ARYABHATTA KNOWLEDGE UNIVERSITY
Patna, Bihar

Bachelor of Technology (B.Tech.) Program

INCLUDES

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- Course Structure
- Detailed Syllabus
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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 MICROBIOLOGY
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:

<table>
<thead>
<tr>
<th>Department</th>
<th>Subject</th>
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<tr>
<td>CH</td>
<td>Chemistry</td>
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<tr>
<td>CS</td>
<td>Computer Science &amp; Engineering</td>
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<tr>
<td>DT</td>
<td>Dairy Technology</td>
</tr>
<tr>
<td>EC</td>
<td>Electronics and Communication Engineering</td>
</tr>
<tr>
<td>EE</td>
<td>Electrical Engineering</td>
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<tr>
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<td>Electrical &amp; Electronics Engineering</td>
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<td>HS</td>
<td>Humanities and Social Sciences</td>
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<tr>
<td>IT</td>
<td>Information Technology</td>
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<td>LT</td>
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<td>Physics</td>
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<td>PY</td>
<td>Pharmacy</td>
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**Program code:**
- **UG Program:** 1
- **PG Program:** 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):**

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<td>10th</td>
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**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.

**Theory and Practical/ Sessional/ Project components have been separated & P is added in the end.**

**M. Tech Prog**
- 1st Sem, 2nd Sem, 3rd Sem, 4th Sem (1,2,3,4)
Note:

- Group A: Civil Engineering and Mechanical Engineering.
- First and Second Semester subjects have been divided in two groups: Group A and Group B. If a set of students 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

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Course Code</th>
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# COURSE STRUCTURE FOR B. TECH. PROGRAM
## BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING

### B.Tech.(Civil Engg.) SEMESTER-I

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**BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING**

**B.TECH. (Mech Engg.) SEMESTER-I**

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**BACHELOR OF TECHNOLOGY IN ELECTRICAL ENGINEERING**

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| 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 |

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| 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 |

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| CSUG  | 6    | 05 1x11 | FORMAL LANGUAGES &amp; AUTOMATA THEORY | 3  | 0  | 0  | 3  |
| CSUG  | 6    | 24 1x06 | INDUSTRIAL ECONOMICS &amp; ACCOUNTANCY | 3  | 1  | 0  | 4  |
| CSUG  | 6    | 05 1x14 | SOFTWARE ENGINEERING              | 3  | 0  | 3  | 5  |
| CSUG  | 6    | 05 1x07 | WEB APPLICATIONS DESIGN &amp; DEVELOPMENT | 3  | 0  | 3  | 5  |
| CSUG  | 6    | 05 1x16 | COMPILER DESIGN                   | 3  | 0  | 3  | 5  | 28.0 |
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B. Tech. (Leather Technology) SEMESTER –V (For 2011 Batch and onwards)
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

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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.

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## 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.

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.

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


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 :
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.


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.

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.

Text Books :
2.  Higher engineering mathematics by Wiley & Barrett-Tata McGraw hill

Reference Books :
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


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**:
2. Higher engineering mathematics by B.S. Grewal

**References**:
2. Complex variable and applications by Churchill & Brown –McGraw hill

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.

Lecture: 4

**Text Books**:

**Reference Books**
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-III: Group Theory: Semigroups and Monoids (definitions 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:

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


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.


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.

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)


**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

**Reference Books**:
3. Lasers and Non-Linear Optics by B.B. Laud; Pub: New Age International (P) Ltd.

**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**

   **Lecture : 7**

   **Lecture : 7**

   **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. 


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 catalysed 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 2.303RT\(F=k\).
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, chilli powder and pepper.
12. Determination of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) of value of sewage volumetrically.
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
4. Engineering chemistry by B. K. Sharma; Pub.: Krishna Prakashan Media (P) Ltd.
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) Learning-meaning, concept, nature, component of learning 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).

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.

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

5. Concept of organization theory, concept of organization structure, form of organizational structure, form of organizational culture.

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.

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.
4. (a) Performance appraised : Meaning, Objective, method of performance appraisal .
    (b) Transfer : meaning objective, types.
    (c) Promotion : Meaning, policies, basis of promotion.
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.

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.

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.

**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:**

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.
   Lecture: 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. **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.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.

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

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

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.

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

**Text Books**:
1. Engineering economics by Degarmo, Sullivan & Canada, McMillan
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.

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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. Precis, 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.

**Text Book**:
2. English grammar by Dr. D. Thakur
4. Technical English by Sharon j Garson and Steve M Garson

**Reference Books**:
1. Communication in English for Technical Student by Orient Longman
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
5. Meaning of Market : Type of market – Perfect competition, Monopoly, Oligopoly, Monopolistic competition, Main feature of these market, Meaning of Supply and Law of Supply, Role of Demand & Supply in price in prime determination imperfect competition Lecture : 7
6. Engineering Economy :

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 :
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
2. N. Das Gupta, Environmental Accounting, Wheeler and co.
3. Daly H.E, Beyond Growth: The Economics of Sustainable Development, Beacon Press

Reference Book
1. Willian P. Cunningham, Mary Ann Cunningham, Principles of environmental science, T.M.H
DEPARTMENT OF CIVIL ENGINEERING

01 1x01  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 : 7
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 : 8
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
   Lecture : 7

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

Text Book :

Reference Books :

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

01 1x02  ENVIRONMENTAL SCIENCE
L-T-P : 3-0-3  Credit : 5

Theory :
   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
   Lecture : 6
   Lecture : 6

Text Books :
1. Introduction to Environmental Engineering and Science, G.M. Masters. Pearson Education
3. Environmental Science, Wright, Pearson Education.
5. Environmental Chemistry, Sawyer and McCarty, McGraw Hill

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 :
   Lecture : 7
2. **Foundation**: shallow foundation (simple calculation)  
   *Lecture*: 5

   *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.
4. Civil Engineering Materials, TTTI Chandigarh
5. Construction Technology by Tony Bryan, Wiley
6. Advance Concrete Technology by Zogjin Li, Wiley

**Reference Books**:
3. “Materials for civil and construction Engineers” by Michael S. Mamlouk and JOHN P. Zaniewski, Addison Longman Inc. USA

**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
   *Lecture*: 7
   *Lecture*: 9
   *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*: 9
   *Lecture*: 8

**Text Books**:
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 stratigraphy of India. Lecture : 10

Text Books:
6. Element of Mineralogy in Engineering Geology by Read, H. H. Rutley’s, CBS Publisher.

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
4. Method of sections for evaluating internal forces in bodies, review of free body diagrams; axial force, shear and bending moment diagram. Lecture : 6
5. Axially loaded members force and deflections; Thermal Stresses. Lecture : 4
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
10. Introduction to energy methods. Lecture : 3

Text Books:
FLUID MECHANICS

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


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


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:

2. Fluid Mechanics by Fox & McDonald, John Wiley.
6. I.H. Shames by Fluid Mechanics, PHI.

Practical:

Viscosity, Metacentric height. Orifice meter, Notches, Reynolds number, Impact of jet.
6. **Hydrographic Surveying**: Scope, methods of sounding, locating of sounding, three-point problem and shoreline survey. 

**Text Books:**

**Practical:**
- Triangulation, Setting out complex curve, Contour plotting etc.

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01 1x09 **SOIL MECHANICS – I**

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

**Credit : 5**

**Theory:**
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.
3. **Seepage analysis**, flow nets, flow through dams.
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.
6. **Vertical stress** below applied load in soils (Boussinesq, Westergaard, and graphical solutions), one and two-dimensional cases.
7. **Compaction characteristics**, water content – dry unit weight relationships, OMC, max, Dry unit weight field compaction control.
8. **Soil stabilization**

**Text Books :**
2. Geotechnical Engineering by S. K. Gulati et. al., TMH Publication Co. Ltd., New Delhi

**Reference Books :**

**Practical :**
Hydraulics & Open Channel Flow

L-T-P : 3-0-0

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:


Reference Books:


STRUCTURAL ANALYSIS - I

L-T-P : 3-1-0

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 Clasingliano’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


Lecture: 7

Text Books:


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
   Lecture : 6

Reference/Text Books :
3. Elementary Hydrology by V.P.Singh Prentice Hall.

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 :

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:

Reference Books:

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


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
Introduction to Structural analysis Software. Lecture : 2

Text Books:

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:
2. Design of Reinforced concrete structure by P.Dayaratnam, Oxford IBM publication, 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
   Lecture : 7
   Lecture : 8
   Lecture : 9
6. Introduction to air noise pollution
   Lecture : 6

Text Books:

Reference Books:
4. CPHEEO Manual on water supply and treatment, Ministry of Urban Development.

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
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

Text Books:
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.
4. Fundamental of Transportation Engineering by Papacostas, C. S., Prentice hall of India, New Delhi

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

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

Text Books:

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. 
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.  
3. In-situ tests: SPT, CPT, plates load tests, methods for ultimate bearing capacity based on in situ tests.
4. Settlement of foundations:
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.
Text Books:
Reference Books:

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.
2. Physical, Chemical and Biological characteristics of waste-water, Primary, Secondary and Tertiary treatment of waste-water. Wastewater; Wastewater Disposal Standards
4. Anaerobic process: conventional anaerobic digester, High rate and Hybrid anaerobic reactors, Sludge digestion and handling, Septic tanks, Disposal of effluent and sludge.
5. Simple design problems on sewerage, waste-water treatment unit and sludge digestion.
6. Introduction to Municipal solid Waste Management's
Text Books:
1. Waste water Engineering Treatment and Reuse by Metcalf & Eddy, TMH Publication.
Reference Books:

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
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:

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.
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.

7. An introduction to river basis development.

Text Books:
1. Fundamental of Irrigation Engineering by Bharat Singh, Nemchand Bros., Roorkee, Uttarakhand.

Reference Books:

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:

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
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:


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:

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: Semianalytical 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:

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  


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

Text Books:  
2. FAO Irrigation and Drainage Paper no. 24 & 58, Rome, Italy.  

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:
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


**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 :

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 :
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:

01 1X45 ADVANCED FOUNDATION ENGINEERING
L-T-P : 3-0-0
Credit : 3

Theory:

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:

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:

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 fine 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:

Text books:

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
3. Irrigation Efficiencies.
4. Irrigation Scheduling: for both Irrigated dry and irrigated wet crops, irrigation scheduling in command areas.
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.
6. LIFT IRRIGATION: Classification, Location, Water lifting arrangement, Yield of wells.
Text Books:
1. Fundamental of Irrigation Engineering by Bharat Singh, Nemchand Bros., Roorkee, Uttarakhand.
Reference Book:

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

**Reference Books:**

**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.

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

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.
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.

Text Books:

Reference Book:

01 1x56 ADVANCED SOIL MECHANICS

2. Clay minerals.


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


Text Book:

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 :-

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.

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.

4. VIBRATION OF CONTINUOUS SYSTEM :-
Introduction to two Degree Freedom system, Multi Degree freedom system, Vibrations of continuous system, Axial and flexural free vibrations of Beime Forced vibrations- Earthquake excitations.

5. EARTHQUAKE RESISTANT:-

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.
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 overriding, 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

**Reference Books**:
1. The C++ Programming language 3/e by Bjarne Stroustrup, Pearson Education.
2. C++, How to Programme, 4/e, by Deitel, Pearson Education.
3. Big C++ by Cay Horstmann, Wiley India.
4. C++ Primer, 3e by Stanley B. Lippman, Josee Lajoie, Pearson Education.
5. C++ and Object Oriented Programming Paradigm, 2e by Debasish Jana, PHI.

**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

   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


Lecture : 4

**Text Books**:

1. Computer System architecture, 3e by M. Morris Mano, Pearson Education.

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**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**:

3. Data Structure using C and C++ by Langsam, Pearson Education.
5. Data Management & File Structures, 2E, by Mary E. S. Loomis, PHI.

**Reference Book**:

2. C and Data Structures by P. S. Deshpande, Wiley India.

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**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


Lecture : 15


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.


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
3. Macros and Macro Processor: Macro definition and call Macro expansion, Nested Macro calls, Design of a Macro preprocessor. Lecture : 8
5. Compiler: Machine- Dependent Compiler, Machine- Independent Compiler, Compiler Design (Options, Interpreter, P-code Compiler), Compiler-, Case study of Compiler, Lecture : 10

Text Books :
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.

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

**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.

**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** 

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**
   **Lecture : 10**
4. **Network Programming**: Java Socket programming for TCP and UDP, RMI (Remote Method Invocation).  
   **Lecture : 2**
   **Lecture : 5**

**Text Books:**
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** 

   **Lecture : 2**
2. **Signal, Noise, Modulation & Demodulation**: Signal analysis, Signal-to-noise ratio, Bit rate, Baud, Digital Modulation.  
   **Lecture : 3**
   **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
    Lecture: 4
    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.
3. Communication system and network by Ray Horak, Wiley India.

**05 1X09 DATABASE SYSTEMS**

L - T – P: 3–0–3  
Credit: 5

   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: 5
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:**
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

   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.

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.

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

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

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

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


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

Text Book:
1. Programming Languages: Design and Implementation, 4/e by Terrance W. Pratt, Marvin V. Zelkowitz, T. V. Gopal, Pearson Education.

Reference Books:
1. Fundamentals of Programming Languages by E. Horowitz, Galgotia,

05 1X11  **FORMAL LANGUAGES AND AUTOMATA THEORY**

**L–T–P : 3–0–0**

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.

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

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

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

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

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

7. **Introduction to Turing Machine**: The 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.

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

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**

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


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
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.

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**05 1x13 COMPUTER NETWORKS**

L–T–P : 3–0–0 Credit : 3


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


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

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

**Text Book:**
2. Computer Network, 4e, by Andrew S. Tenenbaum, Pearson Education/ PHI.
3. Data Communication and Computer Networks, by Prakash C.Gupta, PHI.

**Reference Books:**
3. Computer Networking, by Stanford H. Rowe, Marsha L. Schuh

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**05 1x14 SOFTWARE ENGINEERING**

L–T–P : 3–0–3 Credit : 5

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.
5. **Software Design**: Overview, Cohesion and Coupling, S/W Design Approaches, Object-oriented vs. Function-Operated Design.
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.
14. **Software Reuse**: Basic Issues, Reuse Approach, Reuse at Organization Level.

Text Books:
1. Fundamental of Software Engineering by Rajeev Mall, PHI.
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**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Chapter</th>
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<tbody>
<tr>
<td>Lecture 2</td>
<td>Process Management: Process Migration, Threads</td>
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Text Book:
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, Use of ambiguous grammars in LR parsing, An automatic parser generator, Implementation of LR parsing tables and constructing LALR sets of items. Lecture : 10
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

Text Books:
2. Compiler Design by Santanu Chattopadhyay. PHI

Reference Book

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 Al, Importance of AI. LISP, Prolog and other programming language for AI. Lecture : 3

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

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

7. **Applications of Artificial Intelligence**: AI in E-commerce, AI in Industry, AI in Medicine  

Text Books:  
1. Introduction to Artificial Intelligence by Rajendra Akerkar, PHI  
2. Introduction to Artificial Intelligence by Eugene Charniak, Pearson Education.  
4. Introduction to Artificial Intelligence & Expert system by Dan W. Patterson, PHI  

Reference Book:  
3. Artificial Intelligence application programming by M. Tim Jones, Dreamtech Press  

Programming Lab (AI)  
Implementation in all algorithms in LISP/Prolog  

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**CRYPTOGRAPHY**  
L–T–P : 3–0–0  
Credit : 3  


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

Text Book:  

Reference Books:  
1. Beginning Cryptography with Java by David Hook, Wiley Dreamtech.  

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**MOBILE AND WIRELESS COMPUTING**  
L–T–P : 3–0–0  
Credit : 3  

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

Text Book:  

Reference Books:  
1. Beginning Cryptography with Java by David Hook, Wiley Dreamtech.  
   *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:**
- Mobile Communication by Jochen Schiller. Pearson Education.
- Wireless and Monile All – IP Network by Yi- Bing Line, Ai Chun Pang. Wiley India.
- Mobile Computing by Hansmann. Wiley India.
- Mobile and Personal Communication system & services by Raj Pandya. PHI.
- Bluetooth Technology and its applications with Java and J2ME, by C.S.R. Prabhu and A. Prathap Reddi PHI.

**Reference Books:**
- Cracking the code WAP Bluetooth and 3G programming by Dreamtech Software Team.
multidimensional Association rules from relational databases and Data warehouses, Association mining to correlation analysis, Constraint based association mining.

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.

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.

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

**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.

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**PARALLEL COMPUTING**

L–T–P : 3–0–0

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


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

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

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


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

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.

**Text Books**:
1. Introduction to Parallel Computing by Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Pearson Education.
4. Foundation of parallel processing by Ratan K Ghosh, Rajat Moona, Phalgun Gupta, Narosa publishing House

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**PROJECT – II**

L–T–P : 0–0–9

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**ADVANCED COMPUTER ARCHITECTURE**

L–T–P : 3–0–0

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.

2. **Speedup Performance Laws**: Amdahl’s Law for fixed workload, Gustafson’s law for scaled problems, Memory bounded speedup model.
3. PRAM models and PRAM variants.

Text Books:
2. Advanced computer architecture by Dezső Sima, Terence Foutain and Peter Kacsuk, Pearson Education.
3. Advanced Computer Architecture: A System Design approach by Kain, PHI.

05 1x26 PERFORMANCE EVALUATION OF COMPUTER SYSTEMS
L-T-P : 3–0–0
Credit: 3


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

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.

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

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


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

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


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.

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.


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.


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

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

05 1x28 PATTERN RECOGNITION
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


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

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**INTRODUCTION TO JAVA PROGRAMMING LANGUAGE**

L–T–P : 3–0–3

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


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, 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: 2

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.

**Reference Books:**
1. Professional Java, JDK 6 Ed. by Richardson Avondolio Wr ox.

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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**

   **Lecture : 6**

   **Lecture : 15**

   **Lecture : 15**

**Text Books :**
1. Genetic algorithm by David E. Goldberg, Pearson Education.
2. Introduction to Genetic Algorithm by Mitchell, PHI.

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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**

   **Lecture : 12**

3. **Algorithms** and data structures for implementing natural language processing systems.  
   **Lecture : 10**

   **Lecture : 10**

**Text Books:**
1. Natural Language Processing, A Paninian Perspective by Akshar Bharati PHI.

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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**

   **Lecture : 10**

   **Lecture : 10**

   **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

   Lecture: 6

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**05 1x33 COMPUTER GRAPHICS**  
L–T–P: 3–0–0  
Credit: 3

   Lecture: 10

   Lecture: 8

3. **Graphical Workstations**: Routing output to workstations, Types of GKS, Workstations.  
   Lecture: 8

   Lecture: 16

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**Text Books:**

3. Computer Graphics by Hearn, and Baker, PHI.

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**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

   Lecture: 6

   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. **Incremental 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

   Lecture: 3

   Lecture: 3

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**Text Books** :

1. Neural Network by Simon Haykin, Pearson Education/PHI
3. Neural Network using MATLAB 6.0 by Siva Adam , Tata McGraw Hill

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**05 1x35 SPEECH PROCESSING**  
L–T–P: 3–0–0  
Credit: 3
   
   
3. **Frequency Domain Methods for Speech Processing**: Short-time Fourier analysis, Filter-bank analysis, Spectrographic analysis, Format extraction, Pitch extraction, Analysis.  
   

**Lecture**: 10

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**Text Book**:

1. Speech and Language Processing by Daniel Jurafsky & James H. Martin, Pearson Education.

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**05 1x36 DISTRIBUTED DATABASE**

**L–T–P : 3–0–0**  

**Credit : 3**

1. **Introduction**: Distributed Database System, Promises Complicating Factors, Problem Areas.  
   
2. **Distributed Database Architecture**: DBMS Standardization, Architectural Models, Distributed DBMS Architecture.  
   
   
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.  
   
6. **Introduction to Transaction Management**: Properties types of Transaction  
   
7. **Distributed DBMS Reliability**: Reliability Concepts and measures, Failures and fault Tolerance in Distributed Systems, Failures in Distributed DBMS.  
   
8. **Parallel Database System**: Database Servers, Parallel Architectures, Parallel DBMS Techniques, Parallel Execution Problems.  

**Lecture**: 10

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**Text Book**:


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**Reference Book**:

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
   **Principle and application of SCR and UJT.** Lecture : 4

**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

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**


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 Vrasesic, 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. **Superhetodyne Receivers** : Intermediate Frequency and its advantages, alignment and tracking, image rejection and IC version of the Receiver. **Lecture : 3**

8. **Frequency Multiplexing** in carrier Telephony. **Lecture : 1**

9. **Generation of FM signals** (direct and indirect methods) and demodulation. **Lecture : 3**

10. **Comparative study** of SNR in AM, FM and PM System and use of emphasis Circuit in FM for SNR optimization. **Lecture : 2**

11. **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**

12. **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.
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 2nd order and 4th order filters using Switch Capacitors Elements and making a comparative study of switched capacitors and conventional filters.
8. Generation of FM using variable reactance of JFET.
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_rf = 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
7. Class A, Class B and Class AB power amplifiers with reference to Complementary Symmetry Amplifiers. Lecture : 5
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, 7th 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
7. Splices, Connectors, Couplers and Grating Lecture: 3
8. Optical Transmitters Lecture: 7
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.
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 convertors, 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.

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 : 10

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 : 5

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


   Lecture : 12

Text Books :
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
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-diods, 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 :
   - 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), unijunction transistor(theory of operation)  Lecture : 2

9. Photonics : Photo diodes (pin and avalanche), 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.

04 1x09  ADVANCED ELECTROMAGNETIC FIELD

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

   Lecture: 3

   Lecture: 6

**Text Books:**
1. Electromagnetic waves and radiating systems by Jordan & Balmain, PHI.

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**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

   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:**

**Reference Books:**
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.
MICROWAVE ENGINEERING

1. Microwave oscillators and amplifiers, advantages and uses of microwave, limitations of conventional vacuum tubes at UHF and microwave frequency, UHF and microwave BJT
2. Muticavity klystron, Reflex klystron, Muticavity travelling wave type magnetron, Backward wave oscillator, Gunn oscillator, Tunnel diode, IMPATT diode.
3. Microwave components: Coupling probes & Loops, Attenuator, sorting plunger, Magic tee, Directional coupler, Phase Shifters, Isolators & circulators.
5. Microwave receiver: Block Diagram representation, Varactor Diode as mixer, antenna noise and noise temperature.
6. Antenna-Log-Periodic Antenna, Slot, Horn & Parabolic antenna (Dish Antenna).
7. Microwave Links & space communication: Geostationary satellites, Up – Down Links, Fading effect, Atmospheric effects, and solar activities.

Text Books:
1. Microwave devices and circuits by Samuel Y. Laio, PHI.

Reference Books:
1. Microwave & Radar Engineering by M. Kulkarni, Umesh Publications.
3. Microwave Principles by Reich et. Al., Van Hestrand

ELECTRICAL & ELECTRONIC MATERIAL

2. Dielectric behavior of materials: Polarization, Dielectric constant at low frequency & high frequency, Dielectric loss, Piezo Electricity & Ferro Electricity.
6. Special classification of semiconductor material: Degenerate (Semi-Metal) and none degenerate semiconductor: Elemental and compound semiconductor, direct & indirect band gap material.
7. Superconductors: Low & High temperature (YBaCuO) superconductors, Meissner effect, Applications.

Reference Books:

ELECTRICAL & ELECTRONIC MATERIAL LAB

1. Four point probe for resistively measurement.
5. Measurement of Planck’s constant by photo cell.
6. Dielectric constant Measurement.
8. Biot Savart’s Law 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.

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.

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.

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).

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.

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.

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.

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).

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)


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

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04 1x62 DIGITAL SIGNAL PROCESSORS

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

1. **Introduction**: Discrete-Time Signals, Shannon’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


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. Manakalis,
2. Digital signal Processing by Alan V. Oppenheim Ronald W. Schafer, PHI, India

Reference Book:

04 1x63 BIO-MEDICAL SENSORS AND TRANSDUCERS
L-T-P : 3-1-0 Credit: 4

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.

4. Bio sensors : Ion exchange membrane electrodes, enzyme electrode, glucose sensors, immunosensors, Basic principles of MOSFET biosensors & BIOMEMS.
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 : 14

Text Books :
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.

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 sync details, vertical sync details, scanning sequence details, functions of vertical pulse train, sync 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.

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.

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**04 1x65 MICROCONTROLLERS**

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

1. **Different types of microcontrollers** : Embedded microcontrollers, external memory microcontrollers, processor architecture, Harvard Vs Princeton.  
   **Credit : 4**
   **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 : 5**

10. **Real world interfacing or 8051** : Intelligent LCD display, interfacing keyboard to 8051.  
    **Lecture : 5**

    **Lecture : 6**

**Text Books:**
1. The 8051 Microcontroller and Embedded system by M.A. Mazidi, Pearson/PHI.

**Reference Books:**
1. The 8051 microcontroller by Kenneth Ayala, Thomson Learning.
3. Microcontrollers and Microcomputers by Fredrick M. Cady, Oxford University press

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**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 VHDL, data objects, classes and data types, operators, Overloading, logical operators. Types of delay Entity and architecture declaration. Introduction to behavioural. Dataflow and structural models.


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) demultiplexer
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 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/CPLD kit.

Reference books:
2. Digital design and modelling with VHDL and synthesis by KC Chang; IEEE computer society press.
5. VHDL Analysis & modeling of digital systems by Nawabi Z; McGraw Hill.
6. VHDL- 4TH EDITION by Perry ; TMH (2002).

DIGITAL IMAGE PROCESSING
L-T-P : 3-0-3 Credit : 5
2. DIGITAL IMAGE FUNDAMENTALS : Elements of visual perception, A simple image model, Sampling & quantization, Some basic relationship between pixels, imaging geometry.
3. IMAGE TRANSFORMS : Introduction to the Fourier transform, the discrete Fourier transform, Some properties of the Two – Dimensional Fourier transform, Other separable image transforms.
4. 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.


Text Books :

Reference Books :

04 1x68 BIOMEDICAL INSTRUMENTATION AND IMAGING
L-T-P : 3-0-3 Credit : 5

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:
2. “Medical Instrumentation” by Rajarao.
3. “Medical Instrumentation (application & design)” by Webster.

7. Antennas for biomedical application & Applicator, Biomedical DSP (elementary idea). Biomedical micro-electro-mechanical system (Introductory idea)

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.
2. **Basic Concepts of Computer Architecture**: Concepts, Memory, Input / Output, DMA, Parallel and Distributed computers, Embedded Computer Architecture, etc.
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 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.
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.
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.
6 & 7. **Peripherals and interfacing**: Adding peripherals and interfacing – serial peripherals and interfacing - serial peripheral interface (SPI), Inter Integrated circuit (I²C), adding a real time clock with I²C, adding a small display

Text Books/Reference Books:
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, ion-implmentation 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.
4. Programmable logic, Programmable logic structure, Programmable interconnect and reprogrammable gate array: Xilinx programmable gate array, Algotomix.. Concurrent logic, Gate array design, Full custom mask design.

Text Books:
1 Principles of CMOS VLSI design: a system perspective by Neil H.E. Weste and Kamran Eshraghian; Addision Wesley pub.
3 Modern VLSI Design system on silicon by Wayne Wolf: Adssion 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**: 

04 1x73   BIOMEDICAL SYSTEMS AND ITS APPLICATIONS
L-T-P : 3-1-0   Credit : 4


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
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 ASCII 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.
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 Douglas E. Corner & David stevens, PHI

04 1x75 **SOFT COMPUTING TECHNIQUES AND ITS APPLICATIONS**

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

   **Lecture**: 10

   **Lecture**: 8

   **Lecture**: 10

   **Lecture**: 9

   **Lecture**: 8

**Text Book**:


**References**:


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
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.**
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, nanoprobe 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**:
2. Nano Essentials by T.Pradeep/TMH

04 1x78 FIBER OPTICS AND NETWORKING TECHNOLOGY
1. **Introduction**: Generations of optical communication, Advantages, Elements of an optical fiber transmission link.

   **Credit**: 4  
   **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.

   **Credit**: 4  
   **Lecture**: 10

3. **Attenuation and Dispersion in optical fiber**: Signal attenuation and distortion in optical fibers, Dispersion effects in optical fibers.

   **Credit**: 4  
   **Lecture**: 10

4. **Optical Sources**: Structure and materials of LED and LD sources operating characteristics and modulation capabilities of the LED and LD sources. Source to Fiber Power launching and coupling, Lensing schemes for coupling improvement, Fiber to fiber couplings and alignment methods, Splicing techniques, Fiber Connectors.

   **Credit**: 4  
   **Lecture**: 9

5. **Optical Receiver**: Optical receiver configuration and performance, Pre-amplifier design for optical receiver, Analog and Digital receiver. Point to point transmission links, Wavelength division multiplexing, Optical data buses, Link power and rise time budget, Optical Amplifier.

   **Credit**: 4  
   **Lecture**: 3


   **Credit**: 4  
   **Lecture**: 5

7. **Potential applications and future prospects of optical fibers**: multimode intensity sensors and single mode, Interferometric sensors.

   **Credit**: 4  
   **Lecture**: 3

**Text Books:**


**Reference Books**:

6. “Fibre Optics Communication” by Harold Kolimbirls, Pearson Education.

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**EMBEDDED SYSTEMS (REAL TIME SYSTEMS)**

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


2. **Hardware Considerations**: Basic Architecture, Hardware interfacing, Central Processing Unit, Memory, Input/output, Enhancing performance, other special devices, Non–Von Neumann Architectures.


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.


**Text Book**: 

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Reference Books:

04 1x80 MOBILE COMPUTING
L-T-P: 3-1-0 Credit: 4
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
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

Text Books:

04 1x81 MOBILE AND SATELLITE COMMUNICATIONS
L-T-P: 3-1-0 Credit: 4
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

**Reference books**

1. Mobile communication systems by schiller, Pearson.
2. Satellite communication systems Engg. by Pritchard, Pearson
03 1x01 BASIC ELECTRICAL ENGINEERING

Credit : 5

L-T-P : 3-0-3

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


   Lecture : 12


   Lecture : 8


   Lecture : 5

5. **Basic indicating instruments** for measurements Current Voltage, Power, Energy Insulation resistance.

   Lecture : 5

Text Book:


Reference Books:


03 1x02 ELECTRICAL POWER GENERATION AND ECONOMICS

Credit : 4

L-T-P : 3-1-0

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


   Lecture : 4


   Lecture : 4


   Lecture : 4

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:
### 03 1x03  ELECTRICAL MACHINES-II

<table>
<thead>
<tr>
<th>L-T-P : 3-0-3</th>
<th>Credit : 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> 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. <strong>Lecture : 9</strong></td>
<td></td>
</tr>
<tr>
<td><strong>2.</strong> 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. <strong>Lecture : 9</strong></td>
<td></td>
</tr>
<tr>
<td><strong>3.</strong> 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. <strong>Lecture : 8</strong></td>
<td></td>
</tr>
<tr>
<td><strong>4.</strong> Single phase induction motors : Introduction, Working principle , double revolving field theory , Equivalent circuit, Starting method and Types of single phase Induction motors, Applications. <strong>Lecture : 8</strong></td>
<td></td>
</tr>
<tr>
<td><strong>5.</strong> Special motors : Single phase synchronous motors, Two phase AC Servo Motor, single phase series (universal) motor, stepper motor, Permanent magnet DC motor, etc, Applications. <strong>Lecture : 8</strong></td>
<td></td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>L-T-P:3-1-0</th>
<th>Credit : 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> 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. <strong>Lecture : 6</strong></td>
<td></td>
</tr>
<tr>
<td><strong>2.</strong> 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. <strong>Lecture : 12</strong></td>
<td></td>
</tr>
<tr>
<td><strong>3.</strong> 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. <strong>Lecture : 6</strong></td>
<td></td>
</tr>
<tr>
<td><strong>4.</strong> 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. <strong>Lecture : 6</strong></td>
<td></td>
</tr>
<tr>
<td><strong>5.</strong> 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. <strong>Lecture : 10</strong></td>
<td></td>
</tr>
</tbody>
</table>

**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
5. Filter fundamentals, high-pass, low-pass, band-pass, and band-reject filters. Lecture : 8
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 inductive 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 line 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
   Lecture : 10
2. Range Extension including current and potential transformer  
   Lecture : 4
   Lecture : 6
4. Bridges : D.C bridge, Wheatstone bridge, sensitive and its application bridge. Type of bridge for measure  
   Lecture : 5
5. Standard A.C and D.C potentiometer, Principle and standardization and application.  
   Lecture : 5
   Lecture : 5
7. Digital measurements .

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 (5th 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
   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 :

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.  
   **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

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**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
   **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  

**Reference Books:**
1. Signal & system by H.P Hus, Tata McGraw Hill  
2. Signal & system by I.J. et. at., Tata McGraw Hill

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**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

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Intel 8086

8. **Architecture**: BIU & Execution unit, pin diagram, function of different modes, Registers.  
   *Lecture*: 4

9. **Addressing Modes**, Instruction  
10. **Programming**.

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**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

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**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

   *Lecture*: 5

6. **Closed loop frequency response**.  
7. **Compensation of control system**: Introduction, type compensation approach to compensation.  
   *Lecture*: 8

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**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.

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**03 1x13 PROTECTION OF POWER APPARATUS & SYSTEM**

**L-T-P**: 3-0-3  
**Credit**: 5
1. Name and cause of faults.
2. Schemes of protection: Methods of fault discrimination.
3. Protective relays: Construction and operating principle of over current relays, directional relays, Distance relays, Differential relays.
4. Protection of feeders: Over current protection and distance protection
5. Protection of transformer and generator.
7. Circuit breaker, construction and operating principle of air blast, oil, SF6 and vacuum circuit breaker.
8. Protection against over voltage: cause of over voltage, lightning phenomenon, lightning arrestors, surge absorber, insulation co-ordination.

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

1. Per unit system representation, reactance diagram, impedance diagram.
2. Load flow Analysis; Load flow problem, ybus, Formulation of problem, solution technique using Gauss seidel method
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
4. Symmetrical component; Transformation, phase shift in star-delta transformer, sequence Impedance and sequence network of transmission line, Synchronous machine, Transformer and power system.
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.
6. Power system stability problem, Swing equation, System response to small disturbances, Power angle equation and diagram
7. Transient stability, Equal area criterion, Measures for improving transient stability

Text Books:
1. Power system Analysis by Stevenson and Grainger.

Reference Book
1. Nagraath- 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

1. Development of state space model, state and state equation, transfer function from state equation and state equation from transfer function.
2. State transient matrix, solution of state equation transfer matrix.
3. Concept of controllability and absorbability.
4. State variable feedback, state observes.  
Lecture : 3

5. Control system design via pole placement.  
Lecture : 3

Lecture : 6

Lecture : 8

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

Lecture : 10

Lecture : 6

3. Cooling: Method of cooling by air, hydrogen and water, forced and natural cooling.  
Lecture : 4

Lecture : 5

Lecture : 9

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

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.  


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.  

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  

Reference Books:

4. 80xx Microprocessor Programming by Venugopal, BBP Publication.  
5. Microprocessor Architecture, Programming & Applications with 8056/8086 A by Ramesh S. Gaonkar, Wiley Easter Ltd.  
7. Programming and Customizing the 8051 Microcontroller by Predko; TMH.  
9. Designing Embedded Hardware by John Catsoulis; SHROFF Pub. & Dist. ND.  
10. Design with Micro controllers by John B.Peatman. MH

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**03 1x18 MODERN CONTROL THEORY**

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

1. **Development of state model**: State and equation, transfer function from state equation and state equation from transfer function.  

2. **State transient matrix**, solution of equation transfer matrix.  

3. **Concepts of controllability** and absorbability.  

4. **State variable feedback**, State observers.  

5. **Control System** Design via Pole placement.  

6. **Optimal control system**: Introduction, Performance in devices, transfer function approach, state variable approach, parameter optimization.  

7. **Non liner System**: Common non-liner stability of non-liner system, method for studying non-liner system, linearization, describing function analysis.  


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 : Linear differential equation, solution of linear 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

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, electrical 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

03 1x22  ADVANCED ELECTRICAL MACHINE
L-T-P : 3-1-0  Credit : 4

4. **Dynamics of Electrical machines**, general torque equation, inertia constant, analysis of synchronous machine under transient condition, stability affect of damping.  

5. **State variable model of electrical machines**: Unbalanced operation of two and three-phase induction motors.  


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**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.


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(2) “Data Communication and Networking”, 3/e. by Behrouz A. Forouzan.

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**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.  

2. **Surface Voltage-gradient** on bundled conductors Mangoldt's formula, Gradient factors & their use, Ground level electrostatic field of EHV lines.  

3. **Power frequency** over-voltage control, Series and shunt compensation, Generalized Constants of Compensated line, Static Var Compensators (SVC/SVS).  

4. **Switching** over-voltage in EHV Systems
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.  
6. **Introduction to HVDC system**: Economical advantages, Technical advantages, Critical distance, Submarine transmission.  
7. **Inverter**: Equivalent circuit of HVDC system, Schematics diagram, Reactive power consideration in HVDC system, Harmonics, Filters in HVDC System.

**Text Books:**
1. Extra high Voltage AC Transmission Engineering (2nd Ed) by R.D. Begamudre, Wiley Eastern Ltd.  

**Reference Books:**

### 03 1x25  CONTROL SYSTEM DESIGN

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

**1. Introduction**, Design specifications Controller configuration, Fundamental Principles 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.  

**2. Design with PID controller**: Design with phase lag controller-Time Domain 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.  

**3. Design with lag-lead controller**, Pole zero cancellation design, north filter, forward and feed forward controllers, Design of Robust control systems.  

**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.  

**5. State feedback control**, Pole placement design through state feedback, with integral control, Design of state observer.  

**6. Design of discrete data control system**: Introduction, Digital implementation of analog controller (PID) and lead-lag controllers, Digital controllers, design of discrete data control system in frequency domain and Z-plane.  

**7. Synthesis** through Pole zero configuration, Determinate of closed loop system functions from the specifications, Determination of open loop transfer function from the closed loop transfer function from the closed loop transfer function, Additional correlation between open loop and closed loop characteristics.

**Text Book :**

**Reference Books :**

### 03 1x26  COMPUTER BASED PROCESS CONTROL

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

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.


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.


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.

**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 :

**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


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.

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.
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**

   **Lecture : 5**

7. **Wind Power** : Introduction to Wind Power Generation.  
   **Lecture : 5**

**Text Books :**


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**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**

   **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**

   **Lecture : 4**

   **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. (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

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**03 1x30  POWER SYSTEM DYNAMICS AND RELIABILITY**

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

   **Lecture : 5**

2. **Synchronous Machine Modeling** : Synchronous Machine, Basic Equations, Generator operated as part of large power grid.  
   **Lecture : 5**

   **Lecture : 5**
   **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, the compositional rule of inference, different implications, representing a set of rules.


3. **The control problem**, The FKBC as a non-linear transfer element and type of FKBC such as pill-link FKBC, shing 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 L'e'dices, 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

   **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

   **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 Neural 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.
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 tools 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
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.
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.
5. Outdoor insulation: materials, ageing, diagnostic, polymeric materials ( EPDM, SIR ), semi conducting ceramic, glazes.

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.
2. **Dynamics of Electrical Drives**: Torque equations, Multi-quadrant operation, load torque & their types, calculation of time and energy loss in transient operation, Steady state stability, load equalization.

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.

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.

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.

6. **Induction Motor Drives**: Performance characteristic of three phase induction motors and their modifications.

**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.

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


5. **Three Phase Transformer**: Introduction, Types, Phasor Group, Parallel Operation of three Phase Transformer, Cooling of Transformer.


**Text Book:**
2. Electrical Machine by P.S Bimbra, Khanna Publication.

**Reference Book:**
1. Electrical Machinery by Fitzgerald A.E & Kingsley TMH
DEPARTMENT OF INFORMATION TECHNOLOGY

06 1x01 FUNDAMENTAL OF INFORMATION TECHNOLOGY
L-T-P : 3-0-2 Credit : 4
Theory :
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.

Reference Books :
1. Fundamental of Computer & IT by A. Jaiswal (Wiley India).
3. The C Programming Language, 2e, by Brian W. Kernighan & Dennis M. Ritchie, PHI/Pearson Education.

Practical : Working in windows environment, Internet, C Programming based on above syllabus.

06 1x02 WEB TECHNOLOGY
L-T-P : 3-0-3 Credit : 5

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)
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.

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**06 1x03 OPERATING SYSTEM**

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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**:
2. Operating System by Dhamdhere, TMH.

**Reference Books**:
1. Operating System by Deitel, Deitel & Choffnes.

**Practical**: Familiarization with UNIX/Linux and Windows Operating Systems.

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**06 1x04 VISUAL PROGRAMMING**

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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.


4. **Data Access** : File System Data, XML, Database and ADO.NET, Data Binding.


**Text Books** :
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** :
5. **SOFTWARE FLAWS AND MALWARE** : Software Flaws, Malware, Miscellaneous Software-Based Attacks.

**Text Book** :

**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.
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.
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
5. SOAP Tools : SOAP Toolkit, components and architecture, exposing and invoke Web services.
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.
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
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.
5. Storage models and Access Techniques : Magnetic media, optical media, file systems (traditional, multimedia)
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.

Text Books:

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.
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
2. **Media Access Control** : MAC, SDMA, TDMA, CDMA, Spread Aloha Multiple Access.
3. **Telecommunication System** : GSM, DECT, TETRA.
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).
(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:
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.

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
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.

Text Books:
1. Biometrics – Identity Verification in a Networked World by Samir Nanavati, Michael Thieme, Raj Nanavati, WILEY- Dream Tech

Reference:

06 1x14 NETWORK SECURITY
L-T-P : 3-0-0 Credit : 3

7. E-mail Security : The E-mail Risk, E-mail Protocols, E-mail Authentication.

11. **Communications**: Secret Communication, Covert Communication, Applications of Secure/Covert Communication.


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


06 1x15 INTERACTIVE COMPUTER GRAPHICS
L-T-P : 3-0-0 Credit : 3


4. **Attributes of Output Primitives**: Line Attributes, Curve Attributes Colour and Grayscale Levels, Area-Fill Attributes, Character Attributes, Bundled Attributes, Inquiry functions, Antialiasing.


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.


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.


Reference Books:
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.
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.

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:

06 1x17  INTERNET AND INTRANET ENGINEERING
L-T-P : 3-0-0  Credit : 3

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
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.
7. E-Strategy: The Virtual Value Chain, Seven Dimensions, Planning the E-Commerce Project, Knowledge Management.

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
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 Thresholding Optimal Thresholding; 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.


**Text & References**:

2. Getting Started with GIS by Clarke Keith. C; PE.
5. Introduction to Geographical Information Systems by Chang, TMH.

**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.
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**


**Text Books:**
2. Core Java™ Volume II by Cay S.Horstmann & Gary Cornell (Pearson)

**Reference Book**: J2EE 1.4 Bible by McGovern (Wiley India)

**06 1x22 MANAGEMENT INFORMATION SYSTEM**

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


3. **Applications of Management Information System to E-Business.**


5. **Case Studies**: Tata Home Finance Ltd. and Engineering Product Limited.

**Text Book**: Management Information Systems by W. S. Jawadkar, TMH.

**Reference Books**:
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.

2. REVIEW OF BASIC CONCEPTS OF THERMODYNAMICS : Thermodynamics system, properties, state, processes and cycles, Heat, work and internal energy.
   Lecture : 2

   Lecture : 4

4. PRIME MOVERS: Simple steam turbine, gas-turbine, IC engines (SI and CI), their brief description and principles of working.
   Lecture : 6

5. POWER PLANT : Principles of working of thermal, hydel and nuclear power plants, work output and efficiency.
   Lecture : 8

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

   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

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**

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1. **Machine shop**: Introduction, study and use of lathe 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**

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   **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**: 10
   **Lecture**: 10

**Text Book:**


**02 1306 STRENGTH OF MATERIAL**

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   **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.  

5. **Two dimensional stress analysis**: Plane stress components on general plane at a point, Mohr’s circle of stress.  

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.  

**Text Books**:  
(1) Strength of material by GH Ryder  
(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 Timoshenko & Gere  
(2) Mechanics of solids by Popov  

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**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.  

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.  

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.  

4. **Properties of pure substances**: Properties of steam and process with steam, Use of steam tables and mollier charts.  

5. **Helmhotz and Hibb’s function**, Maxwell’s relation.  

6. **Ideal cycles**: Air standard cycles, Otto, Diesel, Dual and Brayton cycle, Comparison of Otto, Diesel and Dual cycle.  

7. **Vapour cycle**: Carnot and Rankine cycle, Regenerative and reheat cycle.  

8. **Non reacting mixture**: Mixture of two ideal gases and their properties.  

9. **Psychometry**: Air and water-vapour mixture and their properties, adiabatic saturation, Use of psychrometry charts, Simple introduction to psychrometric process.  

**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  

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**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.  

2. **Friction devices**:  

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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 : 7**

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 : 10**

**Lecture : 7**

**Text Books :**

1. Theory of Machine by Thomas Bevan
2. Theory of Machine by RS Bansal
3. Theory of Machine by Sadhu Singh

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**02 1x09 MANUFACTURING BY SHAPING AND JOINING**

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

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 alloys, 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**

**Lecture : 8**

**Lecture : 12**

**Lecture : 6**

**Text Books :**

1. Production technology by RK Jain
2. Manufacturing technology by PN Rao

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**02 1x10 FLUID MACHINERY**

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

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 characterstic, 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. Hydraulic Machine by Jagdish Lal
2. Hydraulics & Hydraulic Machines by Vasandari
3. Hydraulic 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. **Dissemble 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**
   **Lecture : 14**
   **Lecture : 5**
   **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.  

**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.  
2. **Turning moment diagram**: Fluctuations of crankshaft speed and energy in a direct acting engine mechanism, flywheels.  
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.  
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.  
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.

**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.  
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.  
3. **Computer controlled manufacturing process**: NC, CNC, DNC, part programming, Introduction to computer aided manufacturing and robotics.  
4. **Metrology**: Tolerance and limit systems, limit gauges, Measurement of surface roughness, Inspection of gears and screw threads.  
5. **Jigs and Fixtures**: Locating elements, clamping devices, principles of Jigs and fixtures design.
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 : 4

4. **Design of keys**, couplings, shafts levers, columns, studs, power screw, belt drive, pulley  
   Lecture : 12

5. **Springs**, clutches and brakes.  
   Lecture : 14

**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
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 : 6

4. **Unsteady heat conduction**: one dimensional unsteady heat conduction, lumped system analysis; use of Heisler chart, periodic changes of surface temperature.  
   Lecture : 4

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 : 6

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
   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
   Lecture : 8
   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
   Lecture : 5

Text Books:
1. Manufacturing Excellence in Global Markets by W. Euershelm
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 Refrigerants 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

   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, psychrometric 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

   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

Reference Book:
1. Mechanical Engg. Design by Shigely

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
   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
   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
   Lecture: 5
   Lecture: 5
    Lecture: 4
    Lecture: 3

Text Book:
1. Internal Combustion Engines by V Ganesan (Tata McGraw-Hill)
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).

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 : 4
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 : 5
6. Various types of ignition systems with wiring diagram
   Lecture : 6
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. Automotive 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.
   Lecture : 10
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
3. Environmental Impacts of Hydro-electric, Nuclear energy and chemicals forwards a solution. Lecture: 4
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: 10
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. Environmetal pollution by HM Dix
3. Chemistry for environmental engineering by SAWYER

02 1x28   HEAT EXCHANGER DESIGN
L-T-P: 3-1-0
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
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, axisymmetric 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
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**.  Lecture : 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 designs 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

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
   Lecture: 6

   Lecture: 12

Text Book: As referred by Teacher.

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 size**, 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:-

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.

Histology and fiber packing in commercially viable hides/skins.

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.
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.
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.
Structure and functional role of other skin proteins like keratin, Reticelin and Elastic, albumin, globulin and mucine etc.

071x04 CHEMICAL ENGINEERING –I
3. Fluid Dynamics :- Bernoulli’s theorem, Continuity equation, Euler’s equation, Energy and momentum equation, Basic concept of Newtonian and Non-Newtonian fluid.
5. Evaporation :- Types of Evaporators, Operation of Evaporation unit, Different methods of feedings.
6. Size Separation :- Screening, Mixing and agitation, floatation.

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.
1. Nitration, Alkylation, Halogenation, Sulfonation.

2. **Crystallization** :: Theory of crystallization, crystallization equipment for chemical processing.

3. **Adsorption** :: Theory of adsorption, Industrial adsorbents adsorption equipments Decolourization of chemicals.

4. **Diffusion** :: Binary diffusion Concept of mass transfer coefficients and interface mass transfer and stage wise contact.


**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.

**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.

**Aqueous Chemistry of Chromium** ::

Electric configuration, common oxidation states of chromium, stabilities of Chromium (IV) and Chromium (III) salt, Basicity, Oolation, Oxolation and polymerization, complexity of chrome complexes.

**Factor Controlling Chrome tanning** ::

Single and double bath chrome tannage and their relative merits and demerits, preparation of Basic chromium sulphate salt, Effects of float Volume, PH, basicity, Masking temperature, drum speed, ageing chrome tanned substrate.

**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.

**Suggested Books** :: Same as 07 1x02
07 1x07 Principles of Organic Tannage

Vegetable Tannins –

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

2. Analysis of Na₂S
Principles underlying analysis of Na₂S by official international method.

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

4. Analysis of limed pelt
Principles underlying determination of following in limed pelt
(a) Total Alkalinity  (b) Total Ammonia  (c) Hide Substance

5. Analysis of Boric acid

6. Analysis of deliming agent (Ammonium chloride and Ammonium sulfate)

7. Analysis of enzyme bates

8. Analysis of used pickle liquors for following :
(a) Determination of acid
(b) Determination of salt

9. Analysis of Sodium formate

10. Analysis of Chrome liquor to determine
(a) Basic chromium  (b) Basicity of chrome liquor
(c) Degree of Olation.

11. Analysis of basic chromium sulfate for following :
(Power of Crystal)
(a) Moisture  (b) Chromium

12. Analysis of acids & salts in vegetable tannin extracts by different methods.


15. Analysis of chrome tanned leather for following:
   Moisture, ash, Chromic oxide content, Solvent extractable substances, Water soluble matter and difference figure.

16. Analysis of followings of Veg. tanned leather:
   Moisture, ash, Water soluble matter, Solvent extractable substances and difference figure, Degree of tannage.

17. Analysis of followings of Alum. Tanned leather:
   Moisture, total ash, Solvent extractable substances, Aluminium as Alumina.

18. Analysis of followings of Zirconium tanned leather:
   Moisture, Ash, Solvent extractable substances, Zirconium content.

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.

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.

21. Principles underlying examination and analysis of dyes used in leather manufacture

22. Principles underlying examination and analysis of readymade finishes and finishing materials used in leather manufacture.

Suggested Books:
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.

BLEACHING: Definition, Theory, Mechanism of chemical bleaching, classification and application of different methods of bleaching to leathers.
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, wetting agents, dispersing agents and dye fixative, Metal complex dye.

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.

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.

THEORY OF LEATHER DRYING :- principles of energy and mass transfer, Physio-Chemical aspect of leather drying, Different methods of drying followed in leather Industry

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 & hetrotophs, obligate parasites.

Bacteriological media :- Types of media, preparation of media, Physical conditions required for growth.

Reproduction :- Modes of cell division, new cell formation .

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.

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.
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.

Fermentation :- Mechanism of alcoholic fermentation of carbohydrate, bacterial fermentation, fermentation by coliform organisms, fermentation of nitrogenous compound, vinegar.

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.

Lisation of collagenous tissues for Biomedical and other application :-
Collagen and its application in food, cosmetic and medical fields.

Suggested Books :-

07 1x12 Leather Product Technology – I

1. Introduction
History of Footwear industry, Functions of footwear, Different parts of Footwear (Upper, Bottom and hidden components)

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.

3. Last
Definition, Classification of last, Different parts of last, Seasoning of wood for wooden last, Last measurement, Comparison of last with human foot.

4. Shoe Sizes and Fittings
Relation between foot sizes and fittings and shoe, sizes and fittings, English, American, French, Continental and monopoint shoe sizes and fittings system.

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)

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.

7. Footwear Costing
Material, Labour and Overhead cost, Determining the material consumption, Leather consumption – One pair tracing insole consumption, Adhesive and thread consumption etc.

Suggested Books :
1. Manual of Shoe making – Clark

07 1x13 Principles of Material Testing

1. Introduction
Thumb tests, Necessity of Physical Testing, Classification, Sampling positions, Conditioning of test samples

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

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

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)

5. Tests for Finish -film
Determination of bond strength between the leather surface and finish film, cold, crack resistance, Light fasters test.
6. Specification
Shoe upper, Sole, Lining Leather, Clothing, Glove, Technical leathers, Upholestry and fancy leather.

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


2. Filtration :- Theory and Mechanism of filtration, continuous and batch type filtration equipment.

3. Drying :- Drying characteristics of material, Theory and Mechanism of drying, estimation of drying rate. Type of dryers.

4. Extraction:- Extraction, Types of extraction, liquid-liquid extraction liquid-solid extraction, operation of stagewise and differential contact extractors.

5. Chemical Process :- Manufacture of Bleaching powder, Alkali Industries Sodium sulfide, Sodium dichromate Basic Chromium sulphate.

07 1x15 Leather Finishing Materials and Auxiliaries

1. Pigments :-

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

3. Chemistry and Preparation of Nitrocellulose, lacquers, lacuuer emulsion, Coloured lacquers, Wax emulsions, Silicone emulsion.


5. Chemistry and Mechanism of Plasticization, Internal and External Plasticizers.

7. Upgradation technologies in finishing.
General introduction to addition, condensation, Natural polymer, Caesin, Cellulose

Suggested Books :-

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, fertilizers, 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)
3. Radical Chain polymerisation: Mechanism of venyl polymerisation, kinetics of chain growth polymerisation, molecular weight and its distribution,
8. Measurement of Molecular Weight and Size: End group analysis, colligative properties measurement.

Suggested Books: -
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,

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.

Chemistry of chromium salts and chrome tanning, factors affecting the formation and stability of different complexes like Al, Cr, Zr etc.

07 1x16 Organic Chemistry (LTE 1.4)

1. Carbohydrates :-
   Introduction – Mono and Diaccharides, Trisaccharides , Polysaccharides, 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 :-

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.
Modern practices in E.I. tanning, E.I. Kips and their dressing into upper, lining and leather for goods.

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.

Morocco leathers, Chamois leathers, book binding leathers and pleated leathers.

**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.

**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** :- Various 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.
Quantitative Spectroscopy: Beer-Lambert’s law, Limitations, Deviations (Real, Chemical, Instrumental), Estimation 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.

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.

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.

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, mixture of Cu, Co and Ni by Paper, separation of amino acids by paper, estimation of organic compounds by GC and HPLC.

Controls in leather processing: Concept continuous processes, material and energy optimization, conventional and computer assisted control strategies, case studies.
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.

3. Closing operations
(a) Stitching – Types of stitching m/c, Types of stitch, Different types of seam.
(b) Eyeleting, lasting, etc

4. Construction
Assembly, Definition of construction, Types of Construction, Flowchart of different construction., Details of cemented construction – Methods,

5. Treeing Department (Shoe-room operations)
Shoe-room operations for grain, leather and suede leather uppers.

6. Quality control in footwear industry, Marketing of footwear, Hand tools and fittings for footwear industry.

Suggested Books :-

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 patent 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.

Upgradeation 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

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.

Application of colloids, stability of emulsions, electrophoresis, dialysis, coagulation and flocculation and their characteristics summary of surface chemistry.

Adsorption Physisorption and chemisorption and their characteristics, factors affecting adsorption of gases on solids – Freundlich and Langmuir adsorption, Isotherms, Adsorption from solutions.

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)

2. Data Processing :- Introduction to spread sheets, Analysis of data, Graphical representation.
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)

2. Engineering as social experimentation :- Engineering as experimentation – engineers as responsible experimenters-codes of ethics-a balanced outlook on law-the challenger case study.


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.

3. **Technocrats** :
Development of Technocrats, Role of educational institutions, Psychology of India technocrats, Technocrats as entrepreneur, Characteristics of an entrepreneur.

4. **Leadership** :
Attitudes and aptitudes, Qualities and development, Risk taking and decision making, Personal involvement.

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.

6. **Marketing** :
Indian and International markets, Market surveys, Strategies and development of market, Need based marketing techniques.

7. **Business Laws and Regulations** :

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:
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

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

5. Quality System

Suggested Books :-

References :-
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.

**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.

**Primary Treatment:**
Main object of primary treatment – Primary treatment units, Collection system of discharged waste water in tanneries, Screening, Equalisation of waste water.

**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.

**Standards and Specifications:**
Indian standards, International standards specifications for Industrial effluent discharge, Types of effluent disposal.

**Recovery of Waste Water and Materials:**
Different processes in recovery and reuse of waste water & material in tanning industry, Economic feasibility of different processes.

**Suggested Book:**
Environmental & Tannery – M.C.C. Carre et. Al. center technique du cuir, Lyon, France.

**Practices of Leather Manufacturing – III**
General practices and techniques involved in manufacture of different types of light leathers.

Glove kin, Resin upper, Glazed uppers, Lining leathers, Shoe suedes, Garment Swedes, Grain garment leathers, Gloving leathers.

Sheep nappa, Suede garments, Uppers and safety uppers, Lining and diaphragm leathers.
Nubuck, Oil pull up leathers, Dressing of for skins and processing of reptiles.

Combination tanning, Embossing, Grain correction, Special effects by spray, Screen printing, Roller coating, Gravure printing, tie and dye leathers, imitation leathers.

**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.

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).

Different types of sewing machines (Flat bed, inclined bed, special type machines), Feed mechanisms, Various types of assembly techniques for leather goods and garments.

**Pattern Designing**


**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 assessment. 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

2. Micromeric 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.

09 1101P PHARMACEUTICS – I (LAB)
L-T-P : 0-0-4

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.
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.
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.
5. Gennaro et al., “Remington’s The Science & Practice of Pharmacy” (Lippincott William and Wilkins, Baltimore).

09 1102 PHARMACEUTICAL ANALYSIS - I
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-Hesselbach 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 HI04, NaOH, CaC03 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**: Preparation 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.

**Recommended Books:**
3. Garratt, "The Quantitative analysis of drugs".

**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:**
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.
5. Cationic and anionic components of inorganic drugs useful for systemic effects.
9. Complexing and chelating agents used in therapy
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. Identification tests for pharmacopoeial 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.

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 - Apocynaceae, Solanaceae, Rutaceae, Umbelliferae, Leguminosae, Rubiaceae, Liliaceae, Graminae, Labiatae, Cruciferae, Papaveracea.
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, sterulcia and Tragancathy.
   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.
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:
2. Trease G.E. and Evans W.C., Pharmacognosy (Balliene Tindall, Eastbourne)
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

2. Common errors, comparison, Syntax.
3. Antonyms, Homonyms, Comprehension based on topics of Science & Technology
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:
2. English grammar by Dr. D. Thakur
6. Communication in English for Technical Student by Orient Longman.
8. 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

2. Measures of Central Value: Objectives and pre-requisites of an ideal, measure, mean, mode and median.
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:

09 1107 REMEDIAL BIOLOGY
L-T-P : 2-0-0

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.
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 BIOLOGY (LAB)
L-T-P : 0-0-2  
Credit : 1

I. 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.

Recommended Books:
1. Dutta: "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.
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.
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.
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)
3. Chemical 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**

2. The Liquid State: Physical properties (surface tension, parachor, viscosity, refractive index, optical rotation, dipole moments and chemical constituents).
4. Thermodynamics: First, second and third laws, Zeroth law, absolute temperature scale, thermochemical equations, phase equilibria and phase rule.
7. Chemical Kinetics: 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 compound.
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 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:**

**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 modern 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.
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 anthracene, 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)
4. Bently and Drivers text of Pharmaceutical chemistry by Oxford University, New Delhi

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.
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.

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.
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)
4. Human Physiology, C C Chatterjee, Medical allied agency, Calcutta

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 distribution 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:

SEMINSTER – 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.
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.
9. Reactors and fundamentals of reactors design for chemical reactions.

09 1301P PHARMACEUTICS – III (LAB)
L-T-P : 0-0-4
Credit : 2

1. Determination of overall heat transfer coefficient.
2. Determination of rate of evaporation.
3. Experiments based on steam, extractive and azeotropic distillations.
4. Determination of rate 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)
3. Chemical 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).
Nucleophilic aromatic substitutions; α β unsaturated carbonyl compounds; Conservation of orbital symmetry and rules., Electro cyclic, Cycloaddition and sigmatropic reactions; Neighbouring group effects; Catalysis by transition metal complexes, Stereoselective and sterspecific 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.

Recommended Books:
3. Bentley and Driver’s Text Book of Pharmaceutical Chemistry. (Oxford University Press, New Delhi)

Recommended Books:
2. Trease G.E. and Evans W.C., Pharmacognosy (Balliene Tindall, Eastbourne)
4. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)
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**

**Recommended Books:**
1. Vogel’s Text Book of Quantitative Chemical Analysis.
2. Practical Pharmaceutical Analysis by Beckett and Stenlake Vol. I & II.
3. Indian Pharmacopoeia Vol. I & II.
4. Instrumental methods chemical analysis by B.K. Sharma
5. Bently and Driver’s Text Book of Pharmaceutical Chemistry.
8. **Sense Organs**: Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, nose (smell) and skin (superficial receptors).

   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.

**Recommended books:**
1. Anatomy and Physiology in Health and Illness by Ross and Willson (Churchill living stone)
4. Human Physiology, C C Chatterjee, Medical allied agency, Calcutta

**SEMESTER - IV**

**PHARMACEUTICS - IV (Dispensing and Community Pharmacy)**

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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 of: 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, surfactant 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.

**PHARMACEUTICS - IV (LAB)**

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<td>PHARMACEUTICS - IV (LAB)</td>
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1. Dispensing of prescriptions falling under the categories: Mixtures, solutions, emulsions. Creams, ointments, powders, suppositories, ophthalmics, 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.
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.
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.
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.
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:**
2. Trease G.E. and Evans W.C., Pharmacognosy (Balliene Tindall, Eastbourne)
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

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.
   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.
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:**

**09 1406 PHARMACEUTICAL JURISPRUDENCE & ETHICS**

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

1. **Introduction**
   b. Drugs & Pharmaceutical Industry - A brief review.
   c. Pharmaceutical Education - A brief review.

2. **An elaborate study of the following**
   a. Pharmaceutical Ethics
   b. Pharmacy Act 1948.
   c. Drugs and Cosmetics Act 1940 and Rules 1945.
   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
   e. States Shops & Establishments Act & Rules.
   f. Insecticides Act 1968.
   g. AICTE Act 1987.
   h. Factories Act 1948.

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
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.
8. Cosmetology 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)
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.
5. Carbohydrate Metabolism: Conversion of polysaccharide to glucose-1-phosphate, Glycolysis and fermentation and their regulation, Gluconeogenesis and glycolgenolysis, 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.
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.
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.
12. The isolation and determination of RNA and DNA.

Recommended Books:
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. Neuromuscular transmission (autonomic and Somatic)
   b. Parasympathomimetics, Parasympatholytics, Sympathomimetics, Adrenergic Receptor and neuron blocking agents, Ganglionic, stimulants and blocking agents.
   c. Neuromuscular blocking Agents.
   d. Local anesthetic Agents.
3. Pharmacology of Central Nervous System:
   a. Neuromuscular 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

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.


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
4. Text book of Pharmacology by S.D. Sethi
5. The Pharmacological basis of Therapeutics by Goodman and Gilman

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.


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:
2. Trease G.E. and Evans W.C., Pharmacognosy (Balliene Tindall, Eastbourne)
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


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.


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.


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.
3. Remington: The Science & Practice of Pharmacy, Lippincott Williams & Wilkins.

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. Pharmacokinetics :
   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 intravenous 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, Michaelis 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.
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. Biopharmaceuticals 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 biological action. Drug-receptor 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 Designing (CADD) and molecular 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. Antacids
      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

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:
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.
5. Glycosides : Chemistry and biosynthesis of digitoxin, digoxin, hecogenin, sennosides, diosgenin and sarasapogenin.
7. Chemistry and biogenesis of medicinally important lignans and quassinoids, 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:
2. Trease G.E. and Evans W.C. , Pharmacognosy (Balliene Tindall, Eastbourne)
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) Antihyperlipidemic 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 pharmacootherapeutics by Satoshkar and Bhandarkar
4. Text book of Pharmacology by S.D. Sethi
5. The Pharmacological basis of Therapeutics by Goodman and Gilman

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. 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.
   6. Flame Photometry.
   7. Emission Spectroscopy.

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. Instrumental methods of Chemical Analysis by B.K. Sharma
3. Instrumental methods of Analysis by Willard Den & Merrit
4. Practical Pharmaceutical Chemistry by Beckett and Sten Lake Vol. 2
5. Text Book of Pharmaceutical Analysis by Conner
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, lyophilization & 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.


**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)
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)
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
4. Text book of Pharmacology by S.D. Sethi
5. The Pharmacological basis of Therapeutics by Goodman and Gilman

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.
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 Antiplaetlet 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:
3. A Text Book of Medicinal Chemistry by S.N.Pandeya.
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 haptns, 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.
5. Enzyme immobilization: Techniques 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.
8. Molecular Biotechnology by Glick.

09 1705 PHARMACEUTICAL INDUSTRIAL MANAGEMENT
L-T-P : 3-0-0 Credit : 3

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:
(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.

Recommended Books:

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)
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

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-HIV agents.
   e) Immunosuppressives and immunostimulants.

3. Amino acids, peptide, nucleotides 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:
3. A Text Book of Medicinal Chemistry by S.N.Pandeya.
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.
5. Chemotaxonomy of medicinal plants.
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:
PHARMACOLOGY – IV (Clinical Pharmacy and Drug Interactions)

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 (Pediatrics & Geriatrics).
   d) Drug use during Pregnancy.
   e) Drug induced Diseases.
   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.
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
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

ELECTIVES
(To be chosen one each against papers 09 1706 and 09 1706P)

COSMETIC TECHNOLOGY

UNIT -I

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

09 17E1P COSMETIC TECHNOLOGY (LAB)
L-T-P : 0-0-4 Credit : 2

1. Preparation of selected cosmetic preparations representing the following classes:
   a) Shampoo
   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.

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 Aradogrophic 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. Trase and Evan’s Pharmacognosy 15th edition
2. Indian Herbal Pharmacopeia Vol-I and II
4. Quality Control of Herbal drugs by Dr. Pulak K. Mukherjee
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 Bioassays), 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, Vasopressin, 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
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. Handbook 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-Packaging and labeling Quality control.
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:
3. Avery's Drug Treatment, 4th edition, Adis international limited

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, Oxyphenetazone, 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, Chlorpropamid, 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 Benzaaldehyde (PDAB), Folin’s reagent, Gibb’s reagent and para Dimethyl Amino Cinnamaldehyde (PDAC) reagent.
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.
5. A text book of Pharmaceutical analysis by K.A.Conners (John Wiley)
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 opened 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.
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Title</th>
<th>Course No.</th>
<th>Credit</th>
<th>Contact Hour</th>
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<tr>
<td>1.</td>
<td>Physical Chemistry of Milk</td>
<td>DTC-111</td>
<td>3(2+1)</td>
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<td>2.</td>
<td>Milk Production Management &amp; Dairy Development</td>
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<td>Engineering Drawing</td>
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<td>4.</td>
<td>Workshop Practice</td>
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<td>Fluid Mechanics</td>
<td>DTE-113</td>
<td>3(2+1)</td>
<td>2+2</td>
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<td>6.</td>
<td>Economic Analysis</td>
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<td>2(2+0)</td>
<td>2+0</td>
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<td>7.</td>
<td>Fundamental of Microbiology</td>
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<td>Environmental Studies</td>
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<td>29(13+16)</td>
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<td>Optional Courses: (I). Organic Chemistry (II). Industrial Statistics</td>
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**Semester II**

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<td>1.</td>
<td>Market Milk</td>
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<td>2.</td>
<td>Introductory Microbiology</td>
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<td>3.</td>
<td>Heat &amp; Mass Transfer</td>
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<td>Chemistry of Milk</td>
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<td>Thermodynamics</td>
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<td>Biochemistry &amp; Human Nutrition</td>
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**Semester III**
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<td>Traditional Dairy Products</td>
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<td>Ice Cream &amp; Frozen Deserts</td>
<td>DTT-212</td>
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<td>Fat Rich Dairy products</td>
<td>DTT-213</td>
<td>4(3+1)</td>
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<td>Refrigerator and Air Conditioning</td>
<td>DTE-211</td>
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<td>Starter Culture &amp; Fermented Milk Products</td>
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<td>Dairy Engineering</td>
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<td>Food Chemistry</td>
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<td>Marketing Management &amp; International Trade</td>
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<td>Condensed &amp; Dried Milks</td>
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<td>By Products Technology</td>
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<td>Dairy Process Engineering</td>
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<td>Packaging of Dairy Products</td>
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<td>Operation Research</td>
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<td>Dairy Extension Education</td>
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<td>V</td>
<td>IT in Dairy Industries</td>
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<td>Cost Accounting</td>
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<td>Dairy Biotechnology</td>
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<td>Cheese Technology</td>
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<td>Quality &amp; Safety monitoring in Dairy Industry</td>
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<td>Principle of Dairy Machine Design</td>
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<td>Food Technology</td>
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<td><strong>32(16+16)</strong></td>
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<td>VI</td>
<td>Financial Management</td>
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<td>Chemical Quality Assurance</td>
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</table>
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.

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<th>Sr.No</th>
<th>Course Title</th>
<th>Credits</th>
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<td>1.</td>
<td>Hands –on training and experiential learning</td>
<td>25(0+25)</td>
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Total  25(0+25)

VIII Semester: In-plant training in commercial Dairy Plants.

<table>
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<th>Sr.</th>
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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>In-Plant training</td>
<td>20(0+20)</td>
</tr>
<tr>
<td>2.</td>
<td>Training Report Evalutation</td>
<td>5(0+5)</td>
</tr>
</tbody>
</table>

Total  25(0+25)

Hands-on Training /Experiential Learning and in-plant training could also be organized in III year.

Total Credits.

1. Course credit up to (VIth Semester) : 141
2. Hands on training (VIth Semester) : 25
3. In–plant training and report and evaluation (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

**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, clarifiers, tri processors, cream separators self dislodging centrifuge, Bacto-fuge, care and maintenance of separators and clarifiers.


**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:

2. Dairy Process Engineering


3. Dairy Plant Design and Layout


4. Instrumentation and Process Control:

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)

6. Principles Of Dairy Machine Design 3(2+1)

7. Workshop Practice 2(1+1)
Introduction to workshop practice. safety. care and pitctlitions in workshop. Wood work in tools and their lise, Carp'l'ntry and pattern making. Monld material and their application, Heat treatment processes: hardening. tempering, annL'alling, normalizing etc Metal cutting. Soldering & Brazing. l.ectric arc welding. Gas smithy and forging operations
tools and equipment the bench for flat surface filing, Chipping, Scraping, Marketing, Drilling and screwing use of jigs and fixtures in production introduction to following machine tools: (a) Lathe (b) Milling 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


### 9. Heat & Mass Transfer

Basic heat transfer process, thermal conductivity, convective film co-efficient, Stefan Boltzmann'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 flow through slab, cylinder and sphere. Heat flow through slab, cylinder and sphere with non-uniform thermal


**10. Thermodynamics**


11. Refrigeration & Air Conditioning


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 different 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. Disassembling and assemble an open compressor and a sealed unit. Study different parts...
and controls 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 differences) 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 theroretical refrigeration cycle. Study differenr 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)


Measuring Instruments: Classification. of instruments. Elements of a generalized measurement system, Static and Dynamic characteristics.

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.I. (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 efficieny 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


2. DAIRY MICROBIOLOGY

1. Fundamentals of Microbiology

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: bacterial nutations (spontaneous and induced); genet ic recombi nation- (transformation. transduction, 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

2. Introductory Dairy Microbiology  

Hygienic milk production system: microbial quality of milk produced under organized v/s unorganized milk sector in India and comparison with developed countries: microbial and non microbial contaminants. Their sources and entry points in milk during various stages of production; Good Hygiene Practices (GHP) during milk production operations microorganisms associated with raw milk; morphological and biochemical characteristics of important groups and their classification: significance of different groups of bacteria i.e. psychrotrophs, mesophiles, thermodurics, and thermophiles in milk. Microbiological changes in 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, bitter 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 cell count (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, salmonella typhi, Staph aureus, Bacillus cereus etc. Antimicrobial substances in milk: Immunoglobulin, lacto ferin, lysozymes, L.P system etc.


3. Food and Industrial Microbiology  

Microbiology: Basic aspects and scope of food microbiology. Intrinsic and extrinsic Factors that affect microbial growth
in foods. Microbial spoilage or fruits, fruit juices, vegetables, 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 fermentation): criteria for selection of industrially important microorganisms; media for industrial and inoculums development; down stream processing of fermented products. fermenter types, functions, design and control: chemostat 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 fermenter (Demonstration). Isolation of psychrophile, salt and sugar tolerant microorganisms for 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 assaying the antimicrobial activity of the culture. Production ethyl.

Alcohol from molasses and whey by yeasts. Production of fermented whey beverages. Educational tour to food processing/ fermentation industries.

4. Starter Cultures And Fermented Milk Products 3(2+ 1)

Introduction of starter cultures & their importance in dairy industry. Classification of Lactic acid bacteria. Metabolism of Lactic Acid Bacteria and diacetyl production, production of antibacterial 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 Bacteriophages. 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; classification of fermented milks. Microbiology of dahi and yoghurt: Different types of dahi and yoghurt; preparation; defects and their control. Microbiology of Milk products; their nutritional and therapeutic significance. Kefir and Kumiss: origin and characteristics; microbiology of Kefir grains. Microbiology of other termenred milks such as bugarian milk, cultured buttermilk. Leben and Yakult their significance. Concept of probiotic starters and their application in probiotic dairy food.

Practical: Testing for purity or starter cultures: gram's staining. catalase test: creatine test. starter activity tests: die reduction tests. Horall-Lliliker test. Whitehead and Cox test. preparation of single and mixed starter cultures:

5. Dairy Biotechnology 3(2+1)


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 of codex alimentaricious commission (CAC) in harmonization or International standards: quality (ISO 9001 :2(00) and food safety (HACCP) system and their application during milk production and processing. National and international food regulatory standards -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 Microbial and non-microbial contaminants; Enumeration Principles in detection of pre dominant 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.


3. **DAIRY TECHNOLOGY**

1. **Market Milk**


2. Traditional Dairy products 3(2+1)

enhancing the self life of indigenous milk products including active packaging.

**Practical**: Preparation of khoa from cow, buffalo and concentrated milk. Analysis of khoa, channa and paneer for total solids, moisture, fat and acidity. Preparation of kheer. Preparation of chhana from cow and buffalo milk and mixed milk. Preparation of 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


**Butter**


Study of construction and cooperation of the power operated Butter churn 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 churn. Preparation of ghee from cream and butter. Study and operation of continuous ghee

4. Chees Technology


5. Ice cream and frozen deserts

History, Development and status of ice cream industry. Definition, classification and composition or ice cream and other frozen dessert stabilizers 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 Ice cream plant. Effect of process treatments on the physico-chemical properties of ice-cream mixes and Ice cream. Processing and freezing of ice-cream mix and control of over-run. Packaging, hardening storage and shipping of ice-cream. Defects in ice cream, their causes and prevention. Physico-chemical properties of ice-cream and compositional...

6. Condensed And Dried Milk


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 density 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


8. Judging Of Dairy Products

summary measurement.

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 characteristics of fermented milks. sensory evaluation of dahi, yoghurt. 'srikhand lassi and other fermented drinks.
Cream: Desirable attributes and defects cream. Score card for cream. Judging and grading of different types of cream.
Butter: specific requirement of high grade butter, undesirable attributes of butter. butter score-card, evaluation of butter. Ghee: Grades of ghee, special requirements of quality ghee. defects in ghee. Sensory 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.

Concentrated milks: Desirable attributes and defects. Judging and grading of evaporated and condensed milk.
Heat desiccated Indian milk products desirable and undesirable characteristics. Sensory evaluation of khoa and khoa based sweets.

Acid coagulated Indian milk products: desirable and undesirable characteristics. Sensory evaluation of paneer, chhana and chhana based sweets.

Consumer acceptance studies: Objectives. Methods, types of 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 defects, 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.

9. Food Technology – 1

Status of food processing industries in India and 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 vegetables. 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


10. Packaging Of Dairy Products 3(2+1)


11. Dairy Plant Management And Pollution Control


12. Food Technology II

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.


4. DAIRY CHEMISTRY

1. Physical Chemistry of Milk

of electro magnetic radiation, the laws of Lambert and Beer. visible. and ultra-violet Spectroscope. Mention of mass. NM R spectroscopy.


2. Chemistry of Milk


Definition, general composition and classification of milk lipids. Nomenclature and general structure of glycerides. t;ICtorS affecting the tilly 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 elements. physical equil ibria among the milk salts and' Milk contact uralces and metallic contamination.

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


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, I-IIIAT solutions etc. Detection of adulterants, preservatives, and neutralizers in milk and milk products. Chemical analysis of permissible additives used in milk and milk products. Chemical analysis or detergents and sanitizers. Preparation and testing of Gerber sulfuric acid used in titrmination. Testing the amyl alcohol used for fill determination. Analysis or market samples of milk and milk products.

4. Food Chemistry

starch. Production of dextrins and Illaltco dextran. Food Enzymcs:Hydrolases and lipases. utilisation in food industrv.


5. Biochemistry & Human Nutrition


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 IeMR standard) Methods of evaluation of nutritive value of foods Nutritional value of cow, buffalo


6. Organic Chemistry


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 of 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. Iconomic 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)


3. Operation Research


4. Industrial Statistics

Definition and scope; sources of animal husbandry and dairy statistic. Measures of central tendency, Measures of


**5. Marketing Management and International Trade**


**6. Communication Skills and Entrepreneurship Development**

PRACTICAL: 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.

7. IT in Dairy Industry 2(1+ 1)

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 of extension and rural Development programmes. Teaching/learning process, Extension Teaching Methods,


9. Environmental Studies 3(2+1)


10. Milk Production Management & Dairy Development 3(2+1)


PRACTICAL: Handling and restraining of dairy animals. External body parts and judging of cows and buffaloes. Feeding and management practices of calves. Identification or common feeds and fodders. Preparation of rations for adult animals Milking of dairy animals and cleaning and sanitation of milking equipments. Identification IV 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 «= 1 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 between 17
to 335. Exclude integers divisible by 7. Ohm's law is \( I = \frac{V}{R} \). Write a program to calculate \( I \) from given sets of \( V \) and \( R \).

Write a program to generate the Cartesian coordinates or points \((x, y)\) for the values of \( f \) ranging from 0.5, 1.0, 1.5 ------- \( \times \) 6.0, and label the output. Write a program to calculate the resultant focal length \( f \) when \( f_1 \) and \( f_2 \) are placed in contact. Used formula is \( f = \frac{(f_1 + f_2)}{(f_1 \times f_2)} \). Compute for following pairs of local lengths. \( f_1 \) is \( 7, 8, 10 \); \( f_2 \) is \( 0.5, -0.4, -0.4 \).

Write a program to sort an array of \( N \) elements in ascending order.

Write a program to evaluate following series to calculate \( \cos x \)

\[
\cos x = \frac{x^2}{2} + \frac{x^4}{4} + \frac{x^6}{6} + \ldots
\]

Compare the calculated value with the one by using library function. Write a program which reads in indefinite number of Name, Marks 1, Marks 2, Marks 3 from keyboard and store them in a file along with total marks, Percentage marks and Grade in a file.