intramolecular forces, Bond dissociation energy, Polarity of bonds, Polarity of molecules, structure and physical properties, Intermolecular forces, Acids and bases.
2. Stereochemistry: Isomerism and nomenclature and associated physicochemical properties, optical activity, stereoisomerism, specification of configuration, Reactions involving stereoisomers, chirality, chiral reagents conformations.
3. Structure, Nomenclature, Preparation and Reactions of: Alkanes, Alkenes, Alkynes, Cycloalkanes, Dienes, Benzene, Polynuclear aromatic compounds, Arenes, Alkyl halides, Alcohols, Ethers, Epoxides, Amines, Phenols, Aldehydes and ketones, Carboxylic acids, Functional derivatives of' carboxylic acids, Reactive intermediates - carbocations, carbanions, carbenes, nitrene and nitrenium ions.

09 1203P **PHARMACEUTICAL CHEMISTRY - III (LAB)**
L-T-P : 0-0-4 Credit : 2

1. The student should be introduced to the various laboratory techniques through demonstrations involving synthesis of selected organic compounds (e.g. aspirin, p-bromoacetanilide, anthraquinone from anthracine, reduction of nitrobenzene etc)
2. Identification of organic compounds and their derivatisation.
3. Introduction to the use of stereomodels.

Recommended books:
1. Organic chemistry by Morrison and Boyd.(Prentice Hall of India, New Delhi)
2. Advanced organic chemistry by Bhal & Bhal (S.Chand, New Delhi)
3. Organic Chemistry Vol. 1 and II by I.L.Finar (Longman, Singapur)
4. Bently and Drivers text of Pharmaceutical chemistry by Oxford University, New Delhi

09 1204 ANATOMY, PHYSIOLOGY & HEALTH EDUCATION (APHE) -I
L-T-P : 3-0-0 Credit : 3

1. Scope of anatomy and physiology and basic terminology used these subjects.
2. Structure of cell, its components and their functions.
3. Elementary Tissues of the Human Body**:** Epithelial, connective, muscular and nervous tissues, their sub-types and their characteristics.
4. Osseous System: Structure, composition and functions of skeleton Classification of joints, types of movements of joints, Disorders of joints.
5. Skeletal Muscles**:** Gross anatomy; physiology of muscle contraction, physiological properties of skeletal muscles and their disorders.
6. Haemopoietic System: Composition and functions of blood and its elements, their disorders, blood groups and their significance, mechanism of coagulation, disorders of platelets and coagulation.
7. Lymph and Lymphatic System: Composition, formulation and circulation of lymph; disorders of lymph and lymphatic system. Basic physiology and functions of spleen.
8. Cardiovascular System: Basic anatomy of the heart, Physiology of heart, blood vessels and circulation. Basic understanding of Cardiac cycle, heart sounds and understanding of Cardiac cycle, heart sounds and electrocardiogram. Blood pressure and its regulation. Brief outline of cardiovascular disorder like hypertension, hypotension, arteriosclerosis, angina, myocardial infarction, congestive heart failure and cardiac arrhythmias.

09 1204P **APHE –I (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Study of human skeleton.
2. Study of different systems with the help of charts and models.
3. Microscopic study of different tissues.
4. Estimation of haemoglobin in blood. Determination of bleeding time, clotting time, R.B.C. Count, Total leucocyte count, D.L.C. and E.S.R.

5 Recording of body temperature, pulse rate and blood pressure, basic understanding of Electrocardiogram-PQRST waves and their significance.

Recommended books:
1. Anatomy and Physiology in Health and Illness by Ross and Willson (Churchill living stone)
2. Concise Medical Physiology by S.K.Choudhury (New central book agency, Calcutta)
3. Guyton A C, Hall JE., Text book of Medical Physiology, W.B.Sandnders Company
4. Human Physiology, C C Chatterjee, Medical allied agency, Calcutta
5. Tortora G.J., S.R.Grabowski & Anagnodokos N.P., Principles of Anatomy & Physiology

09 1205 ADVANCED MATHEMATICS
L-T-P : 3-1-0 Credit : 3

1. Differential equations: Revision of integral calculus, definition and formation of differential equations, equations of first order and first degree, variable separable, homogeneous and linear differential equations and equations reducible to such types, linear differential equations of order greater than one with constant coefficients, complementary function and particular integral, simultaneous linear differential equations, pharmaceutical applications.

2. Laplace transforms**:** Definition, transforms of elementary functions, properties of linearity and shifting, inverse laplace transforms, transforms of derivatives, solution of ordinary and simultaneous differential equations.

3. Biometrics: Significant digits bend rounding of numbers, data collection, random and non-random sampling methods, sample size, data organization, diagrammatic representation of data, bar, pie, 2-D and 3-D diagrams, measures of central tendency, measures of dispersion, Standard Deviation and standard error of means, coefficient of variation, confidence (fiducial) limits, probability and events, Bayes' theorem, probability theorems, probability distributions, elements of binomial and Poisson distribution, normal Histribution curve & properties, kurtosis and skewness, correlation and regression analysis, method of least squares, statistical inference, Student's and paired t-test, F-test and elements of ANOVA, applications of statistical concepts in Pharmaceutical Sciences.

Recommended Books:

1. Daniel W W, Biostatistics. A Foundation for Analysis in Health Sciences, John Wiley, NY.
2. Grewal B S, Higher Engineering Mathematics, Khanna Publishers, New Delhi.
3. Gupta S P, Statistical Methods, Sultan Chand & Co., New Delhi.
4. Schaum, Differential Equations, McGraw- Hill Singapore.

SEMESTER – III

09 1301 PHARMACEUTICS – III (Unit Operations II)

L-T-P : 3-0-0 Credit : 3

1. **Stoichiometry:** Unit processes material and energy balances, molecular units, mole fraction, tie substance, gas laws, mole volume, primary and secondary quantities, equilibrium state, rate process, steady and unsteady states, dimensionless equations, dimensionless formulae, dimensionless groups, different types of graphic representation, mathematical problems.
2. **Heat Transfer:** Source of heat, heat transfer, steam and electricity as heating media, determination of requirement of amount of steam/electrical energy, steam pressure, Boiler capacity, Mathematical problems on heat transfer.
3. **Evaporation:** Basic concept of phase equilibria, factor affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators, Mathematical problems on evaporation.
4. **Distillation:** Rault's law, phase diagrams, volatility; simple steam and flash distillations, principles of rectification, Mc. Cabe Thiele method for calculations of number of theoretical plates, Azeotropic and extractive distillation. Mathematical problems on distillation.
5. **Drying:** Moisture content and mechanism of drying, rate of drying and time of drying calculations; classification and types of dryers, dryers used in pharmaceutical industries and special drying methods. Mathematical problems on drying.
6. **Size Reduction and Size Separation:** Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mills including ball mill, hammer mill, fluid energy mill etc.
7. **Mixing:** Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipments.
8. **Automated Process Control Systems:** Process variables, temperature, pressure, flow, level and vacuum and their measurements. Elements of automatic process control and introduction to automatic process control systems. Elements of computer aided manufacturing (CAM).
9. Reactors and fundamentals of reactors design for chemical reactions.

09 1301P **PHARMACEUTICS – III (LAB)**

L-T-P : 0-0-4 Credit : 2

I. Determination of overall heat transfer coefficient.
2. Determination of rate of evaporation.
3. Experiments based on steam, extractive and azeotropic distillations.
4. Determination of rare of drying, free moisture content and bound moisture content.
5. Experiments to illustrate the influence of various parameters on the rate of drying.
6. Experiments to illustrate principles of size reduction, Laws governing energy and power requirements of size Reduction.
7. Experiments to illustrate solid-solid mixing, determination of mixing efficiency using different types of mixers.

Recommended Books:

1. Cooper and Gunn’s Tutorial Pharmacy Edited by S.J.Carter (CBS Publishers, Delhi)
2. Pharmaceutical Engineering by K.Sanbamurty (New Age International, New Delhi)
3. Chamical Engineering by Badger and Banchero (Mc Graw Hill, New Delhi)
4. Pharmaceutical Dosage forms by Aulton.(Churchill Livingstone, Edinburg)
5. Gennaro, “Remington’s The Science & Practice of Pharmacy” (Lippincott William and Wilkins).

09 1302 **PHARMACEUTICAL CHEMISTRY - IV (Organic Chemistry - II)**
L-T-P : 3-0-0 Credit : 3

Nucleophillic aromatic substitutions; α β unsaturated carbonyl compounds; Conservation of orbital symmetry and rules., Electrocyclic, Cycloaddition and sigmatropic reactions; Neighbouring group effects; Catalysis by transition metal complexes, Stereoselective and sterospecific reactions; New organic reagents used in drug synthesis.

Heterocyclic Compounds: Chemistry, preparations and properties of some important heterocyclis containing 3, 4,5,6 & 7 atoms with one or two heteroatoms like 0, N, S.

Chemistry of Lipids, Carbohydrates, Proteins and Nucleic acids.

09 1302P **PHARMACEUTICAL CHEMISTRY - IV (LAB)**
L-T-P : 0-0-4 Credit : 2

At least five exercises in synthesis involving various heterocyclic ring systems. An exercise involving stereo selective synthesis of a compound. Resolution of racemic D,L alanine or any other example.

Workshop on molecular modeling of primary, secondary and tertiary structures of proteins, molecular modelling on double helical structure of nucleic acid showing hydrogen bonding.

Recommended Books:
1. Organic Chemistry by R.T. Morrison and R.N.Boyd.(Prentice Hall of India, New Delhi)
2. Advanced Organic Chemistry by B.S.Bahl and Arun Bahl.(S.Chand, New Delhi)
3. Bentley and Driver's Text Book of Pharmaceutical Chemistry. (Oxford University Press, New Delhi)
4. Organic Chemistry – Reactions and Reagents by O. P.Agarwal.
5. Organic Chemistry by I.L. Finar Vol. I & Vol. II.(Longman, Singapore)

09 1303 PHARMACOGNOSY - II
L-T-P : 3-0-0 Credit : 3

1. **Resins:** Study of Drugs Containing Resins and Resin Combination like Colophony, podophyllum, jalap, cannabis, capsicum, myrrh, asafoetida, balsam of tolu, balsam of peru, benzoin, turmeric, ginger.
2. **Tannis:** Study of tannins and tannin containing drugs like Gambir, black catechu, gall and myrobalan.
3. **Volatile Oils:** General methods of obtaining volatile oils from plants, Study of volatile oils of Mentha, Coriander, Cinnamon, Cassia, Lemon peel, Orange peel, Lemon grass, Citronella, Caraway, Dill, Spearmint, Clove, Fennel, Nutmeg, Eucalyptus, Chenopodium, Cardamom, Valerian, Musk, Palmarosa, Gaultheria, Sandal wood.
4. **Phytochemical Screening:**
   a) Preparation of extracts.
   b) Screening of alkaloids, saponins, cardenolides and bufadienolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cynogenetic glycosides, amino acids in plant extracts.
5. **Fibres:** Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass-wool, polyester and asbestos.
6. **Pharmaceutical aids:** Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin and natural colors.

09 1303P **PHARMACOGNOSY - II (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Identification of crude drugs mentioned in theory.
2. Study of fibres and pharmaceutical aids.
3. Microscopic studies of seven-selected crude drugs and their powders mentioned under the category of volatile oils in theory and their chemical tests,
4. General chemical tests for alkaloids, glycosides, steroids, flavonoids and tannins.

Recommended Books:
1. Text Book of Pharmacognosy by Kokate C K, Purohit A P, Gokhale S B (Nirali Prakashan, Pune)
2. Trease G.E. and Evans W.C., Pharmacognosy (Balliene Tindall, Eastbourne)
3. Text Book of Pharmacognosy by T.E.Wallis.(CBS Publishers & Distributors, New Delhi)
4. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)

09 1304 PHARMACEUTICAL ANALYSIS - II
L-T-P : 3-0-0 Credit : 3

Theoretical considerations and application in drug analysis and quality control of the following analytical techniques.

1. Non-aqueous titrations
2. Complexometric titrations
3. Miscellaneous Methods of Analysis: Diazotisation titrations, Kjeldahl method of nitrogen estimation, Karl-Fischer titration, Oxygen flask combustion, gasometry.
4. Extraction procedures including separation of drugs from excipients
5. Chromatography: The following techniques will be discussed with relevant examples of Pharmacopoeial products. TLC, HPLC, GLC, HPTLC, Paper Chromatography and Column Chromatography.
6. Potentiometry
7. Conductometry
8. Coulometry
9. Polarography
10. Amperometry

09 1304P **PHARMACEUTICAL ANALYSIS - II (LAB)**
L-T-P : 0-0-4 Credit : 2

1. **Nonaqueous Titrations:** Preparation and standardization of perchloric acid and sodium / potassium / lithium methoxides solutions; Estimations of some pharmacopoeial products.
2. **Complexometric Titrations:** Preparations and standardization of EDT A solution, some exercises related to pharmacopoeial assays by complexometric titrations.
3. **Miscellaneous Determinations:** Exercises involving diazotisation, Kjeldahl, Karl- Fischer, Oxygen flask combustion and gasometry methods. Determination of alcohol content in liquid galenicals, procedure (BPC) shall be covered.
4. Experiments involving separation of drugs from excipients.
5. Chromatographic analysis of some pharmaceutical products.
6. Exercises based on acid base titration in aqueous and nonaqueous media, oxidation-reduction titrations using potentiometric technique, Determination of acid-base disassociation constants and plotting of titration curves using pH meter.
7. Exercises involving polarimetry.
8. Exercises involving conductometric and polarographic techniques.

Recommended Books:

1. Vogel's Text Book of Quantitative Chemical Analysis.
2. Practical Pharmaceutical Analysis by Beckette and Stenlake Vol. I & II.
3. Indian Pharmacopocia Vol. I & II
4. Instrumental methods chemical analysis by B.K. Sharma
5. Bently and Driver's Text Book of Pharmaceutical Chemistry.

09 1305 ANATOMY, PHYSIOLOGY AND HEALTH EDUCATION (APHE -II)
L-T-P : 3-0-0 Credit : 3

1. **Digestive System:** Gross anatomy of the gastro-intestinal tract, functions of its different parts including those of liver, pancreas and gall bladder, various gastrointestinal secretions and their role in the absorption and digestion of food. Disorders of digestive system.
2. **Respiratory System:** Anatomy of respiratory organs & its functions, respiration, mechanism and regulation of respiration, respiratory volumes and vital capacity.
3. **Central Nervous System:** Functions of different parts of brain and spinal cord. Neurohumoral transmission in the central nervous system, reflex action electroencephalogram, specialized functions of the brain, Cranial nerves and their functions.
4. **Autonomic Nervous System:** Physiology and functions of the autonomic nervous system. Mechanism of neurohumoral transmission in the A.N.S.
5. **Urinary System:** Various parts, structures and functions of the kidney and urinary tract. Physiology of urine formation and acid-base balance. Diseases of the urinary system.
6. **Reproductive System:** Male and female reproductive systems and their hormones, physiology of menstruation, coitus and fertilization. Sex differentiation, spermatogenesis & oogenesis. Pregnancy its maintenance and parturition.
7. **Endocrine System:** Basic anatomy and physiology of Pituitary, Thyroid, Parathyroid. Adrenals, Pancreas, Testes and ovary, their hormones and functions.

8. **Sense Organs:** Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, nose (smell) and skin (superficial receptors).
9. a. **Concepts of health and disease:** Disease causing agents and prevention of disease.
   b. **Classification of food requirements:** Balanced diet, nutritional deficiency disorders, their treatment and prevention, specifications for drinking water.
   c. **Demography and family planning:** Medical termination of pregnancy.
   d. **Communicable diseases:** Brief outline, their causative agents, modes of transmission and prevention (Chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis, poliomyelitis, helminthiasis, malaria, filariasis, rabies, trachoma, tetanus, leprosy, syphilis, gonorrhoea, and AIDS).
   e. **First Aid:** Emergency treatment of shock, snake bites, burns, poisoning, fractures and resuscitation methods.

09 1305P **APHE –II (LAB)**
L-T-P : 0-0-4 Credit : 3

1. Study of different systems with the help of charts and models.
2. Microscopic studies of different tissues.
3. Simple experiments involved in the analysis of normal and abnormal urine: Collection of specimen, appearance, determination of pH, Sugars, proteins, urea and creatinine.
4. Physiological experiments on nerve-muscle preparations.
5. Determination of vital capacity, experiments on spirometry.

Recommended books:

1. Anatomy and Physiology in Health and Illness by Ross and Willson (Churchill living stone)
2. Concise Medical Physiology by S.K.Choudhury (New central book agency, Calcutta)
3. Guyton A C, Hall JE., Text book of Medical Physiology, W.B.Sandnders Company
4. Human Physiology, C C Chatterjee, Medical allied agency, Calcutta
5. Tortora G.J., S.R.Grabowski & Anagnodokos N.P., Principles of Anatomy & Physiology

SEMESTER - IV

09 1401 PHARMACEUTICS - IV (Dispensing and Community Pharmacy)
L-T-P : 3-0-0 Credit : 3

1. Definition and Scope
2. **Prescription:** Handling of prescription, source of errors in prescription, care required in dispensing procedures including labeling of dispensed products.
3. General dispensing procedures including labeling of dispensed products.
4. **Pharmaceutical calculations:** Posology, calculation of doses for infants, adults and elderly patients; Enlarging and reducing recipes percentage solutions, allegation, alcohol dilution, proof spirit, isotonic solutions, displacement value etc.
5. Principles involved and procedures adopted in dispensing o**f:** Typical prescriptions like mixtures, solutions, emulsions, creams, ointments, powders, capsules, pastes, jellies, suppositories, ophthalmic, pastilles, lozenges, pills, lotions, liniments, inhalations, paints sprays tablet triturates, etc.
6. Incompatibilities: Physical and chemical incompatibilities, inorganic incompatibilities including incompatibilities of metals and their salts, non-metals, acids, alkalis, organic incompatibilities. Purine bases, alkaloids, pyrazolone derivatives, amino acids, quaternary ammonium compounds, carbohydrates, glycosides, anesthetics, dyes, surface active agents, correction of incompatibilities. Therapeutic incompatibilities.
7. Community Pharmacy: Organization and structure of retail and whole sale drug store-types of drug store and design, legal requirements for establishment, maintenance and drug store-dispensing of proprietary products, maintenance of records of retail and wholesale, patient counseling, role of pharmacist in community health care and education.

09 1401P **PHARMACEUTICS - IV (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Dispensing of prescriptions falling under the categories: Mixtures, solutions, emulsions. Creams, ointments, powders, suppositories, opthalmics, capsules, pastes, jellies, pastille, lozenges, pills, tablet triturates, lotions, liniments, inhalations, paints, etc.
2. Identification of various types of incompatibilities in prescription, correction thereof and dispensing of such prescriptions.

3. Dispensing procedures involving pharmaceuticals calculations, pricing of prescriptions and dosage calculations for pediatric and geriatric patients.
4. Dispensing of prescriptions involving adjustment of tonicity.
5. Categorization and storage of pharmaceutical products based on legal requirements of labeling and storage.
6. Project report on visit to the nearby community for counseling on the rational use of drugs and aspects of health care.

Recommended books:
1. Cooper & Gunn's Dispensing for Pharmaceutical students CBS Publishers, New Delhi
2. Dispensing Pharmacy by R.M.Mehta (Vallabh Prakashan, Delhi)
3. Remington's "The Science & Practice of Pharmacy" (Lippincott William and Wilkins)

09 1402 PHARMACEUTICAL MICROBIOLOGY
L-T-P : 3-0-0 Credit : 3

1. Introduction to the scope of microbiology.
2. Structure of bacterial cell.
3. Classification of microbes and their taxonomy. Actinomycetes, bacteria, rickettsiae, spirochetes and viruses.
4. Identification of Microbes: Stains and types of staining techniques, electron microscopy.
5. Nutrition, cultivation, isolation of bacteria, actinomycetes, fungi, viruses, etc.
6. Microbial genetics and variation.
7. Control of microbes by physical and chemical methods.
   a. Disinfection, factors influencing disinfectants, dynamics of disinfection, disinfectants and antiseptics and their evaluation.
   b. Sterilization, different methods, validation of sterilization methods & equipments.
8. Sterility testing of all pharmaceutical products.
9. Immunity, primary and secondary, defensive mechanisms of body, microbial resistance, interferon.
10. Microbial assays of antibiotics, vitamins & amino acids.

09 1402P **PHARMACEUTICAL MICROBIOLOGY (LAB)**
L-T-P : 0-0-4 Credit : 2

Experiments devised to prepare various types of culture media, sub culturing of common aerobic and anaerobic bacteria, fungus and yeast, various staining methods, various methods of isolation and identification of microbes, sterilization techniques and their validation, evaluation of antiseptics and disinfectants, testing the sterility of pharmaceutical products as per I.P. requirements, microbial assay of antibiotics and vitamins, etc.

Recommended books:
1. Microbiology of Pelczar and Kreig.
2. Text Book of Microbiology by Anantanarayana and Panicker.
3. Dispensing for pharmaceutical students by Cooper and Gunn.
4. Bently's Text Book of Pharmaceutics
5. Tutorial Pharmacy by Cooper and Gunn
6. Indian Pharmacopoeia
7. Shah and Shah (Pharmaceutical Microbiology)

09 1403 PHARMACOGNOSY - III
L-T-P : 3-0-0 Credit : 3

1. Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups of drugs containing glycosides.
   Saponins : Liquorice, ginseng, dioscorea, sarsaparilla, and senega.
   Cardioactive sterols: Digitalis, squill, strophanthus and thevetia.
   Anthraquinone cathartics: Aloe, senna, rhubarb and cascara.
   Others: Psoralea, Ammi majus, Ammi visnaga, gentian, saffron, chirata, quassia.
2. Studies of traditional drugs, common vernacular names, botanical sources, morphology, chemical nature of chief constituents, pharmacology, categories and common uses and marketed formulations of following indigenous drugs: Amla, Kantkari, Satavari, Tylophora, Bhilawa, Kalijiri, Bach, Rasna, Punamava, Chitrack, Apamarg, Gokhru, Shankhapushpi, Brahmi, Adusa, Atjuna, Ashoka, Methi, Lahsun, Palash, Guggal, Gymnema, Shilajit, Nagarmotha and Neem.
3. The holistic concept of drug administration in traditional systems of medicine. Introduction to ayurvedic preparations like Arishtas, Asvas, Gutikas, Tailas, Chumas, Lehyas and Bhasmas.

09 1403P **PHARMACOGNOSY - III (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Identification of crude drugs listed in theory.
2. Microscopic study of some important glycoside containing crude drugs as outlined above. Study of powdered drugs.
3. Standardization of some traditional drug formulations.

Recommended Books:
1. Text Book of Pharmacognosy by Kokate C K, Purohit A P, Gokhale S B (Nirali Prakashan, Pune)
2. Trease G.E. and Evans W.C., Pharmacognosy (Balliene Tindall, Eastbourne)
3. Text Book of Pharmacognosy by T.E.Wallis.(CBS Publishers & Distributors, New Delhi)
4. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)

09 1404 PATHOPHYSIOLOGY OF COMMON DISEASES
L-T-P : 3-0-0 Credit : 3

1. Basic Principles of Cell Injury and Adaptation: Causes of Cellular injury, pathogenesis, morphology of cell injury. Intercellular alterations in lipids, proteins and carbohydrates, Cellular adaptation, atrophy, hypertrophy.
2. Basic Mechanisms involved in the process of inflammation and repair: Alterations in vascular permeability and blood flow, migration of WBC, acute and chronic inflammation, mediators of inflammation, brief outline of the process of repair.
3. Pathophysiology of Common Diseases: Rheumatoid arthritis, gout, epilepsy, psychosis, depression, mania, hypertension, angina, congestive heart failure, atherosclerosis, myocardial infarction, diabetes, peptic ulcer, asthma, ulcerative colitis, hepatic disorders, acute and chronic renal failure, tuberculosis, urinary tract infections, sexually transmitted diseases, anemia and common types of neoplasm. Wherever applicable the molecular basis should be discussed.

Recommended Books:
1. Pathologic basis of diseases by Robbins S.L. (Harcourt India, New Delhi).
2. Pathology Quick Review and MCQs based on Harsh Mohan's Text Book of Pathology (Jaypee brothers medical publishers, New Delhi)

09 1405 BASIC ELECTRONICS AND COMPUTER APPLICATIONS
L-T-P : 3-0-0 Credit : 3

1. Basic Electronics: Semiconductors, p-n function diode, LED, photodiode and its uses. Rectifiers (half wave, full wave / with filters), transistors configurations, transistor amplifiers. Introduction to Integrated circuits, photo cells and photomultiplier tubes.
2. Computers:
2.1 Introduction to Computers: History of Computer development and respective generation: Abacus, Napier's-Bones, Slide rule, Pascal's Calculator. Need to use computers, applications in pharmacy and in general.
Computer Classification: Mainframe, Mini and Micro Computers, comparison of Analog & Digital Computers, Hardware and Software. Calculator and Computer.
2.2. Operating Systems: Introduction to types of operating systems, UNIX, MS-DOS, etc. RAM, ROM, Virtual Memory etc.
2.3. Type of Languages: Conventional languages; their advantages, limitations; C, Pascal, FORTRAN, Programming of these languages.
2.4. Introduction to Computer Networks: Architecture of seven layers of communications.
2.5. Introduction to Data Structure: Like Queues, list, trees, Binary trees algorithms, Flow chart, Structured Systems, Analysis and development, Ingress-SQL, Gateways etc. Statistics, methodologies. Basic Language: Constants and Variables: Character set, constants, variables, Naming the variables getting data into memory, LET, INPUT, READ. DATA, Print Statement. Expressions: Arithmetic expression, Hierarchy of operations, Rules of Arithmetic, Evaluation of expressions, Relational expressions, Logical operations, Library functions. Printer Control: Comma and semicolon control, the TAB function, PRINT, LPRINT. Functions and Subroutines: User defined functions, subroutines, subscripted variables.
2.6. Computer Graphics:
2.7. Computer applications in pharmaceutical and clinical studies.

09 1405P **BASIC ELECTRONICS AND COMPUTER APPLICATIONS (LAB)**
L-T-P : 0-0-2 Credit : 2

Exercises based on the following are to be dealt:
1. Computer operating systems like Unix, MS DOS, etc.
2. Simple program in BASIC
3. Study of soft-ware packages like WORD-STAR, LOTUS-123 etc.

Recommended Books:

1. Grogona P, Programming in Pascal, Adeison Wesley, Reading, M A. Hunt N and Shelley J. Computers and Commonsense, Prentice _ Hall of India, New Delhi.
2. Jensen K and Wirth N., Pascal User Mannual and Report, Narosa Publishing House, New Delhi.
3. Popst and Perrum "Computer Aided Drug Design", Academic Press, New York.
4. Ramanujan V, Computer Progrannming in Pascal, Prentice- Hall of India, New Delhi, I983.
5. Wirth N, Systematic Programming an Introduction, Prentice Hall Englewood Cliff's New Jersey.

09 1406 PHARMACEUTICAL JURISPRUDENCE & ETHICS
L-T-P : 3-0-0 Credit : 3

1. Introduction
   a. Pharmaceutical Legislations - A brief review.
   b. Drugs & Pharmaceutical Industry - A brief review.
   c. Pharmaceutical Education - A briefreview.
2. An elaborate study of the following
   a. Pharmaceutical Ethics
   b. Pharmacy Act 1948.
   c. Drugs and Cosmetics Act 1940 and Rules 1945.
   d. Medicinal & Toilet Preparations (Excise Duties) Act 1955.
   e. Narcotic Drugs & Psychotropic Substances Act 1985 & Rules.
   f. Drugs Price Control Order.
3. A brief study of the following with special reference to the main provisions.
   a. Poisons Act 1919
   b. Drugs and Magic Remedies (Objectionable Advertisements) Act 1954
   c. Medical Termination of Pregnancy Act 1970 & Rules 1975.
   d. Prevention of Cruelty to Animals Act 1960.
   e. States Shops & Establishments Act & Rules.
   f. Insecticides Act 1968.
   g. AICTE Act 1987.
   h. Factories Act 1948.
   i. Minimum Wages Act 1948. k Patents Act 1970.
4. A brief study of the various Prescription/Non-prescription Products, Medical/Surgical accessories, Diagnostic aids, appliances available in the market.
   (Note: The teaching of all the about Acts should cover the latest amendments).

Recommended Books:

1. A Textbook of Forensic Pharmacy by B.M.Mithal
2. A Textbook of Forensic Pharmacy by N.K.Jain
3. Drugs and Cosmetics Act and Rules published by Government of India
4. Pharmacy Act, Published by Government of India
5. Law of Drugs
6. Drug Cases published by International Law Book Co. Delhi (Reference)

SEMESTER - V

09 1501 PHARMACEUTICS – V (Pharmaceutical Technology - I)
L-T-P : 3-0-0 Credit : 3

1. Liquid Dosages Forms: Introduction, types of additives used in formulations, Vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizer, colors, flavours and others, manufacturing packaging and evaluation of clear liquids, suspensions and emulsions official in pharmacopoeia.
2. Semisolid Dosage Forms: Definitions, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection. General formulation of semisolids, clear gels manufacturing procedure, evaluation and packaging.
3. Suppositories: Ideal requirements, bases, manufacturing procedure, packaging and evaluation.
4. Extraction and Galenical **Products:** Principle and method of extraction, preparation of infusion, tinctures, dry

and soft liquid extracts.

5. Blood Products and Plasma Substitutes: Collection, processing and storage of whole human blood, concentrated human RBCs, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin, foam plasma substitutes, -ideal requirements, PVP, dextran etc. for control of blood pressure as per I.P.
6. Pharmaceutical **Aerosols:** Definition, propellants, general formulation, manufacturing and packaging methods, pharmaceutical applications.
7. Ophthalmic Preparations: Requirements, formulation, methods of preparation, containers, evaluation.
8. Cosmeticology and Cosmetic Preparations: Fundamentals of cosmetic science, structure and functions of skin and hair. Formulation, preparation and packaging of cosmetics for skin, hair, dentifrice and manicure preparations like nail polish, Lipsticks, eye lashes, baby care products etc.

09 1501P **PHARMACEUTICS – V (LAB)**

L-T-P : 0-0-4 Credit : 2

1. Preparation, evaluation and packaging of liquid orals like solutions, suspensions and emulsions, ointments, suppositories, aerosols, eye drops, eye ointments etc.
2. Preparation of pharmacopoeial extracts and galenical products utilizing various methods of Extraction.
3. Collection, processing, storage and fractionation of blood.
4. Formulation of various types of cosmetics for skin, hair, dentifrices and manicure preparations.

Recommended Books:

1. Bently's Textbook of pharmaceutics edited by E.A. Rawlins (All India Traveller Book Seller, New Delhi)
2. The Theory and Practice of Industrial Pharmacy by Lachmann, Libermann and Kanig (Varghese Pub. House, Bombay)
3. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel, Allen and Popovich (B.I.Waverly Pvt. Ltd., New Delhi)
4. REMINGTON : The Science and Practice of Pharmacy, (Lippincott Williams & Wilkins, Baltimore)
5. Pharmaceutics : The Science of Dosage Form Design by Aulton (Churchill Livingstone, Edinburgh)

09 1502 PHARMACEUTICAL CHEMISTRY -V (Biochemistry)

L-T-P : 3-0-0 Credit : 3

1. Biochemical organization of the cell and transport processes across cell membrane.
2. The concept of free energy, determination of change in free energy - from equilibrium constant and reduction potential, bioenergetics, production of ATP and its biological significance.
3. Enzymes: Nomenclature, enzyme kinetics and its mechanism of action, mechanism of inhibition, enzymes and iso-enzymes in clinical diagnosis.
4. Co-enzymes: Vitamins as co-enzymes and their significance. Metals as co-enzymes and their significance.
5. Carbohydrate Metabolism: Conversion of polysaccharide to glucose-I-phosphate, Glycolysis and fermentation and their regulation, Gluconeogenesis and glycogenolysis, Metabolism of galactose and galactosemia, Role of sugar nucleotides in biosynthesis, and Pentosephosphate pathway.
6. The Citric Acid Cycle: Significance, reactions and energetic of the cycle, Amphibolic role of the cycle, and Glyoxalic acid cycle.
7. Lipids Metabolism: Oxidation of fatty acids, oxidation & energetic, a-oxidation, Biosynthesis of ketone bodies and their utilization. Biosynthesis of saturated and unsaturated fatty acids, Control of lipid metabolism, Essential fatty acids & eicosanoids (prostaglandins, thromboxanes and leukotrienes), phospholipids, and sphingolipids.
8. Biological Oxidation: Redox-potential, enzymes and co-enzymes involved in oxidation reduction & its control, The respiratory chain, its role in energy capture and its control, Energetics of oxidative phosphorylation, Inhibitors of respiratory chain and oxidative phosphoryla Mechanism of oxidative phosphorylation.
9. Nitrogen & Sulphur Cycle: Nitrogen fixation. ammonia assimilation, nitrification and nitrate assimilation, Sulphate activation. sulphate reduction. Incorporation of sulphur in organic compounds. Release of sulphur from organic compounds.
10. Metabolism of Ammonia and Nitrogen Containing Monomers: Nitrogen balance. Biosynthesis of amino acids. Catabolism of amino acids. Conversion of amino acids to specialized products, Assimilation of ammonia. Urea. cycle, metabolic disorders of urea cycle. Metabolism of sulphur containing amino acids. Porphyrin biosynthesis. formation of bile pigments. hyperbilirubinemia. Purine biosynthesis. Purine nucleotide interconversion. Pyrimidine biosynthesis. and Formation of deoxyribounucleotides.
11. Biosynthesis of Nucleic Acids: Brief introduction of genetic organization of the mammalian genome, alteration and rearrangements of genetic material, Biosynthesis of DNA and its replication. Mutation: Physical & chemical mutagenesis / carcinogenesis. DNA repair mechanism. Biosynthesis of RNA.
12. Genetic Code and Protein Synthesis: Genetic code. Components of protein synthesis and Inhibition of protein

synthesis. Brief account of genetic engineering and polymerase chain reactions.
13. Regulation of gene expression.

09 1502P **PHARMACEUTICAL CHEMISTRY -V (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Preparation of standard buffers (citrate, phosphate and carbonate) and measurement of pH.
2. Titration curve for amino acids.
3. Separation of amino acids by two dimensional paper chromatography and gel electrophoresis.
4. The separation of lipids by TLC.
5. Separation of serum proteins by electrophoresis on cellulose acetate.
6. Quantitative estimation of amino acids.
7. Quantitative estimation of proteins.
8. The identification of c-terminal amino acids of a protein.
9 The determination of glucose by means of the enzyme glucose oxidase.
10. The isolation and assay of glycogen from the liver and skeletal muscle of rats.
11 Enzymatic hydrolysis of glycogen by. alpha- and beta-amylases.
12. The isolation and determination of RNA and DNA.
13. Effect of temperature on the activity of alpha - amylase.
14. Estimation of SGOT, SGPT, ALP and BRN in the serum.

Recommended Books:

1. Harper's Biochemistry R.K.Murray and Others (Prentice Hall of India, New Delhi)
2. Text Book of Biochemistry by West & Todd (Oxford & IBH Pub., Co., New Delhi)
3. Fundamentals of Biochemistry by Dr.A.C.Deb (New Central Book Agency, Calcutta)
4. Text Book of Biochemistry by Dr.A.V.S.S.Rama Rao (UBS Publishers & Distributors, New Delhi)
5. Text Book of Biochemistry by Dr. U. Satyanarayana

09 1503 PHARMACOLOGY - I
L-T-P : 3-0-0 Credit : 3

1. General Pharmacology: Introduction to Pharmacology, Sources of drugs, Dosage forms and routes of administration, mechanism of action, Combined effect of drugs, Factors modifying drug action, tolerance and dependence, Pharmacogenetics, Absorption, Distribution, Metabolism and Excretion of drugs, Principles of Basic and Clinical pharmacokinetics, Adverse Drug Reactions and treatment of poisoning, ADME drug interactions, Bioassay of Drugs and Biological Standardization, Discovery and development of new drugs.
2. Pharmacology of Peripheral Nervous System:
   a. Neurohumoral transmission (autonomic and Somatic)
   b. Parasympathomimetics, Parasympatholytics, Sympathomimetics, Adrenergic Receptor and neuron blockingagents, Ganglionic, stimulants and blocking agents.
   c. Neuromuscular blocking Agents.
   d. Local anesthetic Agents.
3. Pharmacology of Central Nervous System:
   a. Neurohumoral transmission in the C.N.S.
   b. General Anesthetics.
   c. Alcohols and disulfiram.
   d. Sedatives, hypnotics, Anti-anxiety agents and centrally acting muscle relaxants.
   e. Psychopharmacological agents (anti-psychotics) antidepressants anti maniacs and hallucinogens.
   f. Anti-epileptics drugs.
   g. Anti-Parkinsonian Drugs.
   h. Analgesics, Antipyretics, Anti-inflammatory and Anti-gout drugs.
   i. Narcotic analgesics and antagonists.
   j. C.N .S. stimulants.
   k. Drug Addiction and Drug Abuse.

09 1503P **PHARMACOLOGY – I (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Introduction to Experimental Pharmacology: Preparation of different solutions for experiments. Drug dilutions, use of molar and w/v solutions in experimental pharmacology. Common laboratory animals and anesthetics used in animal studies. Commonly used instruments in experimental pharmacology. Some common and standard techniques. Bleeding and intravenous injection, intragastric administration. Procedures for rendering animals unconscious-stunning of rodents, pithing of frogs, chemical euthanasia.

2. Experiments on intact preparations: Study of different routes of administration of drugs in mice/rats. To study the effect of hepatic microsomal enzyme inhibitors and induction on the phentobarbitone sleeping time in mice.
3. Experiments on Central Nervous system: Recording of spontaneous motor activity, stereotypy, analgesia, anticonvulsant activity, anti-inflammatory activity, and muscle relaxant activity of drugs using simple experiments.
4. Effects of autonomic drugs on rabbit's eye.
5. Effects of various agonists and antagonists and their characterization using isolated preparations like frog's rectus abdominis muscle and isolated ileum preparations of rat, guinea pig and rabbit.

Recommended Books:

1. Essentials of Medical Pharmacology by K.D.Tripathy
2. Pharmacology and pharmacotherapeutics by Satoshkar and Bhandarkar
3. Pharmacology by Prasun K Das, S.K.Bhattacharya and P.Sen.
4. Text book of Pharmacology by S.D. Sethi
5. The Pharmacological basis of Therapeutics by Goodman and Gilman
6. Pharmacology by Rang, Dale and Ritter.
7. Basic and Clinical Pharmacology by B.G.Katzung.

09 1504 PHARMACOGNOSY - IV

L-T-P : 3-0-0 Credit : 3

1. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following alkaloid containing drugs:
   a) Pyridine - piperidine: Tobacco, areca and lobelia.
   b) Tropane: Belladonna, hyoscyamus, datura, duboisia, coca and withania
   c) Quinoline and isoquinoline : Cinchona, ipecac, opium.
   d) Indole : Ergot, rauwolfia, catharanthus, nux-vomica and physostigma
   e) Imidazole: Pilocarpus
   f) Steroidal: Veratrum and kurchi
   g) Alkaloidal amine: Ephedra and colchicum.
   h) Glycoalkaloid: Solanum.
   i) Purines: Coffee, tea and cola.
2. Role of medicinal and aromatic plants in national economy.
3. Biological sources, preparation, identification tests and uses of the following enzymes: Diastase, papain, pepsin, trypsin, pancreatin.
4. General techniques of biosynthetic studies and basic metabolic pathways. Brief introduction to biogenesis of secondary metabolites of pharmaceutical importance.
5. Plant bitters and sweeteners.
6. Introduction, classification and study of different chromatographic methods and their applications in evaluation of herbal drugs.

09 1504P **PHARMACOGNOSY - IV (LAB)**

L-T-P : 0-0-4 Credit : 2

i) Identification of crude drugs listed above.
ii) Microscopic study of characters of eight - selected drugs given in theory in entire and powdered form.
iii) Chemical evaluation of powdered drugs and enzymes.
iv) Chromatographic studies of some herbal constituents.

Recommended Books:

1. Text Book of Pharmacognosy by Kokate C K, Purohit A P, Gokhale S B (Nirali Prakashan, Pune)
2. Trease G.E. and Evans W.C., Pharmacognosy (Balliene Tindall, Eastbourne)
3. Text Book of Pharmacognosy by T.E.Wallis.(CBS Publishers & Distributors, New Delhi)
4. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)

09 1505 PHARMACEUTICS - VI (Hospital Pharmacy)

L-T-P : 3-0-0 Credit : 3

1. Organization and Structure: Organization of a hospital and hospital pharmacy, Responsibilities of a hospital pharmacist, Pharmacy and therapeutic committee, Budget preparation and Implementation.
2. Hospital Formulary: Contents, preparation and revision of hospital formulary.

3. Drug Store Management and Inventory Control:
   (a) Organization of drug store, Types of materials stocked, storage conditions.
   (b) Purchase and Inventory Control principles, purchase procedures, Purchase order, Procurement and stocking.
4. Drug distribution Systems in Hospitals:
   (a) Out-patient dispensing, methods adopted.
   (b) Dispensing of drugs to in-patients. Types of drug distribution systems. Charging policy, labeling.
   (c) Dispensing of drugs to ambulatory patients.
   (d) Dispensing of controlled drugs.
5. Central Sterile Supply Unit and their Management: Types of materials for sterilization, packing of materials prior to sterilization, sterilization equipments, Supply of sterile materials.
6. Manufacture of Sterile and Nonsterile Products: Policy making of manufacturable items, demand and costing, personnel requirements, manufacturing practice, Master formula Card, production control, manufacturing records.
7. Drug Information Services: Sources of Information on drugs, disease, treatment schedules, procurement of information, Computerized services (e.g., MEDLINE), Retrieval of information, Medication error.
8. Records and Reports: Prescription filling, drug profile, patient medication profile, cases on drug interaction and adverse reactions, idiosyncratic cases etc.
9. Nuclear Pharmacy: Introduction to Radio- pharmaceuticals, radio-active half-life, Units of radio-activity Production of radio-pharmaceuticals, methods of isotopic tagging, preparation of radio-isotopes in laboratory using radiation dosimeters, radio-isotope generators, Permissible radiation dose level, Radiation hazards and their prevention, specifications for radio-active laboratory.

09 1505**PHARMACEUTICS - VI (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Experiments based on sterilization of various types of materials used in Hospitals.
2. Practical's designed on the use of computers in Drug Information Centre, prescription filling, documentation of information on drug interaction.
3. Experiments to illustrate handling of radio pharmaceutical products, measurement of radioactivity.

Recommended Books:

1. Hospital Pharmacy-Hassan WE, Lec and Febiger Publication.
2. Text book of Hospital Pharmacy-Allowood MC and Blackwell,
3. Remington: The Science & Practice of Pharmacy, Lippincott Williams & Wilkins.
4. Collet & Aulton, Eds. : "Pharmaceutical Practice," ELBS
5. Owunwanne, Patel, and Sadek : "The Hand Book of Radiopharmaceuticals,"Chapman & Hall.
6. Shroff : "Professional Pharmacy," 1st ed., Part I (Ethics) & Part III (Hospital Pharmacy), Five Star Enterprises.
7. Aulton, Ed. : "Pharmaceutics – The Science of Dosage Form Design," ELBS,
8. Text Book of Hospital Pharmacy," Blackwell Scientific Publications.
9. Merchant & Qadry : "Text Book of Hospital Pharmacy," Shah Prakashan.
10. Chittion & Witcofski : "Nuclear Pharmacy," Lea & Febiger.Aiiwodd & Fell :

SEMESTER - VI

09 1601 PHARMACEUTICS - VII (Biopharmaceutics & Pharmacokinetics)
L-T-P : 3-0-0 Credit : 3

1. Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development and clinical setting.
2. Biopharmaceutics:
   a) Passage of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis).
   b) Factors influencing absorption - Physicochemical, physiological and pharmaceutical.
   c) Drug distribution in the body, plasma protein binding.
3. **Phamacokinetics :**
   a) Significance of plasma drug concentration measurement.
   b) Compartment model-Definition and Scope.
   c) Pharmacokinetics of drug absorption - Zero order and first order absorption rate constant using Wagner - Nelson and Loo- Reigelman method.
   d) Volume of distribution and distribution coefficient.
   e) Compartment kinetics - One compartment and two compartment models.
   f) Determination of pharmacokinetic parameters from plasma and urine data after drug administration by intravascular and oral route.
   g) Curve fitting (method of Residuals), regression procedures.

h) Clearance concept, Mechanism of renal clearance, clearance ratio, determination of renal clearance.
i) Extraction ratio, hepatic clearance, biliary excretion, Extrahepatic circulation.
j) Non-linear pharmacokinetics with special reference to one compartment model after intravenous drug administration, Michaeles Menten Equation, detection of non-linearity (Saturation mechanism).

4. Clinical Pharmacokinetics:
a) Definition and scope.
b) Dosage adjustment in patients with and without renal and hepatic failure.
c) Design of single dose bio-equivalence study and relevant statistics.
d) Pharmacokinetic drug interactions and their significance in combination therapy.

5. Bioavailability and bioequivalence:
a) Measures of bioavailability, C_{max}, t_{max}, and Area under the curve (AUC).
b) Design of single dose bioequivalence study and relevant statistics.
c) Review of regulatory requirements for conduction of bioequivalent studies.

09 1601P **PHARMACEUTICS - VII (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Experiments designed for the estimation of various pharmacokinetic parameters with given data.
2. Analysis of biological specifications for drug content and estimation of the pharmacokinetic parameters.
3. In vitro evaluation of different dosage forms for drug release.
4. Absorption studies - in- vitro and in -situ.
5. Statistical treatment of pharmaceutical data.

Recommended Books:
1. Biopharmaceutics and Pharmacokinetics by D.M. Brahmankar and Sunil B. Jaiswal
2. Fundamentals of Biopharmaceutics and Pharmacokinetics by V. Venkateswarulu
3. Biopharmaceutics and Clinical Pharmacokinetics by Notari
4. Biopharmaceutics and Clinical Pharmacokinetics by Gibaldi
5. Applied Biopharmaceutics and Pharmacokinetics by Shargel and Yu

09 1602 PHARMACEUTICAL CHEMISTRY – VI (Medicinal Chemistry - I)
L-T-P : 3-0-0 Credit : 3

1. Basic Principles of Medicinal Chemistry: Physico-chemical aspects (Optical, geometric and bioisosterism) of drug molecules and bilological action, Drugreceptor interaction including transduction mechanisms.
2. Principles of Drug Design (Theoretic~fll Aspects) : Traditional analog (QSAR) and mechanism based approaches (Introduction 00' graph theory, applications of quantum mechanics, Computer Aided Drug Desigming (CADD) androolecular modeling.
3. Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including physicochemical properties of the following classes of drugs:
   A. Drugs acting at Synaptic and neuro-effector junction sites:
   i. Cholinergics and Anticholinesterases
   ii. Adrenergic .drugs
   iii. Antispasmodic and anti ulcer drugs
   iv. Neuromuscular blocking agents.
   B. Autocoids
   i. Antihistamines
   ii. Eicosanoids
   iii. Analgesic-antipyretics, anti-inflammatory (non-steroidal) agents.
   C. Drugs affecting uterine motility
   Oxytocics (including oxytocin, ergot alkaloids and prostaglandins' Biochemical approaches in drug designing wherever applicable should be discussed.

09 1602P **PHARMACEUTICAL CHEMISTRY – VI (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Exercises based on QSAR: Hansch & Free-Wilson methods.
2. Synthesis of selected drugs from the course content.
3. Spectral analysis of the drugs synthesized.
4. Establishing the pharmacopoeial standards of the drugs synthesized.
5. Determination of partition coefficient, dissociation constant and molar refractivity of compounds for QSAR analysis.

Recommended Books:

1. Wilson and Grisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry.
2. Principles of Medicinal Chemistry by William O.Foye.
3. A Text Book of Medicinal Chemistry by S.N.Pandeya.
4. Medicinal Chemistry by Ashutoshkar.
5. Bentley's and Driver's Text Book of Pharmaceutical Chemistry.

09 1603 PHARMACOGNOSY - V (Chemistry of Natural Products)

L-T-P : 3-0-0 Credit : 3

1. Chemical and spectral approaches to simple molecules of natural origin
2. Concept of stereoisomerism taking examples of natural products.
3. Chemistry, biogenesis and pharmacological activity of medicinally important monoterpenes, sesquiterpenes, diterpenes, and triterpenoids.
4. Carotenoids: α-carotenoids, β-carotenes, vitamin A, Xanthophylls of medicinal importance.
5. Glycosides : Chemistry and biosynthesis of digitoxin, digoxin, hecogenin, sennosides, diosgenin and sarasapogenin.
6. Alkaloids: Chemistry, biogenesis and pharmacological activity of atropine and related compounds; quinine, reserpine, morphine, papaverine, ephedrine, ergot and vinca alkaloids.
7. Chemistry and biogenesis of medicinally important lignans and quassanoids, flavonoids.
8. Chemistry and therapeutic activity of penicillin, streptomycin and tetracyclines.

09 1603P **PHARMACOGNOSY - V (LAB)**

L-T-P : 0-0-4 Credit : 2

i) Laboratory experiments on isolation, separation, purification of various groups of chemical constituents of pharmaceutical significance.
ii) Exercises on paper and thin layer chromatographic evaluations of herbal drug constituents.

Recommended Books:

1. Text Book of Pharmacognosy by Kokate C K, Purohit A P, Gokhale S B (Nirali Prakashan, Pune)
2. Trease G.E. and Evans W.C., Pharmacognosy (Balliene Tindall, Eastbourne)
3. Text Book of Pharmacognosy by T.E.Wallis.(CBS Publishers & Distributors, New Delhi)
4. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)

09 1604 PHARMACOLOGY - II

L-T-P : 3-0-0 Credit : 3

1. **Pharmacology of Cardiovascular System:**
   a) Digitalis and cardiac glycosides.
   b) Antihypertensive drugs.
   c) Antianginal and Vasodilator drugs, including calcium channel blockers and beta adrenergic antagonists.
   d) Antiarrhythmic drugs.
   e) Antihyperlipedemic drugs.
   f) Drugs used in the therapy of shock.
2. **Drugs Acting on the Hemopoietic System:**
   a) Hematinics.
   b) Anticoagulants, Vitamin K and hemostatic agents.
   c) Fibrinolytic and anti-platelet drugs.
   d) Blood and plasma volume expanders.
3. **Drugs acting on urinary system:**
   a) Fluid and electrolyte balance
   b) Diuretics
4. **Autocoids :**
   a) Histamine, 5-HT and their antagonists.
   b) Prostaglandins, thromboxanes and leukotrienes.
   c) Pentagastrin, Cholecystokinin, Angiotensin, Bradykinin and Substance P.
5. **Drugs Acting on the Respiratory System:**
   a) Anti-asthmatic drugs including bronchodilators.
   b) Anti-tussives and expectorants.
   c) Respiratory stimulants.

09 1604P **PHARMACOLOGY – II (LAB)**

L-T-P : 0-0-4 Credit : 2

1. Experiments on Isolated Preparations:
   a) To record the concentration response curve (CRC) of acetylcholine using rectus abdominis muscle preparation of frog.
   b) To study the effects of physostigmine and d-tubocurarine on the CRC of acetylcholine using rectus abdominis muscle preparation of frog.
   c) To record the CRC of 5-HT on rat fundus preparation.
   d) To record the CRC of histamine on guinea pig ileum preparation.
   e) To record the CRC of nor-aderenaline on rat anococcygeus muscle preparation.
   f) To record the CRC of oxytocin using rat uterus preparation.
2. Pharmacology **of Cardiovascular System:**
   a) To study the ionotropic and chronotropic effects of drugs on isolated frog heart.
   b) To study the effects of drugs on normal and hypodynamic frog heart.
3. Blood Pressure of anaesthetized Dog/Cat/Rat:
   To demonstrate the effects of various drugs on the B.P. and respiration including the Vasomotor Reversal of Dale and nicotinic action of acetylcholine.

Recommended Books:

1. Essentials of Medical Pharmacology by K.D.Tripathy
2. Pharmacology and pharmacotherapeutics by Satoshkar and Bhandarkar
3. Pharmacology by Prasun K Das, S.K.Bhattacharya and P.Sen.
4. Text book of Pharmacology by S.D. Sethi
5. The Pharmacological basis of Therapeutics by Goodman and Gilman
6. Pharmacology by Rang, Dale and Ritter.
7. Basic and Clinical Pharmacology by B.G.Katzung.

09 1605 PHARMACEUTICAL ANALYSIS - III

L-T-P : 3-0-0 Credit : 3

A. Quality assurance:
   1. GLP, ISO 9000, TQM, Quality Review and Quality Documentation.
   2. Regulatory control, regulatory drug analysis, interpretation of analytical data.
   3. Validation, quality audit: quality of equipment, validation of equipment, validation of analytical procedures.

B. The theoretical aspects, basic instrumentation, elements of interpretation of spectra, and applications of the following analytical techniques should be discussed:
   1. Ultraviolet and visible spectrophotometry
   2. Fluorimetry.
   3. Infrared spectrophotometry.
   4. Nuclear Magnetic Resonance spectroscopy including 13c NMR.
   5. Mass Spectrometry.
   6. Flame Photometry.
   7. Emission Spectroscopy.
   8. Atomic Absorption Spectroscopy.
   9. X -ray Diffraction. 10. Radio immunoassay.

09 1605P **PHARMACEUTICAL ANALYSIS – III (LAB)**

L-T-P : 0-0-4 Credit : 2

1. Quantitative estimation of at least ten formulations containing single drug or more than one drug, using instrumental techniques.
2. Estimation of Na+, K+, Ca++ ions using flame photometry.
3. IR of samples with different functional groups (-COOH, -COOR, - CONHR, - NH2, -NHR, -OH, etc.).
4. Workshop to interpret the structure of simple organic compounds using UV, IR, NMR and MS.

Recommended Books:

1. Vogel's Text Book of Quantitative Chemical Analysis
2. 2. Instrumental methods of Chemical Analysis by B.K. Sharma
3. 3. Instrumental methods of Analysis by Willard Den & Merrit
4. 4. Practical Pharmaceutical Chemistry by Beckette and Sten Lake Vol. 2
5. 5. Text Book of Pharmaceutical Analysis by Conner

SEMESTER - VII

09 1701 PHARMACEUTICS - VIII (Pharmaceutical Technology II)

L-T-P : 3-0-0 Credit : 3

1. **Capsules:** Advantages and disadvantages of capsule dosage form, material for production of hard gelatin capsules, size of capsules, method of capsule filling, soft gelatin, capsule shell and capsule content, importance of base absorption and minimum/gm factors in soft capsules, quality control, stability testing and storage of capsule dosage forms.
2. **Micro-encapsulation:** Types of microcapsules, importance of microencapsulation in pharmacy, microencapsulation by phase separation, coacervation, multi orifice, spray drying, spray congealing, polymerization complex emulsion, air suspension technique, coating pan and other techniques, evaluation of micro capsules.
3. Tablets:
   a) Formulation of different types of tablets, granulation, technology on large-scale by various techniques, physics of tablets making, different types of tablet compression machinery and the equipments employed, evaluation of tablets.
   b) Coating of Tablets: Types of coating, film forming materials, formulation of coating solution, equipments for coating, coating process, evaluation of coated tablets.
   c) Stability kinetics and quality assurance.
4. Parenteral Products:
   a) Preformulation factors, routes of administration, water for injection, pyrogenicity, non aqueous vehicles, isotonicity and methods of its adjustment.
   b) Formulation details, containers and closures and selection.
   c) Prefilling treatment, washing of containers and closures, preparation of solution and suspensions, filling and closing of ampoules, vials, infusion fluids, lyophillization & preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products.
   d) Aseptic Techniques-source of contamination and methods of prevention, Design of aseptic area, Laminar flow bench services and maintenance.
   e) Sterility testing of pharmaceuticals.
5. Surgical products: Definition, primary wound dressing, absorbents, surgical cotton, surgical gauzes etc. Bandages, adhesive tape, protective cellulosic hemostastics, official dressings, absorbable and nonabsorbable sutures, ligatures and catguts. Medical prosthetics and organ replacement materials.
6. Packaging **of Pharmaceutical Products**: Packaging components, types, specifications and methods of evaluation, stability aspects of packaging. Packaging equipments, factors influencing choice of containers, legal and other official requirements for containers, package testing.

09 1701P **PHARMACEUTICS - VIII (LAB)**

L-T-P : 0-0-4 Credit : 2

1. Experiments to illustrate preparation, stabilization, physical & biological evaluation of pharmaceutical products like powders, capsules, tablets, parenterals, micro capsules, surgical dressing etc.
2. Evaluation of materials used in pharmaceutical packaging.

Recommended Books:

1. Bently's Textbook of pharmaceutics by E.A. Rawlins (All India Traveller Book Seller, New Delhi)
2. The Theory and Practice of Industrial Pharmacy by Lachmann, Libermann and Kanig (Varghese Pub. House, Bombay)
3. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel, Allen and Popovich (B.I.Waverly Pvt. Ltd., New Delhi)
4. REMINGTON : The Science and Practice of Pharmacy, (Lippincott Williams & Wilkins, Baltimore)
5. Pharmaceutics : The Science of Dosage Form Design by Aulton (Churchill Livingstone, Edinburgh)

09 1702 PHARMACOLOGY - III

L-T-P : 3-0-0 Credit : 3

1. Drugs Acting on the Gastrointestinal Tract:
   a) Antacids, Anti Secretory and Anti-ulcer drugs.
   b) Laxatives and anti diarrhoeal drugs.
   c) Appetite Stimulants and Suppressants.
   d) Emetics and anti-emetics.
   e) Miscellaneous-Carminatives, demulcents, protectives, adsorbents, astringents, digestants, enzymes and

mucolytics.

2. Pharmacology of Endocrine System:
   a) Hypothalamic and pituitary hormones.
   b) Thyroid hormones and anti thyroid drugs, parathormone, calcitonin and Vitamin D.
   c) Insulin, oral hypoglycaemic agents & glucagon.
   d) ACTH and corticosteroids.
   e) Androgens and anabolic steroids.
   f) Estrogens, progesterone and oral contraceptives.
   g) Drugs acting on the uterus.
3. Chemotherapy:
   a) General Principles of Chemotherapy.
   b) Sulfonamides and cotrimoxazole.
   c) Antibiotics-Penicillins, Cephalosporins, Chloramphenicol Erythromycin, Quinolones and Miscellaneous Antibiotics.
   d) Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, urinary tract infections and sexually transmitted diseases.
   e) Chemotherapy of malignancy and Immunosuppressive Agents.

4. Principles of Toxicology:
   a) Definition of poison, general principles of treatment of poisoning with particular reference to barbiturates, opioids, organophosphorous and atropine poisoning.
   b) Heavy metals and heavy metal antagonists.

09 1702P **PHARMACOLOGY - III (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Experiments on Isolated Preparations:
   a) To calculate the pA2 value of atropine using acetylcholine as an agonist on rat ileum preparation.
   b) To calculate the pA2 value of mepyramine or chlorpheniramine using histamine as agonist on guinea pig ileum.
   c) To estimate the strength of the test sample of agonist/drug (e.g. Acetylcholine, Histamine, 5 -HT, Oxytocin, etc) using a suitable isolated muscle preparation employing Matching bioassay, Bracketing assay, Three point assay and Four point bioassay.
2. Pharmacology of the Gastrointestinal Tract: To study the Anti- secretary and anti-ulcer activity using pylorus.
3. Clinical pharmacology: To determine the effects of certain clinically useful drugs on human volunteers like:
   (a) Antihistaminics
   (b) Anti-anxiety and sedative drugs
   (c) Analgesics
   (d) Beta blockers.

Recommended Books:

1. Essentials of Medical Pharmacology by K.D.Tripathy
2. Pharmacology and pharmacotherapeutics by Satoshkar and Bhandarkar
3. Pharmacology by Prasun K Das, S.K.Bhattacharya and P.Sen.
4. Text book of Pharmacology by S.D. Sethi
5. The Pharmacological basis of Therapeutics by Goodman and Gilman
6. Pharmacology by Rang, Dale and Ritter.
7. Basic and Clinical Pharmacology by B.G.Katzung.

09 1703 PHARMACEUTICAL CHEMISTRY - VII (Medicinal Chemistry - II)
L-T-P : 3-0-0 Credit : 3

Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including Physico-Chemical properties of the following classes of drugs.

1. Steroids and related drugs: Steroidal nomenclature and stereochemistry, androgens and anabolic agents, estrogens, and progestational agents, adrenocorticoids.
2. Drugs acting on the Central Nervous System: General Anesthetics, Local Anesthetics, Hypnotics and Sedatives, Opioid analgesics, antitussives, anti convulsants, Antiparkinsonism drugs, CNS stimulants, Psychopharmacological agents (neuroleptics, antidepressants, anxiolytics).
3. Diuretics, Cardiovascular drugs, Anticoagulant and Antiplatelet drugs.

Biochemical approaches in drug designing wherever applicable should be discussed.

09 1703P **PHARMACEUTICAL CHEMISTRY - VII (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Workshop on stereomodel use of some selected drugs.

2. Synthesis of selected drugs from the course content involving two or more steps and their spectral analysis.
3. Establishing the Pharmacopoeial standards of the drugs synthesized.

Recommended Books:
1. Wilson and Grisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry.
2. Principles of Medicinal Chemistry by William O.Foye.
3. A Text Book of Medicinal Chemistry by S.N.Pandeya.
4. Medicinal Chemistry by Ashutoshkar.
5. Bentley's and Driver's Text Book of Pharmaceutical Chemistry.

09 1704 PHARMACEUTICAL BIOTECHNOLOGY

L-T-P : 3-0-0 Credit : 3

1. Immunology and Immunological Preparations: Principles, antigens and haptens, immune system, cellular humorai immunity, immunological tolerance, antigen-antibody reactions and their applications. Hypersensitivity, Active and passive immunization, Vaccines- their preparation, standardization and storage.
2. Genetic Recombination: Transformation, conjugation, transduction, protoplast fusion and gene cloning and their applications. Development of hybridoma for monoclonal antibodies. Study of drugs produced by biotechnology such as Activase, Humulin, Humatrope, HB etc.
3. **Antibiotics:** Historical development of antibiotics. Antimicrobial spectrum and methods used for their standardization. Screening of soil for organisms producing antibiotics, fermenter, its design, control of different parameters. Isolation of mutants, factors influencing rate of mutation. Design of fermentation process. Isolation of fermentation products with special reference to penicillins, streptomycins tetracyclines and vitamin B12.
4. **Microbial Transformation:** Introduction, types of reactions mediated by microorganisms, design of biotransformation processes, selection of organisms, biotransformation process and its improvements with special reference to steroids.
5. **Enzyme immobilization:** Techniqes of immobilization, factors affecting enzyme kinetics. Study of enzymes such as hyaluronidase, penicillinase, streptokinase and streptodornase, amylases and proteases etc. Immobilization of bacteria and plant cells.

Recommended Books:
1. Industrial Microbiology by Casida.
2. Industrial Microbiology by A.H. Patel.
3. Industrial microbiology by Prescott and Dunn.
4. Pharmaceutical Biotechnology by Vyas and Dixit.
5. Molecularbiology and Genetic Engineering by A.M.Narayanan, A.M.Selvaraj, A.Mani
6. Text Book of Microbiology by Anantanarayana and Panicker.
7. Concepts in Biotechnology by Balasubramanium.
8. Molecular Biotechnology by Glick.
9. Molecular Biotechnology by Gingold.

09 1705 PHARMACEUTICAL INDUSTRIAL MANAGEMENT

L-T-P : 3-0-0 Credit : 3

1. **Concept of Management:** Administrative Management (Planning, Organizing, Staffing, Directing and Controlling), Entrepreneurship development, Operative Management (Personnel, Materials, Production, Financial, Marketing, Time/space, Margin/Morale). Principles of Management (Co-ordination, Communication, Motivation, Decision-making, leadership, Innovation, Creativity, Delegation of Authority / Responsibility, Record Keeping). Identification of key points to give maximum thrust for development and perfection.
2. Accountancy: Principles of Accountancy, Ledger posting and book entries, preparation of trial balance, columns of a cash book, Bank reconciliation statement, rectification of errors, Profits and loss account, balance sheet, purchase, keeping and pricing of stocks, treatment of cheques, bills of exchange, promissory notes and hundies, documentary bills.
3. Economics: Principles of economics with special reference to the laws of demand and supply, demand schedule, demand curves, labor welfare, general principles of insurance and inland and foreign trade, procedure of exporting and importing goods.
4. Pharmaceutical Marketing**:** Functions, buying, selling, transportation, storage, finance, feedback, information, channels of distribution, wholesale, retail, departmental store, multiple shop and mail order business.
5. Salesmanship: Principles of sales promotion, advertising, ethics of sales, merchandising, literature, detailing. Recruitment, training, evaluation, compensation to the pharmacist.
6. Market Research:

(a) Measuring & Forecasting Market Demands-Major concept in demand measurement, Estimating current demand, Geodemographic analysis, Estimating industry sales, Market share & Future demand.

(b) Market Segmentation & Market Targeting.

7. Materials Management: A brief exposure or basic principles of materials management-major areas, scope, purchase, stores, inventory control and evaluation of materials management.

8. Production Management: A brief exposure of the different aspects of Production Management-Visible and Invisible inputs, Methodology of Activities, Performance Evaluation Technique, Process-Flow, Process Knowhow, Maintenance Management.

Recommended Books:

1. M. J. Etazel , B. J. Walker and W. J. Stanton, Marketing, Tata McGraw Hill, 13th Edition, 2004.
2. R. Saxena, "Marketing Management" Tata McGraw Hill, second Edition, 2003.

09 1706 Elective Theory
L-T-P : 3-0-0 Credit: 3

09 1706P **Elective Practical**
L-T-P : 0-0-4 Credit: 2

SEMESTER - VIII

09 1801 PHARMACEUTICS - IX (Dosage Form Design)
L-T-P : 3-0-0 Credit : 3

1. Preformulation studies:
   a) Study of physical properties of drug like physical form, particle size, shape, density, wetting dielectric constant. Solubility, dissolution and organoleptic property and their effect on formulation, stability and bioavailability.
   b) Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemization, polymerization etc., and their influence on formulation and stability of products.
   c) Study of pro-drugs in solving problems related to stability, bioavailability and elegancy of formulations.
2. Design, development and process validation methods for pharmaceutical operations involved in the production of pharmaceutical products with special reference to tablets, suspensions.
3. Stabilization and stability testing protocol for various pharmaceutical products.
4. Performance evaluation methods
   a) In-vitro dissolution studies for solid dosage forms methods, interpretation of dissolution data.
   b) Bioavailability studies and bioavailability testing protocol and procedures.
   c) In-vivo methods of evaluation and statistical treatment.
   d) GMP and quality assurance, Quality audit.
   e) Design, development, production and evaluation of controlled released formulations.

09 1801P **PHARMACEUTICS - IX (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Preformulation studies including drug-excipient compatibility studies, effect of stabilizers, preservatives etc. in dosage form design.
2. Experiments demonstrating improvement in bioavailability through prodrug concept.
3. Stability evaluation of various dosage forms and their expiration dating.
4. Dissolution testing and data evaluation for oral solid dosage forms.
6. In -vivo bioavailability evaluation from plasma drug concentration and urinary excretion curves.
7. Design, development and evaluation of controlled release formulations.

Recommended Books:

1. Bently's Textbook of pharmaceutics edited by E.A. Rawlins (All India Traveller Book Seller, New Delhi)
2. The Theory and Practice of Industrial Pharmacy by Lachmann, Libermann and Kanig (Varghese Pub. House, Bombay)
3. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel, Allen and Popovich (B.I.Waverly Pvt. Ltd., New Delhi)
4. REMINGTON : The Science and Practice of Pharmacy, (Lippincott Williams & Wilkins, Baltimore)
5. Pharmaceutics : The Science of Dosage Form Design by Aulton (Churchill Livingstone, Edinburgh)

09 1802 PHARMACEUTICAL CHEMISTRY – VIII (Medicinal Chemistry III)
L-T-P : 3-0-0 Credit : 3

1. Drug metabolism and Concepts of Prodrugs.
2 Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship (including physicochemical aspects) of the following classes of drugs. (Biochemical approaches in drug designing wherever applicable should be discussed).
   a) Antimetabolites (including sulfonamides).
   b) Chemotherapeutic agents used in Protozoal, Parasitic and other infection.
   c) Antineoplastic agents.
   d) Anti-viral including anti - HIVagents.
   e) Immunosuppressives and immunostimulants.
3. Amino acids, peptide, nueleotides and related drugs.
   a) Thyroid and Anti thyroid drugs.
   b) Insulin and oral hypoglycaemic agents.
   c) Peptidomimetics and nucleotidomimetics.
   d) Diagnostic agents.
   e) Pharmaceutical Aids.

09 1802P **PHARMACEUTICAL CHEMISTRY – VIII (LAB)**
L-T-P : 0-0-4 Credit : 2

1. Experiments designed on drug metabolism:
   a) Preparation of S9 and microsomes from tissue homogenates and standardization of protein.
   b) Effect of phenobarbital pretreatment on microsomal cytochrome p-450, cytochrome b5, and NADPH-Cytochrome C-reductase and comparison of microsomes from control.
   c) Determination of microsomal aminopyrine demethylase and p- nitroanisole o-demethylase activities.
   d) Determination of microsomal azo- and nitroreductase activities.
2. Synthesis of selected drugs.
3. Establishing the pharmacopoeal standards and spectral studies.

Recommended Books:
1. Wilson and Grisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry.
2. Principles of Medicinal Chemistry by William O.Foye.
3. A Text Book of Medicinal Chemistry by S.N.Pandeya.
4. Medicinal Chemistry by Ashutoshkar.
5. Bentley's and Driver's Text Book of Pharmaceutical Chemistry.

09 1803 PHARMACOGNOSY - VI
L-T-P : 3-0-0 Credit : 3

1. World-wide trade in medicinal plants and derived products with special reference to diosgenin (disocorea), taxol (Taxus sps) digitalis, tropane alkaloid containing plants, Papain, cinchona, Ipecac, Liquorice, Ginseng, Aloe, Valerian, Rauwolfia and plants containing laxatives.
2. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India. Utilization and production of phytoconstituents such as quinine, calcium sennosides, podophyllotoxin, diosgenin, solasodine, and tropane alkaloids.
3. Utilization of aromatic plants and derived products with special reference to sandalwood oil, mentha oil, lemon grass oil, vetiver oil, geranium oil and eucalyptus oil.
4. Historical development of plant tissue culture, types of cultures. Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy.
5. Chemotaxonomy of medicinal plants.
6. Marine pharmacognosy, novel medicinal agents from marine sources.
7. Natural allergens and photosensitizing agents and fungal toxins.
8. Herbs as health foods.
9. Herbal cosmetics.

09 1803P **PHARMACOGNOSY – VI (LAB)**
L-T-P : 0-0-4 Credit : 2

i. Isolation of some selected phytoconstituents studied in theory.
ii. Extraction of volatile oils and their chromatographic profiles.
iii. Some experiments in plant tissue culture.

Recommended Books:
1. Text Book of Pharmacognosy by Kokate C K, Purohit A P, Gokhale S B (Nirali Prakashan, Pune)

2. Trease G.E. and Evans W.C., Pharmacognosy (Balliene Tindall, Eastbourne)
3. Text Book of Pharmacognosy by T.E.Wallis.(CBS Publishers & Distributors, New Delhi)
4. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)

09 1804 PHARMACOLOGY – IV (Clinical Pharmacy and Drug Interactions)
L-T-P : 3-0-0 Credit : 3

1. Introduction to Clinical Pharmacy.
2. Basic Concepts of Pharmacotherapy.
   a) Clinical Pharmacokinetics and individualization of Drug Therapy.
   b) Drug Delivery Systems and their Biopharmaceutic & Therapeutic Considerations.
   c) Drug Use During Infancy and in the Elderly (Pediatries & Geriatrics).
   d) Drug use during Pregnancy.
   e) Drug induced Diseases.
   f) The Basics of Drug Interactions.
   g) General Principles of Clinical Toxicology.
   h) Interpretation of Clinical Laboratory Tests.
3. Important Disorders of Organ Systems and their Management:
   a) Cardiovascular Disorders-Hypertension, Congestive Heart Failure, Angina, Acute Myocardial Infarction, Cardiac arrhythmias.
   b) CNS Disorders: Epilepsy, Parkinsonism, Schizophrenia, Depression.
   c) Respiratory Disease-Asthma.
   d) Gastrointestinal Disorders-Peptic ulcer, Ulcerative colitis, Hepatitis, Cirrhosis.
   e) Endocrine Disorders-Diabetes mellitus and Thyroid Disorders.
   f) Infectious Diseases-Tuberculosis, Urinary Tract Infection, Enteric Infections, Upper Respiratory Infections.
   g) Hematopoietic Disorders-Anemias.
   h) Joint and Connective Tissue Disorders-Rheumatic Diseases, Gout and Hyperuricemia.
   i) Neoplastic Diseases- Acute Leukaemias, Hodgkin's disease.
4. Therapeutic Drug Monitoring
5. Concept of Essential Drugs and Rational Drug use.

Recommended Books:
1. Remington the Science and Practice of Pharmacy
2. Clinical Pharmacology by Laurence, Bennett and Brown
3. Medical diagnosis and treatment by Tierney, Mc phee and Papadakis
4. Clinical Pharmacy & Therapeutics by Roger Walker, Edwards.
5. Clinical Pharmacy and Therapeutics by Herfindal, Gourley and Lloyd Hart.
6. Physiological basis of Medical Practice by John B. West
7. Drug Interactions by Ivan Stockley

09 1805P Project Work and Viva - voce
L-T-P : 0-0-12 Credit : 10

ELECTIVES
(To be chosen one each against papers 09 1706 and 09 1706P)

09 17E1 COSMETIC TECHNOLOGY
L-T-P : 3-0-0 Credit : 3

UNIT -I
1. Fundamentals of cosmetic technology, classification of cosmetics, a brief study of raw materials used for Cosmetic preparations: surfactants, humectants, cream bases, aerosol propellants, perfumes, colours.

UNIT -II
2. Stability aspects of cosmetics: Shelf-life, effects of environmental factors like light, temperatures etc on product stability.
3. Quality control tests of different cosmetic products, Packaging of Cosmetics

UNIT -III
4. Hair Care Products: Hair structure, Shampoos, Conditioners, Setting lotion, Hair creams, Hair dyes.
5. Skin Care Products: Anatomy and physiology of skin, formulation of skin cleaners, moisturizers, sunscreen products, acne products, anti ageing creams.

UNIT -IV
6. Colour Cosmetics: Introduction, lip colour, nail polish, face make-up and eye make-up.

7. Dental products: Dentifrices, Oral rinses, Tooth powder, Tooth paste.
8. Personal Hygiene Products: Shaving creams, after shave products.

09 17E1P COSMETIC TECHNOLOGY (LAB)
L-T-P : 0-0-4 Credit : 2

1. Preparation of selected cosmetic preparations representing the following classes:
   a) Shampoos
   b) Hair conditioners
   c) Hair creams
   d) Skin creams
   e) Nail polish
   f) Face powders
   g) Tooth pastes
   h) Tooth powder
   i) Shaving cream
   j) After shave lotion
2. Evaluation of any two products mentioned above
3. Collection of various packaging materials used for cosmetics and their description

(Each student shall collect at least 10 different types of containers.)

Recommended books:
1. Cosmetics: Formulation, manufacturing, and Quality control by P.P.Sharma
2. A Handbook of Cosmetics by B.M. Mithal, R.N. Saha
3. The Theory and Practice of Industrial Pharmacy by Lachman L., Liberman, H.A.
4. Modern Cosmetics by Thomson, E.G.
5. Paucher's Perfumes, cosmetics & soaps by W.A.Paucher.
6. Hary's cosmeticology by J.B.Wilkimsson.

09 17E2 HERBAL DRUG TECHNOLOGY
L-T-P : 3-0-0 Credit : 3

UNIT -I
Definition of Herbal drug, Importance of Herbal therapies, Herbal verses conventional drugs, Safety in herbal drugs, Toxicity in Herbals and their interactions.
UNIT -II
Herbs used as nutraceuticals and healing agents Herbal cosmetics.
UNIT -III
Making and using herbal medicines for common ailments like cold, skin infections and diarrhoea.
Analytical Profiles of selected herbs- Brahmi Aradrographis paniculata, Aegle marmelos and Gymnema sylvestre.
UNIT -IV
Quality Control and Quality Assurance of Herbal ingredients as per W.H.O. guidelines.
Determination of tannins, Ash value, Extractable matter and Pesticide residues.

09 17E2P HERBAL DRUG TECHNOLOGY (LAB)
L-T-P : 0-0-4 Credit : 2

1. Identification of sugar from plant extracts
2. Preparation of plant extracts and their standardization by analytical profiles (any five)
3. Quality Control tests for raw materials used in Herbal preparation

Recommended books:
1. Trease and Evan's Pharmacognosy 15th edition
2. Indian Herbal Pharmacopeia Vol-I and II
3. Quality Control methods for medicinal plant material by W.H.O., Geneva.
4. Quality Control of Herbal drugs by Dr. Pulak K. Mukherjee
5. Botanical safety hand book by Michael Meguffin, Christopher Hobbs published by American Herbal Product Association.
6. Herbal drugs by P.Mukherjee

09 17E3 BIOASSAYS
L-T-P : 3-0-0 Credit : 3

UNIT -I
Definition , principles , and design of Bioassays.
Requirements applications, importance advantages and disadvantages of Bioassays
UNIT -II
Types of Bioassay (quantal and graded response Bioassys), Bioassay of agonists and antagonists, Biological variation, Biological standardization, Microbiological assay (antibiotics, vitamin B12), Bioassay in Humans
UNIT -III
Bioassay of some important drugs like Digitalis, Adrenaline, Noradrenaline, acetylcholine, Histamine, 5-hydroxy tryptamine, d-tubocurarine, Heparin, antibiotics, Vitamin-D,
UNIT -IV
Bioassay of Insulin, Oxytocin, Vassopressin, Growth Hormone, FSH, LH, Prolactin, Thyrotrophin, Corticotrophin, Androgen, Progesterone, Estrogen..

09 17E3P BIOASSAYS (LAB)
L-T-P : 0-0-4 Credit : 2

1. To find out the strength of the given sample of acetylcholine by comparative bioassay using rectus abdominis muscle of frog.
2. To find out the strength of the given sample of acetylcholine by interpolation bioassay using rectus abdominis muscle of frog.
3. To find out the strength of the given sample of acetylcholine by three-point bioassay using rectus abdominis muscle of frog.
4. To find out the strength of the given sample of acetylcholine by four-point bioassay using rectus abdominis muscle of frog.
5. To find out the strength of the given sample of d-tubocurarine by graphical bioassay using rectus abdominis muscle of frog.
6. To find out the strength of the given sample of acetylcholine by four-point bioassay using guinea pig ileum.
7. To find out the strength of the given sample of histamine by four-point bioassay using guinea pig ileum.
8. To find out the strength of the given sample of oxytocin by four-point bioassay using rat uterus.
9. To find out the strength of the given sample of 5-hydroxy tryptamine by four-point bioassay using rat fundus.
10. To find out the strength of the given sample of 5-hydroxy tryptamine by comparative bioassay using rat fundus.

Recommended books:

1. Sharma, H.L.; Sharma, K.K. General Pharmacology Basic Concepts
2. Barar, F.S.K. Essentials of Pharmacotherapeutics
3. Rang, H.P.; Dale, M.M.; Ritter, J.M.; Moore, P.K. Pharmacology
4. Satoshkar, R.S.; Bhandarkar, S.D.; Ainapure, S.S. Pharmacology and Pharmacotherapeutics
5. Sharma, V.N. Essentials of Pharmacology
6. Derasari and Gandhi's Elements of Pharmacology
7. Remington's Pharmaceutical Sciences
8. Indian Pharmacopeia
9. Pillai, K.K. Experimental Pharmacology
10. Kulkarni, S.K. Hand Book of Experimental Pharmacology

09 17E4 HOSPITAL PHARMACY ADMINISTRATION
L-T-P : 3-0-0 Credit : 3

UNIT -I
1. The role of hospital pharmacy department and its relationship to other hospital departments and staff.
2. Hospital drug policy - Drug Committee, formulary and guidelines, other hospital committees such as infection control committee and research & ethics committee.

UNIT -II
3. Hospital Pharmacy management - Staff (Professional and non-professional), Materials (drugs, non-drugs consumables), Financial (drug budget, cost centers), planning infrastructure requirements (building, furniture and fitting, specialized Equipment, maintenance and repairs), Work load statistics, Hospital formulary.
4. Organization of Hospital Pharmacy Services,

UNIT -III
5. Drug Distribution: Purchasing, warehousing (Storage conditions, expiry date control, recycling of drugs, stock-taking, drug recalls), Drug distribution methods (ward stock, individual patient dispensing, unit doses), specific requirements for inpatients, causality / emergency theatre, ICU/ICCU, Drugs of dependence.

UNIT -IV
6. Manufacturing: Sterile and non sterile production, including total parenteral nutrition, IV additive service, Pre-Packing and labeling Quality control.

09 17E4P HOSPITAL PHARMACY ADMINISTRATION (LAB)
L-T-P : 0-0-4 Credit : 2

1. Experiments based on sterilization of various types of materials used in Hospitals.
2. Practicals designed on the use of computers in Drug information Centre,.
3. Prescription filling documentation of information of drug interaction.
4. Manufacture of LVP used in hospitals.
5. Observing Drug distribution pattern in a local hospital and writing report.
6. Any other experiments to Substantiate theory.

Recommended books:

1. Hospital Pharmacy-Hassan WE, Lec and Febiger Publication ., 1999.
2. Text book of Hospital Pharmacy-Allowood MC and Blackwell, 1980, 1st ed.
3. Avery's Drug Treatment, 4th edition, Adis international limited
4. Managing Drug Supplt-2nd Edition, Management Sciences for health, Kumarian press, 1997.

09 17E5 ADVANCED PHARMACEUTICAL ANALYSIS
L-T-P : 3-0-0 Credit : 3

UNIT -I
1. Theory, instrumentation and applications of the following Instrumental Methods of Analysis.
(i) X-ray fluorescence spectrometry
(ii) X-ray diffraction
(iii) Electron spin resonance spectroscopy (ESR)
(iv) Advanced chromatographic techniques like super critical fluid chromatography, size exclusion chromatography.
(v) Differential scanning calorimetry, Differential thermal analysis and Thermal gravimetric analysis,

UNIT - II
2. Theory and procedure involved in the qualitative and quantitative analysis of pharmaceutical properties and dosage forms containing the following drugs: (Biological and microbiological method excluded).
   - NSAID - Analgesics and antipyretics (Diclofenac sodium, Ketoprofen, Oxyphenebutazone, Paracetamol, Allopurinol, Aspirin + Caffeine)
   - Barbiturates (Phenobarbitone sodium)
   - Steroids (Nandrolone, Cortisone acetate, Fludrocortisone acetate, Prednisolone, Dexamethasone)
   - Antihistaminics (Mepyramine maleate, Chlorpheniramine maleate, promethazine hydrochloride, Cyclazine hydrochloride, Astemizole)
   - Alkaloids (Codeine, Opium, Vincristine, Ergotamine and Ergometrine)

UNIT -III
3. Theory and procedure involved in the qualitative and quantitative analysis of pharmaceutical properties and dosage forms containing the following drugs: (Biological and microbiological method excluded).
   - Antibiotics (Cycloserine, Chloramphenicol, Ampicillin, Rifampicin, Cefotaxim sodium)
   - Vitamins (Riboflavin, Nicotinamide, Pyridoxine hydrochloride, Folic acid, Cyanocobalamine)
   - Cardiovascular agents (Digoxin, Isosorbide dinitrate, nifedipine, Verapamil hydrochloride, Propranolol hydrochloride, Timolol maleate, Atenolol)
   - Hypoglycaemic agents (Insulin and its different forms, Chlorpropamide, glibenclamide, Metformine)
   - Sulphonamides (Sulphadiazine, Sulphamethoxazole, Sulphacetamide)

UNIT - IV
4. Theory and procedure involved in the qualitative and quantitative analysis of pharmaceutical preparations and dosage forms using the following reagents / reactions.
(i) Diazotisation followed by coupling.
(ii) Oxidation followed by complexation.
(iii) Condensation reactions using the reagents Para Dimethyl Amino Benzaldehyde (PDAB), Folin's reagent, Gibb's reagent and para Dimethyl Amino Cinnamaldelyde (PDAC) reagent.

09 17E5P ADVANCED PHARMACEUTICAL ANALYSIS (LAB)
L-T-P : 0-0-4 Credit : 2

1. Estimation of following classes of drugs using different analytical methods.
   - NSAID - Analgesics and Antipyretics.
   - Barbiturates.
   - Sulphonamides.
   - Antibiotics.

- Steroidal hormones Vitamins
- Alkaloids
- Cardiovascular drugs
- Hypoglycaemic agents
- Antihistaminics

2. Estimation of different classes of drugs using the following reagents.
   - Feric chloride.
   - Perchloric acid.
   - 2-6 Dichlorophenol indophenol.

Recommended books:

1. Instrumental methods of analysis by Scoog and West.
2. Chemical Analysis - Modern Instrumentation methods and techniques by Wiley.
3. Instrumental methods of analysis by Willard Den & Merrit.
4. Hand book of Instrumental techniques for analytical chemistry edited by Frank Settle by Prentice Hall Inc.
5. A text book of Pharmaceutical analysis by K.A.Conners (John Wiley)
6. Spectrometric identification of organic compounds by silverstein.
7. IP. BP. & USP.

DAIRY TECHNOLOGY

Introduction: - India is the largest producer of milk in the world in the world producing 94 million tones of milk annually .There are 678 milk processing plant in the country requiring large human resource pool to run these dairies. With the introduction of modern technology in the production and processing of dairy products, the concept of milk is shifting towards value added dairy business. The milk production in the country is increasing @4% per annum contributing more than Rs. 1,00,000 crore to GDP . In split of large infrastructure available for processing milk, only 15% of milk is at present processed in the organized sector, hence there is lot of scope for value addition and export in Dairy sector. The dairy industries have opend up new avenues for employment & economy. It is estimated that dairy industries is generating new jobs to the extent of 1.04 lakhs every year. Dairy sector is further expected to grow faster and generate more employment in the near future. Adoption of latest & advanced dairy and value addition technology in milk processing can minimize loses, provide better quality, nutrition and more employment opportunity. Dairy technologies offer promising option for value addition and resource recovery in terms of consumer food availability and simultaneously more earning at farmers and industries level. There is large scope for milk industries to grow in view of globalization and increasing purchasing power of consumers. This will further increase the requirement of dairy technologist and researchers.

The existing course curricular of B.Tech (Dairy Technology), is a unique job oriented degree, which leads to a total development of graduates and make them capable to face various situation in very field of work. Students are also enriched with entrepreneurial qualities to start their own industries. Additionally, the graduates get acquainted with various facts of professionally manages industries which include production management, raw material purchases, personnel management, sales and marketing by virtue of industrial implant training. This helps students to acquire to confidence to work as highly professional human recourse for dairy industries.

Mission

Development of highly professional dairy specialists through value based education, research and training in dairy technology for meeting technological and societal needs.

Objective

- Offering under graduate and post graduate education in dairy technology.
- Teaching research and development in the various aspects of dairy technology discipline.
- Transfer of technology for employment generation and entrepreneurship development in milk processing.
- Advisory and consultancy service to industries and users.

Semester wise Courses

Sl. No.	Course Title	Course No.	Credit	Contact Hour
Semester 1				
1.	Physical Chemistry of Milk	DTC-111	3(2+1)	2+2
2.	Milk Production Management & Dairy Development	DBM-111	3(2+1)	2+2
3.	Engineering Drawing	DTE-111	2(0+2)	0+4
4.	Workshop Practice	DTE-112	2(1+1)	1+2
5.	Fluid Mechanics	DTE-113	3(2+1)	2+2
6.	Economic Analysis	DBM-112	2(2+0)	2+0
7.	Fundamental of Microbiology	DTM-111	3(2+1)	2+2
8.	Environmental Studies	DBM-113	3(2+1)	2+2
	TOTAL		**21(13+8)**	**29(13+16)**
	Optional Courses: (I). Organic Chemistry (II). Industrial Statistics	DTC-112 DBM-114	**3(2+1) NC Do**	
Semester II				
1.	Market Milk	DTT-121	4(3+1)	3+2
2.	Introductory Microbiology	DTM-121	3(2+1)	2+2
3.	Heat & Mass Transfer	DTE-121	3(2+1)	2+2
4.	Chemistry of Milk	DTC-121	3(2+1)	2+2
5.	Thermodynamics	DTE-122	3(2+1)	2+2
6.	Electrical Engineering	DTE-123	3(2+1)	2+2
7.	Biochemistry & Human Nutrition	DTC-122	3(2+1)	2+2
8.	Computer Programming	DBM-121	3(1+2)	1+4
	TOTAL		**25(16+9)**	**34(16+18)**
Semester -III				

1.	Traditional Dairy Products	DTT-211	3(2+1)	2+2
2.	Ice –Cream & Frozen Deserts	DTT-212	4(2+2)	2+4
3.	Fat Rich Dairy products	DTT-213	4(3+1)	3+2
4.	Refrigerator and Air Conditioning	DTE-211	3(2+1)	2+2
5.	Starter Culture & Fermented Milk Products	DTM-211	3(2+1)	2+2
6.	Dairy Engineering	DTE-212	3(2+1)	2+2
7.	Food Chemistry	DTC-211	3(2+1)	2+2
8.	Marketing Management & International Trade	DMM-211	2(2+0)	2+0
	TOTAL		**25(17+8)**	**33(17+16)**
Semester -IV				
1.	Food Technology 1	DTT-221	4(3+1)	3+2
2.	Condensed & Dried Milks	DTT-222	5(3+2)	3+4
3.	By Products Technology	DTT-223	4(3+1)	3+2
4.	Dairy Process Engineering	DTE-221	3(2+1)	2+2
5.	Packaging of Dairy Products	DTT-224	3(2+1)	2+2
6.	Operation Research	DBM-221	2(2+0)	2+0
7.	Dairy Extension Education	DBM-22	2(1+1)	1+2
	TOTAL		**23(16+7)**	**30(16+14)**
Semester -V				
1.	IT in Dairy Industries	DBM-311	2(1+1)	1+2
2.	Cost Accounting	DBM-312	2(2+0)	2+0
3.	Dairy Biotechnology	DTM-311	3(2+1)	2+2
4.	Cheese Technology	DTT-311	5(3+2)	3+4
5.	Instrumentation & Process Control	DTE-311	3(2+1)	2+2
6.	Quality & Saftey monitoring in Dairy Industry	DTM-312	3(2+1)	2+2
7.	Principle of Dairy Machine Design	DTE-312	3(2+1)	2+2
8.	Food Technology	DTT-312	3(2+1)	2+2
	TOTAL		**24(16+8)**	**32(16+16)**
Semester VI				
1.	Financial Management	DBM-321	3(2+1)	2+2
2.	Chemical Quality Assurance	DTC-321	3(2+1)	2+2

3.	Food and Industrial Microbiology	DTM-321	3(2+1)	2+2
4.	Dairy Plant Design and Layout	DTE-321	3(2+1)	2+2
5.	Judging of Dairy Products	DTT-321	3(2+1)	2+2
6.	Dairy plant Management & Pollution Control	DTT-322	2(1+1)	1+2
7.	Communication Skill and Entrepreneurship Development	DBM-322	2(1+1)	1+2
8.	Food Engineering	DTE-322	4(3+1)	3+2
	TOTAL		**23(15+8)**	**31(15+16)**

VII Semester:-

Hands-on Training and Experiential Learning: The student will undergo campus training in various departments of college or off campus training in other College of Dairy Technology, Where facility of hand –on training is available.

Sr.No	**Course Title**	**Credits**
1.	Hands –on training and experiential learning	25(0+25)
	Total	**25(0+25)**

VIII Semester: In plant training in commercial Dairy Plants.

Sr.	**Course Title**	**Credits**
1.	In-Plant training	20(0+20)
2.	Training Report Evalutation	5(0+5)
	Total	**25(0+25)**

Hands-on Training /Experiential Learning and in-plant training could also be oraganised in III year.

Total Credits.

1. Course credit up to (VIth Semester) : 141
2. Hands on training (VIIth Semester) : 25
3. In –plant training and report and evalution (VIIIth Semester): 25

Hand-on Training and experiential Learning: A minimum of two areas for creating infrastructural facilities for Hands-on Training and experiential has been proposed by each university as detailed below. The areas of specialization opted by colleges is decided upon local needs and industrial demand.

3.6 DAIRY TECHNOLOGY

1. Dairy Engineering

1. Dairy Engineering: 3(2+1)

Sanitization: Materials and sanitary features if the dairy equipments Sanitary pipes and fitting, standard glass piping. Plastics tubing, fittings and gasket, installation, care and maintenance of pipes & fittings .Description, working and maintenance of can washer, bottle washers. Factors affecting washing operation, Power requirements of can bottles washers CIP cleaning and designing of system. Mechanical separation: Fundamentals involved in separation .Sedimentation, principles involved in filtration .Types rates of filtration, pressure drop calculations. Gravity setting principle of centrifugal separation, different types of centrifuges. Application in dairy industries, clarfiers, tri processors, cream separators self dislodging centrifuge, Bacto-fuge, care and maintenance of separators and clarfiers. Homogenization: Classification, single stage and two stage homogenizer, Pumps power requirements care and maintains of homogenziers, aspects homogenizer. Pasteurization Batch, flash and continuous (HTST) pasteurizers, flow diversion valve. Pasteurizers control care and maintains of pasteurizers . Different type of sterilizers in bottle sterilizers autoclaves .Continuous sterilization plant. UHT sterilization . Aspect packaging and equipments . Care and maintenance of strelizers . Filing Operation : Principle and working of different types of bottles filters and capping machine . Pouch filing machine (Pre-pack and aseptic filling bulk handling system. Care and maintenance. Mixing and agitation: Theory and purpose of mixing . Equipments used for mixing solids and gases. Different type of stirrers. Paddles agitators . Power consumption of mixer –imppeller. Selection of mixing equipments in dairy industries , mixing pumps.

Practical : To study : S.S Pipes and fitting gasket materials and S.S Milk pumps : Milk tanker and milk storage tanks: Can washer and bottles washer CIP Cleaning equipments :

Homogenizers :Batch and Continuous pasteurizers :Different controls on Pasteurizers Different sterilizers :Pouch filling machine :Different types of agitators :Bottles filling and Capping machine : Determination of the rate of filtration and setting :Visit to a dairy plant.

2. Dairy Process Engineering: 3(2+1)

Evaporation: Basics principles of evaporation ,constructions and operation .Different types of evaporation used in dairy industry. Calculation of heat transfer area and water requirement of condensers .Basic concept of multiple effect evaporators. Operations and various feeding systems .Economy of operations. Thermo processor and MVR system. Care and maintenance of evaporations .Drying : Introductions to principle of drying Equilibrium moisture constant bound and unbound moisture .Rate of drying – constant and falling rate. Effect of shrinkage. Classification of dryers –

spray and drum dryers. Drying etc. air heating systems Atomizations and feeding systems. Factor affecting bulk density of power spray dryers controls. Theory of solid gas separation .Bag filters care and maintenance of drum and spray dryers fluidization fluidized bed dryers Mechanization and equipments used in manufacture of indigenous dairy products. Butter and ghee making machine. Ice-cream and cheese making equipments . Packaging machine for milk and milk products. Membrane processing : Ultra filtration .Reverse Osmosis and electro dialysis. Materials for membrane constructions .Ultra filtration of milk. Effect of Milk constituents on operation. Membranes for electro – dialysis.

Practical : Study of constructions and operations of : Vacuum Pan: Double effect evaporator : Spray dryer : Vacuum and atmospheric drum dryers . Study and operation of butter ,Ghee ,Ice-cream and cheese making equipments . Study the Reverse Osmosis and Ultra filtration system: Design problems on double effect evaporator and Vacuum pan. Visit to a milk product plant.

3. Dairy Plant Design and Layout 3(2+1)

Introduction of Dairy Plant design and layout. Type of dairies , perishable nature of milk. Reception flexibility . Classification of dairy plants . location of plant .Location problems selection of site. Dairy building planning .Process schedule , basis of dairy layout , importance of planning principles of dairy layout, Space requirement for dairy plants . estimation of service requirements including peak load consideration. General points of consideration for designing dairy plant. Floor plant types of layouts .Service accommodation ,single or multilevel design. Arrangements of different sections in dairy .Sitting the process sections. Materials handling in dairies ,Common problems ,office layouts – flexibility .Development and presentation of layout .Choice of building construction materials . floor. Generals requirement of dairy floor finishes .floor for different section of dairy . Foundations . Walls doors and windows . Drains and drain layout for small and large dairies . Ventilation. Fly control. Mold prevention , illumination in dairy plants.

Practical : Building symbols and convention layouts for small , medium and large size dairies . Isometric presentation of piping. Design and layout of Milk collection/chilling centre : fluid milk plant (small, medium and large): Single products dairy (i) Cheese. (ii) Ice-cream (iii)butter and (iv) ghee , composite dairy plant.

4. Instrumentation and Process Control: 3(2+1)

Absolute and secondary instruments. Types of secondary instruments, Essentials of indicating instruments, Constructional details of indicating instruments. Principle of induction type instruments –shaded pole method and two pole methods. Compensation for frequency and temperature errors. Induction type voltmeter . Ammeter , advantage and disadvantages. Inductions type single phase watt hour meter, their errors and remedies . Numerical. Wattmeter, Power fractometer, etc. Characteristics of instruments Elements of generalized measuring system ,static calibration, accuracy sensitivity , responsibilities static errors dead zone .drift in measuring instruments and measuring Rotameter. Study the different parts and working of pressure switch. Study the different parts of an indicating instrument. Study the

different parts and their working of single phase induction type watt-hour meter. Visit to a microprocessor controlled dairy plant.

5. Engineering Drawing: 2(0+2)

Drawing of lines, lettering and dimensioning types or lines, types, types of lettering, types or dimensioning. Drawing of scales. Plain scale, diagonal scale, comparative scale and Vernier scale. Drawing of projections: Orthographic projections. methods of projections. Drawing of screw threads: Types of threads and terminologies used in lit. Screw fastening: Types of nuts. types of bolts, stud. locking arranu.ements for nuts and Foundation bolt. Drawing of rivets and riveted joints forms of vivet heads. types or riveted: joints, tililun: of riveted joints, Drawing of welded joints: Forrns or welds. location and dimensions or welds. Drawing or keys, colter joint. pin joint-, t) pes or keys, types of cotter joints, pin .ioints Drawing of shaft couplings: Rigid couplings. loose couplings, flexible couplings universal coupling, Drawing of shaft bearings, Journal bearings, pivot bearings, collar bearings.

6. Principles Of Dairy Machine Design 3(2+1)

Basic concepts in Statics and Dynamics. Force Systems. Equilibrium condition. friction. Law offriction. Second moments of inertia, Parallel axis theorem. Dynamics: Equation of motion. Translation and rotation of a Rigid body, work and mechanics of materials : Stress-Axial toad classification Strain-Hooke's law, stress-strain diagram. Poisson's Ratio : Shearing Stresses. Torsion, Torsion formula, Angle to Twist of circular members. Power transmission shear force and bending moments, Shear in Beams. Bending Moment in beams. Pure bending of beams, Flexural stress shearing stresses in beams relations between centre, Torsional and flexural loads. Machine Design: Procedures, Specification, strength, design factor, factor of safety selection of factor of' safety. Materials and properties. Static strength, ductility. hardness, fatigue, designing lor fatigue conditions. Theories of failure, Stresses in elementary machine parts, Design of a drive system. Design of length and thickness of belt. Bearing:Journal and Anti-friction bearing«. Selection of hall. tapered roller and thrust bearing. Springs, helical and Ieafsprings. I-nergy stored in sprinus Design and selection of springs.Practical: Engineering Statics & Dynamics. Work and Energy. Linear and Angular Momentum. Stress-strain diagram evaluation of elastic constants. Power transmission. Shear force and bending moment diagrams. Flexural stresses. Shearing stresses in Beans. Fits and tolerances. Design stresses in elementary machine parts. Design of shafts. axles keys Springs, Couplings, Bearing

7. Workshop Practice 2(1+1)

Introduction to workshop practice. safety. care and pITcatltions in workshop. Wood work in tools and their lise, Carpl'ntry and pattern making. Monld material and their applicatior-, Heat treatment processes: hardening. tempering. annL'allng, normalizing etc Metal cutting. Soldering & Brazing. l.lectric arc welding. Gas smithy and forging operations

.tools and euipments the bench :flat surface filing Chipping. Scraping Marketing out. Driling and screwing use of jigs and fixtures in production intoduction to following machine tools : (a) Lathe (b)Miling machine (c) Shaper and planer (d) Drilling and boring machines (e) Grinder (f) CNC machines

PRACTICAL: Simple exercises in Filing and Fitting. Chipping and Hack sawing. Chiseling. Tapping and Smithy practice, Simple exercises in Arc. Gas. & Argon welding. Simple exercises in Soldering, Brazing. Basic joints in carpentry

8. Fluid Mechanics **3(2+ 1)**

Units and dimensions, Properties of fluids. Static pressure of liquids: Hydraulic pressure. absolute and gauge pressure,pressure had of a liquid. Pressure on vertical rectangular surfaces. Compressible and non compressible fluids. Surface tension. apillarity. Pressure measuring devices, simple. differential, micro. inclined manometer. mechanical gugcs. Piezometer. Floating bodies: Archimedes principle. stability of floating bodies. Equilibrium oftloating bodies. Metacentric height. Fluid Ilow: Classification. steady uniform and non uniform flow. Laminar and turbulent. cont inuitv equation, Bernullis theorem and its applications. Flow through [1IPC\: Loss or head. dctcnn inatiun of pipe diameter. Determination or discharge. friction factor. critical velocity. Iltm through orifices. mouthpieces, notches and weirs. Vena contractu. hydraulic coefficients, discharge losses. Time for emptying a tank. Loss of head due to contraction. enlargement at entrance and exit of pipe. External and internal mouthpieces. types of notches. rectangular and triangular notches, rectangular weirs. Venturimeters, pitot tube. Rota meter. Water level point gauge. hook gauge. Dimensional analysis: Buckingham's theorem application to fluid flow phenomena. Froude Number, Reynolds number. Weber number and hydraulic similitude. Pumps: Classification, reciprocating, centrifugal pump. Pressure variation, work efficiency. Types of chambers, selection and sizing.Practical: Study of different tools and fittings. Plotting now rate versus pressure drop with U-tube manometer.Verification of Bernoulli's theorem. Determination of discharge coefficient for venturi. Orifice. V-Notch. Verification or emptying time formula for a tanx. Determination of critical Reynold's number by Reynold" apparatus. Study of reciprocating. centrifugal and gear pump. Calibration of Rota meter. Study of different types of valves. Problems on following topics: Pressure. capillarity and surface tension. Floating bodies. Liquid flow. venturi meter. orifice. weir. flow through pipes. pumps.

9. Heat & Mass Transfer **3(2+1)**

Basic heat transfer process. thermal conductivity. convective film co-efficient. Stefan Boltzmau's constant and equivalent radiation co-efficient. Overall heat transfer co-efficient. physical properties related to heat transfer. Working principles and application of various instruments for measuring temperature. One-dimensional steady state conduction: Theory of heat conduction. Fourier's law, Derivation of Fourier's equation in Cartesian co-ordinates. Linear heat tlow through slab, cylinder and sphere. Heat now through slab. cylinder and sphere with non-uniform thermal

conductivity. Concept of electrical analogy and its application for thermal circuits. Heat transfer through composite walls and insulated pipelines. One dimensional steady state heat conduction with heat generation: Heat flow through slab, hollow sphere and cylinder with uniform heat generation. Development of equations of temperature distribution with different boundary conditions. Steady-state heat conduction with heat dissipation to environment. lntroduction to extended surfaces (FINS) uniform area or cross-section. lquution of emperature til:,trihutilln with different boundar conditions. Effectiveness and efficiency of the FNS Introduction to unsteady state heat correlating variables affeeting convection heat transfer. Convection : Forced and free convection. Use of dimensional analysis for correlating variables affecting convection heat transfer. Concept of Nusselt number Prandtl number, Reynolds number, Granshoff number. Some important cmpirieal relations used for determination of heat transfer cocfficint. Heat Exchnagers : General Discussion. Fuling .factors, jacketed kettles , LMTD. parallel and counter flow heat exchangers. Shell and tube and plate heat exchangers. Heat exchanger design. Application of different types of heat exchangers in dairy and food industry. Ficks Law of diffusion, steady state diffusion of gases and liquids through solids. Equimolal diffusion. Mass transfer co-efficient and problems on Mass transfer.

PRACTICLE : Determination of thermal conductivity: milk. solid dairy & food products. determination of overall heat transfer co-efficient of: Shell and tube. plate heat exchangers and Jacketted kettle used in Dairy & Food Industry. Studies on heat transfer through extended surface. Studies on temperature distribution and heat transfer in HTST pasteuriser. Design problems on heat exchangers. Study of various types of heat exchangers. Design problems on mass transfer.

10. Thermodynamics **3(2+ 1)**

Basic concepts: systems. processes. cycles. energy. The Zeroth Law of Thermodynamics.Equation of state. Compression and expansion of gases. The first Law of thermodynamics Internal energy. enthalpy. The second Law of Thermodynamics: thermodynamics temperature scale, Carnot cycle. entropy. reversibility. availability. AirCycle Otto. Diesel. dual efficiencies. Plotting the cycles on various thermodynamic planes viz, P-V, T-S,p-h diagram: etc. IC. Engines: Two stroke and.four stroke cycles. Construction. Injection and ignition of fuel, Performance of IC engines. Fuels: Chemical properties, air for combustion, Calorific value and its determination, Burners, firing of fuels. Renewable energy sources Properties of steam: Wet dry saturated. superheated steam. Use of steam tables and sources mobiler charts. Steam generators: Fire tube boilers, Water tube boilers. Boiler mountings and boiler accessories. Draught: Natural, forced. fan, jet. Measurement of Height of chimney. condensers. Layout of pipe-line and expansion joints. Boiler trial: Codes, Indian Boiler regulation acts. Air Compressors: Reciprocating. Single and two stage air compressors.

PRACTICAL : Application of thermodynamics in engineering. problems. Study of 2-stroke engine and 4 stroke engines. Performance tests on I.C. engines. Determination of dryness fraction of steam .To study the boiler installed in Model Plant Water softening plant, Lancashire boiler , Locomotive boiler. Bahcok & Wilcox boiler. l. lectrodc boiler. Boiler mounting and steam – line layout and steam traps. Visit to sugar mill/rice mill or plant with steam urilization. Study of Solar water heater and biogas plants and appliances

11. Refrigeration & Air Conditioning 3(2+1)

"Basic refrigeration cycles and concepts: Standard rating refrigerating machines, Elementary vapour compression refrigeration cycle with reciprocating, rotary and centrifugal compressors. Theoretical vapour compression cycle. Departure from theoretical vapour compression cycle. representation on T- and p-h diagrams. Mathematical analysis of vapour compression refrigeration system. Refrigerants: Primary and secondary refrigerants. common refrigerants (Ammonia. Freon). Brine. Their properties and comparison. Multiple evaporator and compresser systems: Applications. One compressor systems: dual compression. comparison of system. Control of multiple evaporator system, Working and mathematical analysis of above systems. Refrigeration equiprnents:Compressor. Condenser. evaporator. Cooling tower. spray pond. Basic elements of design. Construction, operation and maintenance. balancing of different components of the system Refrigeratior Controls :Low side and high side float valves. High pressure and low pressure cutouts thermostat, overload protector, common defects and remedies. Refrigeration piping :purpose materials ,joint and fitting .water and brine pipe size selection . Absorption Refrigeration system.

Simple vapour absorption refrigeration systems. Practicle absorption system, Refrigerant absorbent combinations Absorption cycle analysis. Psychromctry: definition, properties of air-vapour Psychrometric charts. Processes involving air vapor mixtures. Dehumiditication. Humidityfiers, Humidity measurement. humidity control. Wet bulb. dry bulb temperature dew point temperature. cooling load calculations: Types of loads. design conditions for air cooling, air Conditions loads. Cold storage: Types of cold storage. Types of loads in cold storage. construction of cold storage. Insulating materials and vapour barriers.

Practical : Study of tools used in installation of a refrigeration plant including charging and detection of leaks. To study different parts and learn operation of bulk milk cooler. Study of diffrent parts and learn the operation of a refrigeration plant/ice plant using ammonia refrigerant. Study of different parts and learn the operation of a vapour absorption refrigeration plant. Dismaltiling and assemble an open compressor and a sealed unit. Study different parts

andcontrols of the following (a) Refrigerator (b) Water cooler (c) Deep Freezer (d) compare their cooling coils and other systems. To find out the rating (cooling rate) at different suction (temperature diffrences) and air handling capacity of the air cooling unit. Plotting the practical refrigeration cycle on a pressure enthalpy diagram and to compare it with a theretical refrigeration cycle. Study diflerenr parts and operation of a (a) Air washer. (b) Room cooler (c) Air conditioner. (d) Chemical dehumidifiers. (e) Cooling. Plotting of psychrometric process Sensible heating & cooling. Dehumidification & cooling and heating & humidification. Study of different humidity indicating. recording and controlling devices. Problems on cold storage.Visit to cold storage.

12. Electrical Engineering 3(2+1)

Alternating current fundamentals: Electromagnetic induction magnitude of induced E.M.F. Alternating current, R.M.S. value and average value of an alternating current. Phase relations and vector representation. A.C. series and parallel circuits, Concept of resonance, polyphase transformation current circuits, three-phase concept Star and delta connections, star delta transormation Energy measurement. Transformers: Fundamental of transformer. Theory. vector diagram without load and with load, Losses. voltage regulation and efficiency of transformer. auto-transformer. A lternators: Elementary Priuciples, Construction and different Types of alternators. E.M F. in alternators, circuit breakers. Induction motors: Fundamental principle production of rotating fields. construction. Rotor winding - squirrel cage and phase wound rotors, Analysis or current and torque, starting of induction motors. Motor housing. selection of motor and its controls. D.C. Machines: Construction and operation of D.C.Generator Types of'generators, various characteristics of generator. D.C. motors. torque speed characteristics of D.C. motors. Starting and speed control of D.C. motors. Electric power Economics: Maximum demand charge, Load factor and power factor correction. Measuring Instruments: Classification. of instruments. Elements of a generalized measurement system, Static and Dynamic characteristicts.

Practical : Study of voltage resonance in L.C.R. circuits at constant frequency; (a) Star connection- study of voltage and current relation (b) Delta connection-study of voltage and current relation. Measurement of power in 3-phase circuit; (a) For balanced loads (b) For unbalanced loads. by wattmeter and energy meters. Polarity test, no-load test. efficiency and regulation test of single phase. Voltage and current relation in a 3-phase transformer of various kinds or primary and secondary connection system. Starting of induction motor by the following starters: (i) D.O.l.. (ii) Manual start delta (iii) Automatic start delta (iv) Manual auto-transformer. Starting or slip-ring, induction motor by normal and automatic rotor starters Test on 3-phase induction motor. Detemination of efficency line current current. speed. slip,

power factor at various outputs. Determination relation between the induced armature voltage and Speed of separately excited D.C. generator. Magnetization characteristic or D.C. generator. study the starter connection and starting reversing and adjusting speed of a D.C. motor. study of various measuring instruments.

13. Food Engineering 4(3+1)

Rheology of processed food, properties of fluid foods, Rheological method, Measurement of rhelogical parameters. properties of granular food and powders. Properties of solids foods.Visco – clastic models. Measurement of food texture. Food Freezing: Thermal properties of .frozen food Predication of freezing rates. Plank's equation, Neurnanna problem and Tao Solution. Design of food freezing equipment, Air blast freezers. Plate freezers and immersion freezers, storage of frozen foods. Food dehydration : Estimation of drying time for food Product , constant rate period and falling rate period dehydration. Diffusion controlled falling. rate period. Use of heat and mass balanced in analysis of continuous dryers, fixed tray dehydration, cabinet drying. tunnel drying, Freeze Dehydration : Heat and mass transfer. calculation of drying times. Industrial freeze drying. Equipment for pulping, Fruit juice extraction Balanching, Dchulling, Size reduction and distillation.

PRACTICAL : Study of rheological properties of foods. Study of freezers and freeze dryers. design problems on batch freezers. Design problems tor continuous freezers. Design problems on dryer. Visit to cold storage. Visit to food processing plant.

2. DAIRY MICROBIOLOGY

1. Fundamentals of Microbiology 3(2+1)

Microbiology : history and scope; contributions of Leeuwenhoek, Pasteur and Koch. Principie microbiology : Light Microscopy (Bright field-dark field. phase contrast, fluorescence); preparation and staining of specimens; electron microscopy. Microbial taxonomy: principles; numerical taxonomy; major characteristics used in taxonomy; classification according to bergey's manual of systematic bacteriology. Structure and functions of prokaryotic cells; Diffrence between prokaryotics and eukaryotes, Microbial growth and nutrition: the growth curve factors affecting growth of micro organisms. estimation of bacterial growth; bctriostatic and bactericidal agents; the common nutrient requirements and nutritional types of microrganisms. Bacterial genetics: DNA as the genetic material: structure of DNA: bactarial nutations (spontaneous and induced); genet ic recombi nation- (transformation. tranduction, conjugation). Microflora of air. soil and water: methods lor controlling microrganisms in air; water as carrier of pathogens .

Practical : General instruction for microbiological laboratory. Microscope- simple and compound Microbiological equipments; autoclave, hot air oven. incubator,centrifug.colorimeter, laminar airflow. membrane filter. Simple "staining-methylene blue;' crystal violate negative staining. Differential staining (Gram. spore. acid fast). Mortality of

microorganisms; hanging drop technique. Measurement of microorganisms by micrometry. Preparation of commonly used growth media liquid and solid: simple and differential media.Isolation technique for microorganisms- Streak & pour plate enumeration of microorganisms in air and soil. Enumeration of microorganisms in water: total viable count coliform (MPN).

2.Introductory Dairy Microbiology 3(2+1)

Hygienic milk production system: microbial quality of milk produced under organized v/s unorganized milk sector in India and comparison with developed countries: microbial andnon microbial contaminants. their sources and entry points in milk during various stages of production; Good Hygiene Practices (GHP) during milk production operations microorganisrns associated with raw milk; morphological and biochemical characteristics of importent groups and their classification: significance of different groups of bacteria i.e. phychrotrophs, mesophiles, therrnodurics, and thermophiles in milk. Microbiological changesin bulk refrigerated raw milk; Impact of various stages like milking, chilling, storage and transportation on microbial quality of milk with special reference to psychrotrophic organisms ; Direct and indirect rapid technique for assessment of microbial quality of milk. role of microorganisms in spoilage of milk: souring. curdling. bitty cream, proteolysis. lipolysis; abnormal flavors and discoloration. Mastitis milk: Processing and public health significance, organisms causing mastitis, somatic cells secreted in milk; detection of somatic cellcount (Sec) and organisms causing mastitis in milk. Milk as a vehicle of pathogens: food infection. intoxication and toxic infection caused by milk borne pathogens like E. coli. salmonila tvphi. Staph aureus. Bacillus cereus etc. Antimicrobial substances in milk:Immunoglobulin, lacto ferin, lysozymes,L.P system etc.

PRATICAL: Morphological examination of common dairy organism (size and shape. arrangement and sporulation). Enumeration of psychrotophic, thermophilic, thermoduric and spor forrming bacteria in milk.Detection of sources of contamination: air, water. utensils. equpiment and personnel line testing. Spoilage of milk caused by microorganisms souring . . sweet curdling, gassiness, lipolysis, ropiness, proteolysis and discoloration. Detection ofmastits milks, pH, SLST, somatic cell count, chloride content, Hotis test. CAMP test. detection and estimation of coliforrns; presumptive test, rapid coliform count, IMVIC test. detection of important pathogens using selective media; E.coli. Staphylococcus aureus salmonella and Bacillus cereus. Estimation of microbial load in milk by SPC and Dye reduction tests-(MBRT, RRT). Detection of antibiotic residues using. qualitative test.

3. Food and Industrial Microbiology 3(2+1)

Microbiology: Basic aspects and scope of food microbiology. Intrinsic and extrinsic Factors that affect microbial growth

in foods. Microbial spoilage or fruits, fruit juices. vegtables , cereals. meat. poultry. sea foods. carbonated soft drinks. canned foods: control of spoilage Food preservation : physical methods: chemical preservatives and natural antimicrobial compounds, biology based preservation system. Industrial Microbiology:fermentation processes: the range. components and types (submerged, surface and solid state ferrnentation): criteria for selection of industrially important microorganisms; media for industrial and inoculurns development; down stream processing of fermentated products. fermenterstypes, functions. design and control: chernostat and turbidostat. Microorganism and processes involved in the production of industrial-alcohol, organic acids (citric lactic). enzymes (protease, lipase and rennet). vitamin (B-12). antibiotic (nisin) and microbiology of effluent treatment in food industry.Practical: Microbiological examination of: fresh and canned fruits/ vegetables/ juices: Hour and bread, eggs and meat. Design and control of a tabletop and 10 liter lab ferrnenter (Demonstration). Isolation of psychrophile, salt and sugar tolerant microorganisms fror-i foods. Isolation of industrially important microorganisms from environment. Production and assaying of microbial enzymes (protease/ lipase) Production (of lactic acid from whey Production of nisin and assiying the antimicrobial activity of the culture. Production ethyl .

Alcohol from molasses and whey by yeasts. Produc(ion of' fermented whey beverages.Educational tour to food processing/ lerrnentation industries.

4. Starter Cultures And Fcrmcnlaled Milk Products 3(2+ l)

Introduction of starter cultures & their imporlancl' ill dairy industry. classification of Lactic acid bactiria Metabolism of Lactic Acid Bacteria and diacetyl production, production of anti bactirial substances by lactic starter cultures. Mixed and define strain starter culture; propagation of starter cultures; factors affecting their propagation; starter concentrates- direct bulk and direct vat starter cultures; starter distillates. Quality and activity of starter cultures: defects in starters and their control; starter failures; antibiotic residues, sanitizers and Bactiriophages. Preservation of starter cultures: freezing and freeze-drying; factors affecting the survival of cultures during preservation. Role of starter cultures in the preparation of various fermented milks; c1assitication oftermented milks Microbiology of dahi and yoghurt: Diffrent types of dahi and yoghurt; preparation; defects and their control. Microbiology of Milk products ; their nutritional and therapeutic significance. Kefir and Kumiss: origin and charastirictis microbiology of Kefir grains. Microbiology of other terrnenred milks such as bugarian milk. cultured buttermilk. Leben and Yakult their signiticance. Concept of probiotic starters and their application in pro biotic dairy food.

Practical : Testing for purity or xlartcr cultures: gram's staining. catalase test: creatine test. starter activity tests: die reduction tests. Horrall-Llliker test. Whitehead and Cox test. preparation of single and mixed starter cultures:

homotermentation and hetrotermentation separately and also in combinations. Maintenance and preservation of starter cultures- Freeze drying techniques demonstration. Preparation of concentrated starter freeze dried and frozen type.Effect of physical factors on dairy starter: temperature. pH, salt. sugar. Testing Milk for the presence of inhibitory substance using B. stearothermopnttue and S. thermophilus as indicator organisms. Effect of antibiotic residues in milk on starter activity associative growth of microorganisms in milk and cream. Deteclion of bactriophages in cheese whey by plaque assay. Preparation and evaluatiori of quality and Gradin of Dahi, Yoghurt, cultured butter milks, acidophilus milk and Kumiss. Microbiological analysis of processed cheese- Total spore count & Anaerobic Spore count. microbiological analysis at different stages of manutacture of (storage and ripening) hard verities cheese- such as Cheddar cheese.

5.Dairy Biotechnology 3(2+1)

Definition ,Scope and historical dcvelopment of biotechnology. achievement and future Application : structure of DNA and RNA; DNA replication. protein synthesis. genetic code . Mutations . Vectors, cloning strakgies in bacteria and animals. DNA technology. Protoplast fusion & Tissue culture in dairy cultures. Application or biotedlllology in food and dairy Industry, dairy ctlluents. Genetic manipulation of dairy starters for improved a.ttributes 01' comercial value. Dairy enzymes and whole cell ilfHllobilization. Ethical issues relared to use of genetically modified foods.

PRACTICAL: Isolation of plasmid and genomic DNA from bacteria (E. coil. lactic acid bacteria Agarose gel electroporesis of DNA fragments). Restriction analysis of' DNA. Curing of plasmids. Preparation of competent cell. Conjugal transfer in E. coli cells. Transformations of E. coli by calcium chloride treatments/electro oration. Preparation of protoplasls and protoplast fusion. PCR technique demonstration. Visit to a biotechnology lab,

6. Quality and Safety Monitoring in dairy Industries 3(2+1)

Current awareness on quality and safety of dairy foods: consumer awareness and their demand for safe foods: role uf codex alirnentarious commission (CAC) in harmonization or International standards: quality (ISO 9001 :2(00) and food safety (HACCP) system and their application during milk producuon and processing. National and international food regulatory Standerds -BIS. PFA. ICMSF. IDF etc . their role in the formulation of standards for Controlling the quality and safety of dairy toads. Rapid assessment of dairy food for Microboile and non-microbial contaminants; Enumeration Principles in detection of pre dominent spoilage organisms and pathogens like indicator organisms. E.coli. salmonella. Shigella staph aureus. Bacillus cereus and non microbial contaminants like antibiotic residues aflatoxin. pesticides other inhibitors etc from. dairy foods and their control Measures Microbial quality of water and

environmcntal hygiene in dairy plant; chlorination of dairy water supply. quality of air. Personnel hygiene. treatment and disposal of waste water and eftluents: setting up of a microbiological! pathogen lab in a dairy plant and its Safety concern.

PRACTICAL: Evaluation of common sanitizing agents used in dairy plants by a) suspension b)Capacity Test. Microbiological tests tor assessing equipment and personnel hygiene by swap and rinse methods. Detection or faecal and non- faecal coliforms and faecal streptococci in dairy plant Detection and enumeration of different pathogenic becteria in dairy products: staphylococus aureus, Bacillus cereus. Salmonella and Shigella. Bacteriological analysis of dairy water for: a) total viable counts b) coliform counts (MPN). Detection of antibiotic Residues pesticides. aflatoxins and staphylococcal enterotoxins in milk using rapid techiques.Determination of BOD in dairy waste water. Quality evaluation by HACCP in the preparation of dairy products.

3. DAIRY TECHNOLOGY

1. Market Milk 4(3+1)

Market milk industry in India and abroad: Distinctive features of tropical dairying as Compare to those of the tropical climate of developed countries. Collection and transportation of milk; a) Organization of milk collection routes b) Practices for collection of milk, preservation at farm. refrigeration. natural microbial inhibitors. lactoperoxidase system. c).microbiological quality of milk produced on farm. Effect of pooling and storing on microbial quality of refrigerated milk. Role of psychrotrophs. Role of tropical climate on spoilage of d).Chemical tests for grading raw milk. e) Microbio-logical tests for grading raw milk. reception and treatment (pre-processing steps) of milk in the dairy plant: a) Reception chilling clarification and storage: General practices. b) Hornogen isation: Definition.Pretreatments . theories. synchronization of homogenizer with operation or pasteurizer HTST c) Effect of homogenization on physical properties of milk. d) Bactofugation: Theory .and microbiology. Thermal pnleessing of milk: a) Principles of thermal processing: kinetics of microbial destruction. thermal death curve, arrhenius equation. D value. Z value, Fo value. Q_{10} value. b) Factors affecting thermal destruction of micro-organisms. c) Definition and description of processes: Pasteurization. thermisation. sterilization. UHT Processing. d) Microbiology of pasteurised milk. therrndzes, sterilized & UHT milk. e) Product control 'n market milk plant. f) Defects in market milk. g) Manufacture or special milks: toned. doubled toned, reconstituted, recombined. flavoured, homogenized vitaminised and sweet ac idophilus milk. h) Manufacture of sterilized milk. i) Distribution systems for market milk. Quality: and safety aspectes in dairy food chain, good manufacturing practices (GMP) in dairy processing. UHT processing of milk: a) Relevance of UHT processing in the tropical climate b) UHT plants discription . Direct Indirect. with upstream and downstream homogenization. third generation UHT plants. c) Aseptic packaging. types and

systems of packaging. Sterilizing Packages filling systems. d) Technical control in the UHT plant. Training (If personnel. Plant hygience c).Shelf lite of UHT milk and tests for UHT milk. Nutritive value (If milk. Effect of heat processing on nutritive value. ifficiency of plant operation: product accounting. setting up norms for operational and processing losses for quantity. Fat and SNF. monitoring efficiency maintaining plant hygiene & HACCP.

Practical : Familiarization with cquipments for reception of milk in plant: Pretreatments: chilling clarification. filtration. Standardization and nurnericals relating to it. CreamSaparation parts of separator and the process. Operation of LTLT. HTST pasteurizer. laboratory steriliser. Sampling and chemical examination of pasteurized. sterilized and UHT processed milk. Sampling and routine microbiological examination of microbiological examination of pasteurized and sterilized milk. Preparation of special milks; toned. double loned standardised , flavoured, sterilised. Cleaning of storage tanks, cream separators. HTSTPlants manual cleaning and CIP. Detection of adulterants and preservatives in milk. assisment of homogenisation efficiency in milk. Strength of common detergents and canitizers in market milk plant.

2. Traditional Dairy products **3(2+1)**

Status and significance of traditional milk products in India. Khoa: Classification of types . standered methods of manufacture and preservation factors affecting yield of khoa. Physico-Chemical changes during manufilcture and storage of khoa. Mechanization in manufacture of khoa. condectioneries made from Khoa-Burfi, peda, Milkcake, Kalakhand. Gulabjaman and Their compotional profile and manufacture practices. Rabri and Basundhi: Product Identification, process description. factors affecting yield physico-chemical changes during Manufacture Channa: Product description, Standards method of manufacture, packaging and Preservation . Chhana-based sweets. Rasogolla, Sandesh, Ras-maJai. Mechanization of manufacturing . process. Paneer: Product description standards method of manufacture packeging preservation. Physico-chemical changes during manufacture and storage. mechanization of paneer manufacturing/packaging process. Srikhand: Chakka-product description, standards method of manufacture, small scale and industrial, packaging and preservation aspects, Shrikhand-save as chakka. Physico-chemical changes and quality Assuring during manufacture and storage. Sandesh: Product description method of Manufacture and packaging process. Misti dahi : Product description method of manufacture and packaging process. Kheer and Payasam: Product description methods of manufacture. innovation in manufacturing and packaging processes. Microbiology of indigenous milk products. predominance of spoilage & pathogenic organisms in Khoa. Chhanna, Paneer. shreekhand. their spoilages. control measures & .legal specifications. Biopreservative principals in

enhancing the sclf life (If indigenous milk.products including active packaging.

Practical : Preparation of khoa from cow, buffalo and concentrated milk. Analysis of khoa. channa and paneer fix total solids, moisture. fat and acidity. Preparation of kheer. Preparation of chhana from cow and buffalo milk and mixed milk. Preparation or pancer from cow and buffalo milk and mixed milk. Preparation of misti dahi. chhaka and srikhand. preparation of khoa and chhana based sweets. Microbiological examinations of traditional dairy products: Khoa. paneer. spore counts. coliform counts yeast, molds counts etc. Field trip.

3. Fat Reach Dairy Products 4(3+1)

Status of fat reach dairy products in India and abroad. Cream: a) Detinition & Legal standards. efficiency of cream separation and factors affecting it; control of fat concentration in cream. b). Planning and operating a cream production unit) neutralization. standnrdization. Pasteurization and cooling of cream. c) Preparation and properties of different types of cream: table cream sterilized cream, whipped cream, plastic cream. frozen cream and chip-dips (cultured cream). UHT processing of cream. d) Bacteriology of cream including defects.Factor affecting quality of cream: ripening of cream e) Packaging storagl' and distrihution. defects (non-microbial) in cream and their prevention butter a). introduction to the butter making process: theory of churning, Legal standards. b) technology of Butter manufacturure , Batch and continuous methods. Over-run in butter: contrl of fat loses in butter-milk; packaging and storage: transportation: defects in butter: rehology of butter; uses of butter. Microenvironment in cream and butter. impact of critical process factor on entry of spoilage and pathogenic organisms in cream & butter, their spoilages and control measures. Legal microbiologies specifications of cream & butter. Butter making equipment : Construction, operation, care and maintenance of cream separators.Coolers and vacreator, factory butterchurnand continuous butter making machine. Special butter and related products:a) Manufacture, packaging. storage and properties of whey butter :flavoured butter. whipped butter, renovated butter / fractionated and polyunsaturated Milk fat products ,vegetable oil-blended products and low-fat spreads. b) Manufacture, packging, storage and characteristics of margarine of different types.Ghee and butter oil: a) method of ghee making-batch and industrial processes, innovations in ghee production.Producor packeging and preservation of ghee; utilization of substandard milk. b) Ghee: compogition and changes during manufacture fat constants.Practical microbiological examination of cream:Direct microscopic count. Dye reduction tests microbiological examination of cream: a)Total viable count b)Lipolytic count c) coliform count Standardization, neutralization, pasteurization and cooling of cream. preparation of sterilized cream. Study of construction and cooperation of the power operated Butter churan and butter packaging machine. Preparation of cooking butter by the hand operated churn Preparation of desi butter. Manufacture of table butter using the power-driven chran. Preparation of ghee from cream and butter. Study and operation of continuous ghee

plant. Sampaling , determination of melting/slip point, moisture by gravimetric method, B.R. index and baudouinTest. Acidity, Helphen Test for the presence of cotton-seed oil. R.M. valu and polenske value. Saponification value. Iodine value. Peroxide value. Detection of animal body fats and vegetable oils. Examination of the quality of sodium chloride for butter making

4. Chees Technology **5(3+2)**

Origin and history of devdoprnent of cheese mamifacturc status and scope in India and abroad. definition, standards and classification of cheese. Milk quality in relation to cheese making . Treatment of milk: Physical and chemical. Cheese additives and prcservativex Role of starter culture in relation to cheese quality. Rennet preparation and properties. rennet substitute Action of rennet on milk in relation to cheese making. I'vlanufilcture of different verieties of cheese: Cheddar. Gouda, Swiss. Mozzarella. Cottage.Microhiological changesduring preparation ripening in cheese. Role of milk constituents and changes during manufacture and ripening in cheese. Factors affecting yield of cheese. Packing, storage and distribution of cheese. Accelerated ripening of cheese. Microbiological defects in cheese; their cause and prevention. Manufacture of processed cheese, cheese spread and processed Cheese foods. Mechanization and automation in cheese processing. Microbiological critical control of cheez cold-store.

Practical : familiarization with equiprnents, accessories and standardization numericals study of factors affecting rennet action. Manufacture of Cheddar cheese. Manufacture of gond cheese manufacture of Mozzarella cheese. Manufacture of Swiss cheese. manufacture of cottage cheese. Manufacture of Processed cheese. Manufacture of Processed cheede spread Manufacture of processed cheese food. Analysis of cheese; proximate composition, determination of ripening index

5. Ice cream and frozen deserts **4(2+2)**

History, Development and status of ice cream industry, History. development and status of ice cream industry, Definition. classification and composition or ice cream and other frozen desert stbilizers and emulsifiers-their classification, properties and role in quality of ice cream technological aspects of ice cream manufacture, Thermodynamics of freezing and calculation of refrigeration loads, Types of freezers, refrigeration control/instrumentation. type of freezers refrigeration control/instrumentation, Hygiene, cleaning and sanitation of Icecream plant Effect of process treatments on the physico-chemical properties of ice-cream mixes and Icecream. Processing and freezing of ice-cream mix and control of over run. pakeging,hardening storage and shipping of ice-cream. Defects in ice cream, their causes and prevention Physico-chemical properties of ice-cream and compositional

standards .micro environment in ice cream, microbiological quality of ingredients. critical process factors and their impact on entry of pathogen in ice cream, their survival during storage. food poisoning out breaks, food safety & legal standards, Recent advances in ice-cream industry and plant management, Technology for preparation of dried icc-cream milk mix. and nutritive value of ice-cream.Practical calculation of standardization of ice-cream mixes.Manufacture of plain and fruit flavoured ice ceram Manufacture of chololcate. fruit and nut ice cream. Preparation of Sherbets/ices Preparation of soft served and tilled ice-cream. Manufacture of kulfi, Study of continuous and batch type freezers. Manufacture of ice-cream by continuous process. compositional analysis of ice-cream. Microbiological examination of ice-cream and other frozen desert :SPC, coliform, staphylococci & Salmonella. Field trips.

6. Condenced And Dried Milk **5(3+2)**

History, status and scope in India and abroad, Definition and legal standards: Condensed milk sweetened condensed milk and evaporated milk., Manufacturing techniques:a) manufacture of evaporated milk including pilot sterilization test b) Manufacture of sweetened condensed milk c) Recombined sweetened condensed milk.Grading and quality of raw milk for condensed and evaporated" milk, Physico-chemica] changes taking place during manufacture of condensed milk, Heat stability of milk and condensed milk. Physico-chemical properties of condensed milk and role of stabilizers in the stability of condensed milk.Chemical defects in condensed milk. their causes and prevention .Microbiological qualities of condensed milks. preservative used in evaporated. condensed & dried milks. a) Type of micro organisms occurring in condensed milks b) Survival and growth of microorganisms during manufacture and storage.c) Microbiological standards. d) Type of spoilage and their prevention. Recent advances with reference to freeze conccntrat ion and membrane concentration , Dried Milks: History and status in India and abroad. Grading and quality of Raw . milk for dried milks, Manufacture of skim milk powder (SMP). whole milk powders and heat classified powders, Physico-chemical changes taking place during manufacture of dried Milks. Physical properties of dried milks, Defects in dried milk during manufacture and Storage their cause . and prevention, PFA, BIS and International Standards for dried milk,Manufacture of infant foods, malted milk foods and other formulated dried products, microbiological quality of various dried milks including infant foods and Management of condensed and dried milk industry.

PRACTICAL :- Manufacture of plain skim concentrated milk. Chemicals and microbiological examination of concentrated and dried milks for (a) Moisture. T.S., Fat lactose, sucrose, bulk dersity solubility index, and (b) SPC, coliforms. yeasts and molds. toxins etc. Manufacture of SCM Manufacture of EM. Concentration of milk by membrane processing. Manufacturing of SMP by spray drying/roller drying. Manufacture of instant milk powder.

7. By Product Technology **4(3+1)**

Status availability and utilization of dairy by-products in india and Abroad. Associated economic and .pollution problems .. Physico chemical characteristics of whey, butter milk and ghee residue By-products from skim milk: a) Casein: types of commercial casein, their specification manufacturing processes with basic principles involved. b) Industrial and food uses of c) Manufacture of sodium and calcium caseinates their physico-chem ical and functional propertise bronerties and food applications d) Manufacture of casein hydrolysates and its industrial application e) Cooprecipitates: types, their specifications, manufacturing processes with basic principles involved, functional properties and food applications. Whey processing: a) Fermented products from whey, b)Beverages from whey c) Deproteinized and dermineralized whey d)Condensed whey e)Dried whey, types and their specification, manufacturing techniques. F)lJtilization of whey products. Whey protein concentrates: a) method od isolated with basic principles involved. physico-chemical properties of whey proteins concentratesb)Functional properties and food applications of WPC. Lactose:method for the industrial production of lactose. refining of lactose, uses of lactose and hydrolysis of Butter milk processing.a) Condensed butter milk b) Dried butter milk c) Utilization. butter milk products Ghee residue. Composition, processing and utilization. Nutritional characteristics of by products.

PRACTICAL : manufacture of edible casein from cow and buffalo milk. Manufacture of rennet casein manufacture of sodium caseinate. Manufacture of calcium caseinate. Manufacture of co-preceinate. Chemical analysis of whey, buttermilk, casein, casein and co-precipitates.Isolation of whey proteins by cold precipitation technique. Manufacture of whey proteins, concentration by ultra filtration process. Manufacture of whey drinks. Manufacture of dried whey manufacture of lactose. Chemical analysis of whey protein concentrates and lactose. microbiological analysis of casein and dried whey. Incorporation of whey protein Concentrates in processed cheese foods.Manufacture of coffee whitener.

8. Judging Of Dairy Products **3(2+1)**

Introduction definition and importance of sensory evaluation in relation: to consumer acceptability and economic aspects: factors affecting food acceptance. Terminology related to sensory evaluation. Design and requirements of sensory evaluation laboratory.Basics .principles: Senses and sensory perception. Physiology of sensory organs. Classification of tastes and odours, threshold value factors affecing sens. visual. auditory, tactile: and Other responses. Fundamental rules for scoring and grading of milk and milk products, Procedure : Types of tests difference tests (Paired comparison. due-trio. triangle) ranking. Scoring , Hedonic scale and descriptive tests. Panel selection, screening and training of judges Requirements of sensory evaluation, sampling procedures. Factors influecncing

summary measuremnet ·Milk:Classes of raw and processed milks. defects associated with milk score card and its use . .Judging and grading of milk. Fermented milks: Desirable undesirable charactersitics of fermented milks. sensory evaluation of dahi, yoghurt. 'srikhand lassi and other fermented drinks. Cream: Desirable attributes and defectscream.Score card for cream Judging and grading of different types of cream. Butter: specific requirenment of high grade butter, undesirable attributes of butter. butter score-card, evalution of butter, Ghee: Grades of ghee, special requirements of quality ghee. defects in ghee Serlsory.evaluation of ghee. Frozen dairy products: Desirable and undesirable characteristics of frozen dairy products Sensory evaluation of ice cream. kulfi and milk cheese :quality attributes of some common cheese varieties and their defects. score card for chesse. Sensory evaluation and grading for cheddar. cottage and other varieties of Dried dairy products: Desirable and undesirable characteristic of dried milks. jugdging and grading of dry milk products. Concentrated milks: Desirable attributes anddefects judging and gradidng of evaporated and condensed milk. Heat desiccated Indian milk products desirablc and undesirable charaoteristics. Sensory evaluation of khoa and khoa based sweet .Acid coagulated Indian .milk products: desirable arid undesirable characteristics sensory evaluation of paneer,chhana and chhana based sweets. Consumer acceptance studies Objectives. Methods, types or questionnaires. development of questionnaires parison of laboratory testing and Consumers studies, limitations. "interrelationship between sensory properties of dairy products and various instrumental and physico –chemical tests. Preparation of milk and milk products with detects, techniques for simulation.

PRACTICAL :Determination of threshold value for basic tastes. Determination of threshold value for various odours selection of Judging panel. Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests. Judging of milk and cream judging of butter and ghee. Judging of condensed and evaporated milk. Judging . of khoa and khoa based sweets of cheese and related products. Judging of frozen products. Judging Of milk powders sweets.Judging of chhana wid chhana based sweets. Judging of dahi and fermented products products.

9.Food Technology – 1 **4(3+1)**

Status of food processing industries in Indiaand abroad, magnitude and inter- dependence of dairy and food industry. prospects for future growth in India. Harvesting, transportation and storage of food and vegetables. Post harvest processing of fruits and vegetables. Peeling.Sizing blanching, Canning of fruits and vegetables.Drying and freezing of fruits .and vegitables , juice processing- General steps in juice processing, role of enzymes in fruit .Juice Extraction , equipments and methods of fruit juice extraction, preservation of fruit juices. Fruit juice clarification. concentration. of fruit juices, fruit juice powders. Fruit juice processing orange and tangerine. Lemon and lime juice .Apple juice. Grape

juice, Nectars. puply juices, tropical blends, Vegetable juices. Jam, Jelly, Marmalade. Pectin: Chemistry & technology Fruits and vegetable preserves, Glazed. Crystallized fruits. Tomato base products (Juice, puree, paste, sauce. ketchup. Pickles: Principle of pickling. technology of pickles,Beverages - Classification, scope, carbonated non-alcoholic beverages and its manufacture Fruit beverages and drinks, additives for fruit based beverages, Coffee: production practices. structure of coffee/cherry, Coffee processing including roasting.grinding. brewing extraction. dehydration. arornatizxatiun. instant coffee. Tea-Tea leaf processing , green. red. yellow. instant tea.Tcchnology of confectionery products chewing gums and bubble gums. Toffees. Caramels. Standards PI' confectionery products products: Cocoa bean processing, chocolate liquor. Stundards of contcctionery Products . Functional foods: Introduction, Phytochemicals. Milk ingredients as nutraceuticals. ghee-rich food products etc.

PRACTICAL : Manufacture of toffees and caramels, Testing the efficacy of blanching process.Drying of fruits and vegetables, Preparation of fruit based drinks and beverages: Ready-to serve drink, Nectar, Squash, Whey-fruit based bevrages. Manufacture of fruit jam. manufacture of fruit jelly. Manufacture of chocolate confections. Manufacture of tomato katchup /tomato sauce. Manufacture of soups. Manufacture of fruit preserve. Manufacture of candied fruits. Manufacture of fruit bar.Manufacture of pickles

10. Packaging Of Dairy Products **3(2+ I)**

Introduction ; Importance of Packaging, History or Package Development. Packaging materials a) Characteristics of basic packaging materials: Paper (paper board. corrugated paper . fibre board). G lass. Metal. Plastics, Foils and lam inures. retort pouches. Package forms Legal requirements or packaging materials and product informatio. Packaging of milk and dairy products such as pasteurized milk. UHT-sterilized milk, aseptic packaging. fat rich Products ghee and butter, coagulated and desiccated indigenous dairy products and their sweetmeads concentrated and dried milks including baby foods. Modern Packaging techniques Vacuum Packaging, Modified atmosphere packaging (MAP). Eco-friendly packaging.Principles and methods of package sterilization. Coding and Labelling of Food Packages Aseptic Packaging (AP), Scope of AP and pre-requisite conditions for AP. description of equipments (including aseptic tank) and machines- Micro-processor controlled system employed for AP, Package conditions and quality assurance aspects of AP, microbiological aspects of packaging materials. Disposal of waste package materials. packaging Systems.

PRACTICAL : Identification of packaging materials, Flame Hot wire test Testing of Papers /paperboards . Percentage moisture, Grease resistance. Water absorptiveness. Grammage , Tearing resistance. Bursting strength. Testing of glass bottle -- resistance to Thermal shock Testing' of plastics and laminates - Thickness, Water vapour transmission

rate (WVTR) Grease resistance. Packaging of different dairy products by using prepak and'vacuum packaging machines. Microbiological evaluation of packaging materials (SPC. Y & M. Spore count).

11. Dairy Plant Management And Pollution Control 2(1 + I)

Production Management. Definition. Function and structure of Production Management. production planning & Control. Work study and measurement rnoiton and time study, Plant operations. Efficiency factors losses, Financial and Managerial efficiency Provision for Industrial Legislation in India, Particularly in dairy industry. Personal Management.Man power planning. recruitment, training, transfer. promotions policies . Job specifications.Job evaluation, Job enhancement, Job enrichment, MBO. working. conditions. Safty hazards. hazards , prevention security for plant machinery and the employees. Plant Maintenance. Prevention & Break-down maintenance Spare parts inventory. tools & lubricants etc. Food hygine, personnel hygine, plant hygine, water quality etc. Cleaning and Sanitation .- different type of cleaning and sanitizing agents. Effluent treatment: Type. degree and treatment of waste.

PRACTICAL: Flow process charts of different milk products,identification of steps of materials losses on Dairy plants, ldcntification of hazardous process'" and equipments, safty and precautions. ldcnticat ion ami uses of common lubricants waste utilization process. Treatment in waste disposal. Analysis of cleaning agcnts and sanitizers. Reports and mainantenance of dairy plant. Operational precaut ions. C I P cleaning

12. Food Technology II 3(2+ 1)

Cocal grains. legumes and oilseeds: Structure and cornposruon of cereals. legumes and Milling of paddy, quality factors of rice grains, processing of rice bran oil. Instant rice quick cooking rice, canned rice, Milling technology of wheat, Criteria of wheat flour quality improvers for wheat flour, Types of wheat flour, Milling technology of maize, wet milling of corn. Milling technology of barley, malting of barley and its utilization in manufacture of value added food products including malted milk foods, Alcoholic beverages. debulling and processing technology of important pulses. Dehulling and extraction of oil in major oilseed crops like soy bean. mustard, sunflower. ground nut. Vegetable protein concentrated / isolates, Utilization of oil cake in food formulation. Bakery and Snack Technology :Technology of bread. biscuits, crackers and cakes, I echnology of manufacturing process of Pasta foods- Macaroni, Noodles and Spaghetti .. Technology of breakfast cereals: corn flakes puffed. extruded snacks. Potato chips. Meat. lish and egg technology : Development of meat. poultry. egg and fish industry in India. Pre-slaughter care. handling and ante – mortem inspection of animal. Stunning and slaughtering techniques. Postmortem inspection -rigor mortis and conversion of muscle to meat. Processing of meat and meat Products. : curing. smoking, edehoning and comminuted.

Slaughterhouse sanitation, meat hygiene 'and zoonotic diseases, Processing of poultry meat. Egg and egg products processing of albumen, yolk and whole egg, drying and freezing of egg, quality assessment of egg. Types. handling. transportation and marketing of fish, Preservation of fish .Manufacturing turing process of fish protein concentrate, fish sausages. dehydrated fish and fish pickles Cleaning and sanitation, Waste management of food processing plants.

PRACTICLE : Manufacture of barley malt. Determination of cooking quality of rice. manufacture of bread and bun. Manufacture of biscuits. Preparation of noodles. Preparation of cake. Manufacture of potato chips. Preparation of malt based food products. Manufacture of sausages. 'Preparation of salami. Preparation of-chicken soup. Manufacture of chicken picles. Preparation of fish stick and fish keema

4. DAIRY CHEMISTRY

1.Physical Chemistry of Milk 3 (2+1)

Constituents and gross composition of milk of different species and breeds of milch animals.Colloidal State: Distinction between true and colloidal solution. lypophilie & IypophobicSolution . properties of colloidal system. Properties of colloidal systems, Gels-their formation and properities . Milk as a colloidal system and its stability. Elementary idea about emulsion. Density: Density and specific gravity, pyknometer method. hydrometer lactometer. Density and specific gravity of milk, effect of various processing variables on the density and specific gravity of milk. Liquid State: Surface tension. surface energy interfacial tension. Surface tension of mixtures. Surface tension of milk and the factors affecting it. Viscosity- Definition of viscosity. Newtonian and Non-Newtonian liquids. Stokes Law. influcuce of temperature .and concentration of solute on viscosity. Viscosity or milk. evaporated milk and condensed - milk. Refractive index. .Colligative ' Properties or Dilute Sniutillll vapour pressure. Roults Law, Depression or freezing point. Elevation of boiling point Freezing point and boiling point of milk. Osmosis and Osmotic pressure. inter- relation pf colligative properties. Aqueous solution or Electrolytes : Electrolytes : non-electrolytes, ionic mobility. Electrical conductance, Ostwald Dilution Law, Kohlrawsch Lim. Lkclflcal conductance of milk. Ionic Equilibria: Dissociation of water. ionic product of water. concept or pH and pOH and their scale. Acids and bases: Bronsted Lewis concepts of acids and bases. Dissociation constants of acids and bases. Salt-their hydrolysis. Buffer solutions. Derivation or Henderson Hasselbach equation and it application, buffer capacity and buffer index. milk as a buffer system. Equilibrium of electrolytes. pH indicators. Oxidation- Reduction: Redox potential. Nernst equation. electrochemical cells. Hydrogen.glass and calomelelectrodes. Redox system of milk. Nuclear Chemistry: The nature of isotopes. radio isotopes. Half life period or radio isotopes. Some of the important radio isotopes. Occurrence of radio nuclide in milk & milk products. Molecular Spectroscopy: The spectrum

of electro magnetic radiation, the laws of Lambert and Beer. visible. and ultra-violet Spectroscope. Mention of mass. NM R spectroscopy.

Practical: Determination of density and specific gravity of milk using pyknometer. hydrometer and lactometer. Determination of viscosity of milk using Ostwald viscometer.Determination of surface tension of milk using Stalagmomekr. Intcrfacial tension between water-oil phase. Determination of freezing point of milk. Preparation of a buffer solution . Determ ination pH of buffer solut ion and milk electrometrically. Determ inat ion of acidity of milk electrometrically. Determ inat ion of electrical conductance of JI1 ilk. Determ ination of redox potential of milk. Coagulation of milk using electrolytes. Determination of refractive index of skim milk and Whey. Titration of amino acid in the presence and absence of formaldehyde. Determination of PKa I PKa2 and PL. Verification of Lambert Beer Law.

2. Chemistry of Milk **3(2+1)**

Definition and structure of milk, factors affecting composition of milk, Nomenclature and classification of milk proteins, Casein: Isolation, fractionation and chemical composition. physico-chemical properties of casein, Whey proteins: Preparation of total whey proteins α-Lactalbumin and β- Lactoglobuline. Properties of α-Lactaibumin and β lactoglobulin, immmunogloubin and other minor milk proteins and non proteins nitrogen constituents of 'milk, Hydrolysis and denaturation of milk proteins under different physical and chemical ,environments, Estimation of milk proteins using different physical and chemical methods, :importance of genetic polymorphism of milk proteins .Milk enzymes with special reference to lipases,. Xanthine Oxidase. phosphates, proteases and lactoperoxidase. Milk carbohydrates their status and importance. Physical and chemical properties of lactose. Sugar amine condensation. amadori re arrangement. production of hydroxyl methyl furfural (IIMF).:Processing related degradation of lactose. Definition. general composition and classification of-milk lipids. Nomenclature and general structure or glycerides. t;ICtorS affecting the tillly acid composition. Milk phospholipids and their role in milk products. I Jnsaponitiable matter and fat soluble vitamins. Milk Salts: Mineral in milk (a) major mineral (b) Trace clements. physical equil ibria among the milk salts and' Milk contact surtilces and metallic contamination.

Practical: Sampling techniques of chemical examination of milk. Determination of pH and titratable acidity of milk. Determination of fat in milk by difkrentlllcthods. Determination of total solids and solids not fat in milk. Determination of total milk proteins by Kjeldabal method. Determination of casein. whey proteins and NPN in milk. Estimation of alkaline phosphatase and lipase in milk. Determination of lactose in milk, Determination of ash in milk. Determination

of phosphorus and calcium in milk. Determination or chloride in milk. Determination of temporary and permanent hardness of' water estimate of available chlorine from bleaching powder

3. Chemical Quality Assurance **3(2+ I)**

Importance of chemical qllalit} control in dairy induxtr , : selling up quality control laboratories and testing facilities: mobile testing laboratories. Sampling procedures: labeling of samples for analysis: choice of analytical tests for milk and milk products for chemical analysis: instrumental mcthods or analysis. Calibration of dairv glassware including butyrometer, pipettes, burettes. hydrometers, Iactometers and fn::czing point thermometer Preparation and standardization of reagents required in the analysis of milk and milk products. Application or PFA, AGMARK, BIS and codex related to dairy products for the quality control of milk and milk products. Preservatives. neutralizers and adulterants in milk and milk products and their detection. Accreditation of analytical laboratories : Hazard analysis and critical control points (HAeCP). Prediction of shelf life behavior of milk and milk products. Milk contact surfaces. metallic contamination, environlllental contaminates such as pesticides, antibiotics. heavy metals in dairy products: methods of estimation. Soft and hard water. temporary and permanent hardness, softening of hard water.

PRACTICAL : Calibration of dairy glassware such as pipette. burette. volumetric flasks. hydrometer, butyrometers. Preparation and standardization of dairy reagents such as acids. alkalies. sodium thiosulfate. silver nitrate. Fehlings. l-:llTA solutions etc. Detection of adulterants, preservatives. and ncutralizers in milk and milk products. Chemical analysis of permissible additives used in milk and milk products. Chelllical analysis or detergents and sanitizers. Preparation and testing of Gerber sulfuric acid used in 1:lt (ktcrrninatioll. Testing the amyl alcohol used for fill determination. Analysis or market samples of milk and milk products.

4. Food Chemistry **3(2+1)**

Water: Water binding and chemical reactions mediated by water. Food Proteins: Classification, physico-,chemical properties, Reaction involved in processing. Reactions with alkali, Enzyme catelysed reactions involving hydrolysis and proteolysis. Theories of formation of texturised proteins. Lipid: Reactions involved during deep frying of food viz .autoxidation of saturated acyl lipids and polymerization. Lipoprotein and membrane : definition, classification and involvement in the formation of biological membranes. Unsaponifiable matter contents in various fats and oils. Edible fats and oils. classification and chemical composition. Carbohydrates: Legumes. jellies fJolysaccharide viz. linear. branched and modi tied. Properties and utilization of common potysaccharidcs. viz. cellulose, glycogen. hemicellulose and pectin. Fllzymatic degradation of polysaccharides. vi>. agar. alginate. Carrangccnall. gums and

starch. Production of dextrans and Illalto dextran. Food Fnzymcs:Hydrolases and lipases. utili/ation in food industrv. L'ffl.'Ct of inihibitorx, pi I and temperature. Minerals in foods: Main Llements. trace elements in eg,!!s. cereal and cereal products. vegetables and fruits. Aroma compounds in foods: Threshold value. ofT flavours. Food additives: Vitamins. amino acids. minerals. Aroma" substance flavour enhancL'rs-moflosodillm glutamate, nucleotides. Sugar substitutes, sorbitol. SweetenCl"s-saccharin. L'yclalllalL'. Food colours. Anti-nutritional factors and Food contanirnanr : Toxic-trace elements. radio nuclides Cereals and cereal products: Individual constituents. like proteins. lipids. carhohydrates and vitamins in cereals flour and their relationship in dough making. Tvpc of flours. bread making and non-bread making: chemical composition. influence of additiws/minor ingredients on baking properties. Physical. chemical changes during baking. Legumes Classification composition and physico-chemical properties. Vegetables and fruits Classification. general composition. chemical changes during ripening and storage jams jellies and pickles : C lassificat ion. composit ion and preservation Beverages : classification Coffee. Tea and Cocoa-gradation. composition. chemical changes during processing. volatile compounds. Preservation of Foods: General principles of rood preservation. chemical preservation, preservation through irradiation.

PRACTICAL: Determination of moisture, acidity and gluten content in flour. Determination of total ash and acid insoluble ash in flour. Determination of starch in Ilour. Determination of total nitrogen in cereal products. Determination or acidity and vitamin C in citrus fruits. Analysis of tomato ketchup for total solids. acidity, ash and sail. Dcrcrtninatim, of total sugar ill tomato ketchup. Ikterlllinatiun of total ash and alkalinity or soluble ash in tea Determination of water extractive in tea leaves. Determination of presence or Chicory in coffee powder. Determination of reducing sugars in Jam. Determination of iron in infant foods.

5. Biochemistry & Human Nutrition **3(2+ 1)**

Biochemistry Enzymes Ribozymes, isozyrnes, allosteric enzymes, zyrnogens, regulatory. Classification and mechanism of enzyme action, Factors affecting rate of enzyme catalyzed reaction, enzyme inhibition, Enzymes coenzymes and eo-factors immobliation of enzymes. Nucleic acids and Bioenergetics : Structure and function, definition and composition. Structure of RNA & DNA-Anabolism and Catabolism of carbohydrates. lipids and proteins. Vitamins and Hormones: Structure & functions, general description. Relationship between vitamins and hormones in terms of their biological role. Elementary knowledge of milk synthesis in mammary gland.

Human Nutrition. Theory and definition, Scope of Nutrition : Function, of the various nutrients in body. Digestion, absorption and assimilation of nutrients. Comparative requirements and nutritional requirement of different age groups. (WHO and leMR standard) Methods of evaluation of nutritive value of foods Nutritional value of cow, buffalo

and human milk. Milk intolerance: lactose deficiency and protein hyper sensitivity. Safety aspects of food additives, toxic elements, radionucJides, pesticides and antibiotic residues in milk and milk product Institutional feeding of workers. Planning and implementation of national food and nutrition policies and programme. Regulatory aspects of nutrition. IDF code on nutrition, nutrition facts under NLEA, Nutrient deScriptors, serving size and nutritional claims.

PRACTICAL: Biochemistry Estimation of alkaline phosphatase and the effect of temperature and pH on its activity. Estimation of catalases and the effect of temperature and pH on its activity. Determination of the M ichealis constant of an enzyme. Est imation of RNA by colorimetric method Estimation of DNA by colorimetric method. Measurement or proteolysis. Lipolysis. Alllylase activity. Estimation of vitamin 'A: inghec, Estimation. ifascorbic acid in milk. Estimation of vitamin D in milk. Estimation of proteins by Lowry's method. Buret method. Estimation of Lipids and Lipids analysis by TLC. Estimations of cholesterol in milk. Estimation of denaturation of proteins in heated milk by dye binding method. Estimation of HMF content in food.

6. Organic Chemistry **3(2+1)**

Hydrogen bonding: Concepts of hydrogen bonding inter and intra molecular hydrogen bonding in alcohol, carboxylic acids and other molecule. Hydrophobic interactions:Elementary idea of hydrophobicity and its importance in the structure of proteins. Alcohols:Important properties of mono. di and trihydric alcohols (Glycol and Glycerol)Aldehydes and Ketone : Reactions of aldehydes and ketones.Importance of carbonvl compounds in food flavors. Carbox ylic acids: ionization constant and strength of carboxylic acids. Important reactions of carboxylic acid, Derivatives: Esters, Arnides. Lactones their preparation and reactions. Amines: Basic character of amines. important reactions. Phenols: Acidic character of phenols and effect of nuclear subsituents on it. Reactions in phenols. Substituted carboxylic acid: important reactions of halogen substituted, Keto and Hydroxy acids. Zwilter-ion forms, its properties viz. melting point and volatility. Amino Acids and Peptides: Synthetic and natural amino acids General properties of amino acids. Definition and classification of proteins. Primary. secondary. tertiar-, and quaternary structure of Proteins. Carbohydrates: Definition. Classification and isomerism. Derivation of structure of (ilucose. open chain and ring structure. evidences for ring structure stercochem istrv and stability of anomers. Reactions of monosaccharides. Fatty acids and Lipids: Definition and classification. Important reaction of fatty acids (saturated and unsaturated) Structure and properties of Neutral lipids. phospholipids and cholesterol.

Practicals: Systematic identification of Organic Compounds: Aliphatic and Aromatic character, Instauration, Detection of elements (Nitrogen. Sulpher and Halogens), Detection of functional groups (Alcoholic, Phenolic, Carboxylic, Carbonyl, Aldehyde, Ketonic esters. Amino, Amide, Nitro etc.). Preparation of derivatives: Dinitrophenylhydrazone.

Oxime and Osazone. Qualitative test for Amino Acids and Proteins: Biuret test, Million's test. Nitroprusside Test, Ninhydrin test, Xantho proteic test. Hopkin's cole reaction. Detection of Carbohydrates (reducing & non reducing sugars) by Molisch IOrcinollResoreinol/Silvermirror test. Detection of lipids and phospholipids

5. DAIRY BUSINESS MANAGEMENT

1. Economic Analysis **2(2+0)**

Basic concepts-wants, goods, wealth. utility, consumption. demand and supply, Consumer behaviour-law of diminishing marginal utility and equi-marginal utility, cardinal and ordinal utility approach, for consumer's behaviors. Theory of demand-law of demand; demand schedule, demand function, determinates of demand. individual consumer demand and market demand, demand forecasting, elasticity of demand. price elasticity, income elasticity and cross elasticity, Consumer's surplus. Theory of production- concepts of firm and industry, basic factors of production and their role, production function for a single product. nature of production function, laws of returns. Concepts of costs-fixed and variable costs, short run and long run costs, average and marginal costs, economics and diseconomies cf scale. Concept of market- types of market, pricing and output under different market situations, market price and normal price, price determination under perfect Competition. monopoly, oligopoly and monopolistic competition. National income.- GOP. GNP, NNP. disposable personal Income, per capita income. inflation. lconornic features and characteristics of dairy sector ill India. Dairy development strategy with special emphasis in post- independence era and Operation Flood Programme

2. Financial Management And Cost Accounting **4(3+1)**

Introduction: Definition, scope and objectives of tinancial rnanauemcnt. Different Systems or Accounting: Financial Account ing. Cost accounting. Managernent Account ing. Doubles entry system of Book-Keeping. Preparation of Accounting Records: Journal. Purchases and Sales Book and Posting in Ledger, Cash Book. Preparation of Final Accounts and adjustments at the end of trading period. Preparation of Trial Balance Banking Transactions and Bank reconciliation statements. Statements of Financial Information: Accounting system: A SOurce of financial statements. Classification of capital and revenue expenditure. Balance Sheet. Profit and Loss Account, Statement of changes in the financial position, funds flow statements, cash flow statement, uses of funds flow and cash flow statements in financial decision making. Financial Analysis: Nature and uses of financial analysis. Liquidity ratios. Leveratge ratios. Activity ratios. Profitability ratios. Utility of Ratio analysis. Cost Volume Profit analysis and operating leverage. Break-even analysis, Profit analysis and operating analysis. Utility of CYP analysis. Capital Structure: C.S Planning. risk

return trade oft: financial leverage. Cost of capital: Management of cost of capital. cost of debt, debentures. preference share capital. equity share capital & retained earning. overall cost of capital. Investment decision: Time value of money. Net present value. Investment evaluation criteria. NPV method. Internal rate or return method. Profitability index method. Pay back period method, Accounting rate of return method. Capital budgding: Complex Investment Decisions: Investment timing & duration Investment decisions under inflation, Investment decisions under capital rationing. Project Report: Feasibility Report Valuation. Working capital management- Concept & determinants of working capital. Estimating working capital needs. Depreciation - Concept and method. Introduction. Definition. Objectives, Common terms. Costing: ;Essentials of sound costing system. Different methods of costing. elements of cost: Labour- recording of time, idle time, methods of remunerating labour, Premium & Bonus Plans, Materials, Overheads. Cost classification: Direct and Indirect expenses, fixed and variable costs. Various methods of apportioning indirect expenses. Inventory Management: Planning, control and costing. Stores & storekeeping, scope & importance. purchase procedure; types of purchase, location of stores & materials. procedure tor the movement of stores, different methods of pricing materials, store records. Cost Sheets Different methods, Statement of cost and statement of profit estimates, Tenders or Quotations. Contract or Terminal costing. Process Costing: Process losses and inter-process profits, joint products and by pwductsilosting. Ascertainment of cost of milk production. Preparation of-Cost AC'countJnlbrrnationfot~manageria' decisions.

PRACTICAL: Pniparation or Profit and Loss account. Preparation of>Balance Sheet. Preparation of Cash flow statements. Preparation of Funds flow statements. Problems on RatioanaJysis. Problems on Break-Even Analysis. Problems on Profit analysis. Problems, on 0peratiRg Analysis. Problems on Financial leverage. Problems on Cost of Capital. Problems on Investment decisions. Problems on Capital budgeting .

3. Operation Research **2(2+0)**

Introduction - Elementary concepts, objectives of operations research, Applications of OR in decision-making. Modeling in Operation Research. Linear Programming: Introduction, mathematical formulation of the problem, Graphical solution. Simplex technique for solving simple LP problems. Inventory Control - Introduction and general notations, Economic lot size models with known demand.

4. Industrial Statistics **3(2+1)**

Definition and scope; sources of animal husbandry and dairy statistic. Measures of central tendency, Measures of

dispersion. Morrie skewness and kurtosis. Elementary notions probability, Laws of addition and multiplication probability. Theoretical frequency distributions: Binomial distributions and applications, Poisson distribution and is applications, Nor distribution and its applications. Concepts of' sampling methods- Simple random sampling, stratifyrandom sampling. cluster sampling, systematic sampling. Introduction to testing of hypotheses. Tests of significance-Z, r^2. a. F tests, and their application in the field of dairying. Analysis of variance- One way and two way classification. Simple correlation coefficient and its test of significance, Line regression, rank correlation. Basic concepts of statistical quality control. Control charts for variables and attributes, Fundamental concepts of acceptance sampling plan.

Practical: Measures of central tendency.· Measures of dispersion. Moments. Skewness and Kurtosis Filling of bionornical and Poisson distribution. Selection of random sample. Application of 'r test for one and two sample problems. Application or 'I' test for one and two sample problems. Application of Chi-square test and I·-test. Correlation and regression. Rank correlation coefficient. Control chal for variables & attributes

5. Marketing Management and International Trade 2(2+0)

Concept of marketing: Functions of marketing: concepts of marketing management: score of marketing management: marketing management. Process: concepts of marketing- mix. elements of marketing- mix. Market Structure and Consumer Buying Behaviour: Concept "I' market structure. marketing environment, micro and macro environments. Consumers buying behaviour, consumerism. Marketing Opportunities Analysis: Marketing research and marketing information systems; Market measurement- present and future demand : Market forecasting; market segmentation. targeting and positioning. Allocation and marketing resources. Marketing Planning Process. Product policy and planning: Product-mix: product line; product life cycle. New product development process. Product brand, packaging. services decisions. Marketing channel decisions. Retailing. wholesaling and distribution. Pricing Decisions. Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry. Promotion-mix decisions. Advertising; How advertising works: Deciding advertising objectives. advertising budget and advertising message; Media Planning; Personal Selling. Publicity: Sales Promotion. Food and Dairy Products Marketing. International Marketing and International Trade. Salient features or International Marketing. Composition & direction of Indian exports: International marketing environment; Deciding which & how to enter international market: Fxports-Direct exports. indirect exports, Licensing, Joint Ventures, Direct investment & internationalization process. Deciding arketing Programme: Product. Promotion. Price. Distribution Channels. Deciding the Market Organization; World Trade Organization (WTO)

6. Communication Skills and Entrepreneurship Development 2 (1+1)

Communication Skills: Structural and functional grammar: meaning and process of communication, verbal and non-verbal communication: listening and note taking, writing skills, oral presentation skills: field diary and lab record: indexing. footnote and bibliographic procedures. Reading and comprehension of general and technical articles. precis writing. summarizing, abstracting; individual and group presentations. impromptu presentation, public speaking; Group discussion. Organizing sem inars and conferences. Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social. political and economic systems and their implicnrions 1'01' decision making b) individual entrepreneurs. Globalisation and the elll~r~ing business / entrepreneurial cnvironment. Concept (If' entrepreneurship: cntreprenl:urial and managerial characteristics: managing an enterprise: motivation and elltrerrl'llellrship development: importance ()j' planning, monitoring, evaluation and follow up: managing competition: entrepreneurship development programs: SWOT analysis. Generation. incubation and commercialization of ideas and innovations. Government schemes and inccni ivcx for proruot ion of entrepreneurship. Government policy on Small and vlcdium Llltcrpriscs (SMFs) / SSls. Export and Import Policies relevant to horticulture sector. v'cnturc capital. Contract limning and joint ventures. public-private partnerships 0\ en lew of' hurt i inputs industry. Characteristics of Indian horticultural processing and export industry. Social Responsibility of Business.

PRACTICAL: Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, ootnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing, summarizing. abstracting; individual and group presentations.

7. IT in Dairy Industry **2(1+ 1)**

Importance of Computerization and IT in dairv industries. Computers. Operating. Environments and lnforrnation Systems for various types of dail) Industries. Principles or communication. Role of Computer in Optimization: Introduction to Operation. Research. A Computer Oriented Algorithmic approach: Queuing systems and waiting models. PERT CPS and CPM. Dairy Process Modeling and Simulation. Introduction to SCADA & INTELUTION. CAD and CAM in Dairy Industries: Instrumentation. Process control. Inventory control, Automation. Robotics, Expert Systems and Artificial Intelligence. Instrumentation

PRACTICAL: Applications of MS Excel to solve the problems of dairy technology: Statistical quality control, Sensory evaluation of food. Chemical kinetics in dairy processing. Use of word processing software for creating reports and presentation. Familiarization with the application of computer in dairy industries: Milk plant Dairy units. Fruit & Vegetable processing unit. Familiarization with software related to dairy industry. Visit to Industry and knowledge of computer application in the same

8. Dairy Extension Education **2(1+ 1)**

History, need definition. philosophy. principles. approaches and objectives of extension education, Present status ofextension and rural Development programmes. Teaching/learning process, Extension Teaching Methods,

lassification and selection of teaching methods. Nature and importance of communication. Key elements of communication. Models of communication. process. feedback and problems in communication. Importance of audio visual aids in extension education. Classification, planning and selection of A.V.Aids. Identification of rural leaders, their characteristics. roles and functions in rural development, training of rural leaders. Definition of groups. natural types. principles of working with groups and their mobilization. Need. principles and steps of programme planning. Evaluation of extension programmes. Diffusion of innovations and categories of farmers. Conceptual orientation about different terms. like- PRA, RRA, IVLP/TAR. A TMA, A TIC, PTD etc.

PRACTICAL: Acquiring skill in use of audio-visual & other aids: Overheads Projector, Slide Projector. Use of VCR and PA system. Camera handling. Preparation and usc of visual aids and printed material; Poster and chart. Flash card and Ilaune l Craph. Circular letter, leaflet pamphlet, folder. Group Discussion Technique. Dcveloping Communication and Overall Skills. Brain-storming Technique for developing the Decision making Process, Interview technique(s). Identification or problems of village farmers through interview method. Writing a radio script.

9. Environmental Studies 3(2+1)

Environmental Science An introduction, Ecosystem kinds. structure. characteristics functioning, Biochemical cycles. Natural resources and their mauagcmcnts. Environmental pollution. Air pollution. Water pollution. Solid waste po l lut iori, Noise pollution. Soil pollution. Radio active pollution. Food processing industr, waste and its management. Management of urban waste water. Recycling of organic waste. Recycling of factory effluent. Control of environmental pollution through low, COITlposting of biological waste and Sewage. uses of water disposal effluent treatment, microbial examination.

PRACTICAL: Environment and its analysis. Water qual it) parameters. collection of sample for pollution study, Determination of pH/acidity/alkalinity from sample. Estimation of dissolved oxygen, Estimation of BOD. Estimation of COD. Estimation of nitrates. Estimation of phosphates. Estimation of pollutant clements. Estimation of heavy/toxic elements, Estimation of lead/ mercury. Visit to industrial sewage disposal unit.

10. Milk Production Manauement & Dairy Development 3(2+1)

Introduction to Animal Husbandry. Distinguishing characteristics of Indian and exotic breeds of dairy animals and their performance. Systems of breeding and methods of selection of dairy animals. General dairy farm practices-identification, dehorning, castration, exercising, grooming, weighing. Care of animals at calving and management of neonates. Management of lactating and dry cows and buffaloes. Methods of milking. milking procedure and practices for quality milk production. Dairy farm records and their maintenance. Systems of housing dairy animals and maintenance of hygiene and sanitation at dairy farm premises. Common disease problems in dairy animals, their

prevention and control. Feed nutrients required by animal body. Feed resources for milk production and their nutritive values. Digestive system of ruminants. Measures of feed energy. Nutrients requirements for growth and milk production. Feeding standards. Structure and function of mammary system. Milk secretion and milk let-down. Male and female reproductive system. Estrus to reproductive cycle. Ovulation. fertilization. gestation. parturition, pregnancy diagnosis. Artificial insemination and embryo transfer and their mit: in animal improvement. Introduction to biotechniques in dairy animal production. Socio-economic and geographical features of Indian dairying. Traditional Systems of cattle keeping. estimates of milk production. utilization and sail': cattle & buffalo population and its distribution: trends in population growth. annual milk production and per capita availability: productivity profile of indigenous dairy stock. industrial by-products of livestock industry. Five year plans and dairy development; resource inadequacy, post partition pressure: catalytic action of international air: major aided dairy projects: public sector m ilk supply schemes: co-operative dairy organizations. Anand pattern and perspectives: milk products manufacture in private sector. import substitutions in dairy products. Strategy of cattle improvement; pioneering role military dairy farm: key village scheme and its limitations. intensive cattle development programme concept, approach and achievements. Public sector dairy schemes, Economic burden performance analysis, National Dairy Development Board-aim and objectives, policy orientation in dairy development. Operation Flood- I.II,III : programmes & Outlay. implementation. success, achievements. integrated infrastructure of milk production. improvements Dr dairy co-operative organization. Dairy development Corporations, Co-operative Dairy Federations, Self-reliance in dairy development, income & employment potential. Conversion of milk into products. utilization pattern indigenous & western products. Dairy problems and policies.

PRACTICAL: Handling and restraining of dairy animals. Fxternal bodv parts and jUdging of cows and buffaloes. Feeding and management practices of clavcs. Identification or common feeds and fodders. Preparation of rations for adult animals Milking of dairy animals and cleaning and sanitation of milking equipments. ldcntification Ill' reproductive and digestive organs. Demonstration of semen collection, processing and artificial insemination.

11. Computer Programming **3 (1+2)**

Problem solving with computers. flowchart and algorithm development. Data types variables. constants, arithmetic and logical expressions, input/output statements. conditional statements. control structures, arrays. functions, structures, unions.

Practical: Understand different Components of Computer System. Write a C program to calculate volume of a prism having trapezoidal base. Write a program. which can input a positive integer «= I 00000(0) and print it in reverse order. For example 1)875674 to 4765789. Write a program to calculate sum of squares of' all odd integers hctween 17

to 335. Exclude integers divisible by 7. Ohm's law is I~Y/l{. Write a program to calculate I lrorn givenn sets of V and R. Write a program e to generate the Cartesian coordinates or points (x.y for the values 0 f ranging from 0.5, I 0, 15 ------- t.>O. t it le and label the output. Write a program to calculate the resultant focal length f when fI and 12 are placed in contact. Used formula is f= (f'I +t2)/(fl xfx). Compute for followinj, pairs of local lengths. fI 07 10.,8.-6.-1 ..... +8, + 10; 12= 0.5.-0.4 +0.4. +O.S Write a program to sort an array of N elements in ascending order.

Write a program to evaluate following series to calculate cos x

Cosx= I x2/2+x4/4+x6/6+ Compare the calculated value with the one by using library function. Write a program which reads in indefinite number of Name. Marks I. Marks2, Marks3 from keyboard and store them in a file along with total marks, Percentage marks and Grade in a file.