# RAYALASEEMA UNIVERSITY, KURNOOL

Common Framework of CBCS for Colleges in Andhra Pradesh
w.e.f. 2017-2018 (Revised in April, 2016)

## Table-1 : BSc Semester-I

| S# | Course | Total Marks | Mid-Sem Exam | Sem-End Exam | Teaching Hours | Credits |
|---|---|---|---|---|---|---|
| 1 | First Language (Tel/Hin/Urdu/Sanskrit…) | 100 | 30 | 70 | 4 | 3 |
| 2 | Second Language English | 100 | 30 | 70 | 4 | 3 |
| 3 | *Foundation Course – 1* Human Values & Professional Ethics | 50 | 0 | 50 | 2 | 2 |
| 4 | *Foundation Course – 2* Environmental Studies | 50 | 0 | 50 | 2 | 2 |
| 5 | DSC 1 Paper-1 (Core) | 100 | 30 | 70 | 4 | 3 |
| 6 | DSC 1 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 7 | DSC 2 Paper-1 (Core) | 100 | 30 | 70 | 4 | 3 |
| 8 | DSC 2 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 9 | DSC 3 Paper-1 (Core) | 100 | 30 | 70 | 4 | 3 |
| 10 | DSC 3 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| | Total | 750 | 150 | 600 | 30 | 25 |

#DSC: Domain (Discipline/Subject) Specific Course (Paper), Foundation Course: value or skill related
Note: For Science Domain Subjects which had no lab practical component earlier (eg. Mathematics) the following format is applicable. They, however, will have co-curricular activities (eg. Problem solving sessions etc.). The total marks will change accordingly for such combinations. For example for Mathematics, Physics and Chemistry the total marks will be 700.

| | | | | | | |
|---|---|---|---|---|---|---|
| | DSC (without Lab Practical) | 100 | 30 | 70 | 6 | 5 |

## Table-2 : BSc Semester-II

| S# | Course | Total Marks | Mid-Sem Exam | Sem-End Exam | Teaching Hours | Credits |
|---|---|---|---|---|---|---|
| 1 | First Language (Tel/Hin/Urdu/Sanskrit…) | 100 | 30 | 70 | 4 | 3 |
| 2 | Second Language English | 100 | 30 | 70 | 4 | 3 |
| 3 | *Foundation Course – 3* ICT-I (Computer Fundamentals and Office Tools) | 50 | 0 | 50 | 2 | 2 |
| 4 | *Foundation Course – 4* CSS-I | 50 | 0 | 50 | 2 | 2 |
| 5 | DSC 1 Paper-2 (Core) | 100 | 30 | 70 | 4 | 3 |
| 6 | DSC 1 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 7 | DSC 2 Paper-2 (Core) | 100 | 30 | 70 | 4 | 3 |
| 8 | DSC 2 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 9 | DSC 3 Paper-2 (Core) | 100 | 30 | 70 | 4 | 3 |
| 10 | DSC 3 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| | Total | 750 | 150 | 600 | 30 | 25 |

## Table-3 : BSc Semester-III

| S# | Course | Total Marks | Mid-Sem Exam | Sem-End Exam | Teaching Hours | Credits |
|---|---|---|---|---|---|---|
| 1 | First Language (Tel/Hin/Urdu/Sanskrit…) | 100 | 30 | 70 | 4 | 3 |
| 2 | Second Language English | 100 | 30 | 70 | 4 | 3 |
| 3 | *Foundation Course – 5* ICT-II (Internet Fundamentals and Web Tools) | 50 | 0 | 50 | 2 | 2 |
| 4 | *Foundation Course – 6* CSS-I | 50 | 0 | 50 | 2 | 2 |
| 5 | DSC 1 Paper-3 (Core) | 100 | 30 | 70 | 4 | 3 |
| 6 | DSC 1 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 7 | DSC 2 Paper-3 (Core) | 100 | 30 | 70 | 4 | 3 |
| 8 | DSC 2 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 9 | DSC 3 Paper-3 (Core) | 100 | 30 | 70 | 4 | 3 |
| 10 | DSC 3 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| | Total | 750 | 150 | 600 | 30 | 25 |

## Table-4 : BSc Semester-IV

| S# | Course | Total Marks | Mid-Sem Exam | Sem-End Exam | Teaching Hours | Credits |
|---|---|---|---|---|---|---|
| 1 | *Foundation Course – 7* CSS-III | 50 | 0 | 50 | 2 | 2 |
| 2 | *Foundation Course – 8* Analytical Skills | 50 | 0 | 50 | 2 | 2 |
| 3 | *Foundation Course – 9* Entrepreneurship | 50 | 0 | 50 | 2 | 2 |
| 4 | *Foundation Course – 10* Leadership Education | 50 | 0 | 50 | 2 | 2 |
| 5 | DSC 1 Paper-4 (Core) | 100 | 30 | 70 | 4 | 3 |
| 6 | DSC 1 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 7 | DSC 2 Paper-4 (Core) | 100 | 30 | 70 | 4 | 3 |
| 8 | DSC 2 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 9 | DSC 3 Paper-4 (Core) | 100 | 30 | 70 | 4 | 3 |
| 10 | DSC 3 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| | Total | 650 | 90 | 560 | 26 | 23 |

## Table-5 : BSc Semester-V

| S# | Course | Total Marks | Mid-Sem Exam | Sem-End Exam | Teaching Hours | Credits |
|---|---|---|---|---|---|---|
| 1 | DSC 1 Paper-5 (Core) | 100 | 30 | 70 | 4 | 3 |
| 2 | DSC 1 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 3 | DSC 2 Paper-5 (Core) | 100 | 30 | 70 | 4 | 3 |
| 4 | DSC 2 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 5 | DSC 3 Paper-5 (Core) | 100 | 30 | 70 | 4 | 3 |
| 6 | DSC 3 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 7 | DSC 1 Paper-6 (Core) | 100 | 30 | 70 | 4 | 3 |
| 8 | DSC 1 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 9 | DSC 2 Paper-6 (Core) | 100 | 30 | 70 | 4 | 3 |
| 10 | DSC 2 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 11 | DSC 3 Paper-6 (Core) | 100 | 30 | 70 | 4 | 3 |
| 12 | DSC 3 Lab Practical/Project | 50 | 0 | 50 | 2 | 2 |
| | Total | 900 | 180 | 720 | 36 | 30 |

## Table-6 : BSc Semester-VI

| S# | Course | Total Marks | Mid-Sem Exam | Sem-End Exam | Teaching Hours | Credits |
|---|---|---|---|---|---|---|
| 1 | Elective-1<br>DSC 1 Paper-7 (Core)<br>(Applied/Advanced) | 100 | 30 | 70 | 4 | 3 |
| 2 | Elective-1 DSC 1 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 3 | Elective-1<br>DSC 2 Paper-7 (Core)<br>(Applied/Advanced) | 100 | 30 | 70 | 4 | 3 |
| 4 | Elective-1 DSC 2 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 5 | Elective-1<br>DSC 3 Paper-7 (Core)<br>(Applied/Advanced) | 100 | 30 | 70 | 4 | 3 |
| 6 | Elective-1 DSC 3 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 7 | Elective-2<br>DSC 1 Paper-8 (Core)<br>(Applied/Inter-domain/General) | 100 | 30 | 70 | 4 | 3 |
| 8 | Elective-2 DSC 1 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 9 | Elective-2<br>DSC 2 Paper-8 (Core)<br>(Applied/Inter-domain/General) | 100 | 30 | 70 | 4 | 3 |
| 10 | Elective-2 DSC 2 Lab Practical | 50 | 0 | 50 | 2 | 2 |
| 11 | Elective-2<br>DSC 3 Paper-8 (Core)<br>(Applied/Inter-domain/General) | 100 | 30 | 70 | 4 | 3 |
| 12 | Elective-2 DSC 3 Lab Practical/Project | 50 | 0 | 50 | 2 | 2 |
| | Total | 900 | 180 | 720 | 36 | 30 |

*7th paper of each of the domain specific subjects (1st paper of semester VI) will be a domain related Elective. More than one Elective may be offered giving choice to students. The Electives may be of Domain specific applied or advanced (specialization) in nature. The number of Electives may be decided (along with the syllabus) by the University concerned keeping the feasibility of conduct of University examinations in view.
** Applied Elective: It is desirable that around 25% of syllabus is taught by field experts. The college has to make such an arrangement.

*8th paper of each of the domain specific subjects (2nd paper of semester VI) will also be an Elective. The Electives may be of Inter-domain Clusters**- each Cluster having three papers with or without project work. or General in nature. The number of Clusters may be decided (along with the syllabus) by the University concerned keeping the feasibility of conduct of University examinations in view. It is desirable that around 25% of syllabus is taught by field experts.

***Cluster: In the last semester, for paper-8, each domain subject has one elective totaling three papers for each student. Electives may be given as Clusters of three papers each for each subject. A student can opt for all the three papers of the same subject (cluster or stream) including or excluding project work for a wider learning experience. The student will not study the other two domain subjects for paper-8.*

**Total Credits for BSc Course : 158**

# MATHEMATICS

**SEMESTER – V, PAPER -5**

## RING THEORY & VECTOR CALCULUS

**60 Hrs**

***UNIT – 1 (12 hrs) RINGS-I : -***

Definition of Ring and basic properties, Boolean Rings, divisors of zero and cancellation laws Rings, Integral Domains, Division Ring and Fields, The characteristic of a ring - The characteristic of an Integral Domain, The characteristic of a Field. Sub Rings, Ideals

***UNIT – 2 (12 hrs) RINGS-II : -***

Definition of Homomorphism – Homorphic Image – Elementary Properties of Homomorphism –Kernel of a Homomorphism – Fundamental theorem of Homomorhphism –
Maximal Ideals – Prime Ideals.

***UNIT –3 (12 hrs) VECTOR DIFFERENTIATION : -***

Vector Differentiation, Ordinary derivatives of vectors, Differentiability, Gradient, Divergence, Curl operators, Formulae Involving these operators.

***UNIT – 4 (12 hrs) VECTOR INTEGRATION : -***

Line Integral, Surface Integral, Volume integral with examples.

***UNIT – 5 (12 hrs) VECTOR INTEGRATION APPLICATIONS : -***

Theorems of Gauss and Stokes, Green's theorem in plane and applications of these theorems.

***Reference Books :-***


1. Abstract Algebra by J. Fralieh, Published by Narosa Publishing house.
2. Vector Calculus by Santhi Narayana, Published by S. Chand & Company Pvt. Ltd., New Delhi.
3. A text Book of B.Sc., Mathematics by B.V.S.S.Sarma and others, published by S. Chand & Company Pvt. Ltd., New Delhi.
4. Vector Calculus by R. Gupta, Published by Laxmi Publications.
5. Vector Calculus by P.C. Matthews, Published by Springer Verlag publicattions.
6. Rings and Linear Algebra by Pundir & Pundir, Published by Pragathi Prakashan.


***Suggested Activities***:

Seminar/ Quiz/ Assignments/ Project on Ring theory and its applications

**SEMESTER – V, PAPER -6**

## LINEAR ALGEBRA

**60 Hrs**

***UNIT – I (12 hrs) : Vector Spaces-I :***

Vector Spaces, General properties of vector spaces, n-dimensional Vectors, addition and scalar multiplication of Vectors, internal and external composition, Null space, Vector subspaces, Algebra of subspaces, Linear Sum of two subspaces, linear combination of Vectors, Linear span Linear independence and Linear dependence of Vectors.

***UNIT –II (12 hrs) : Vector Spaces-II :***

Basis of Vector space, Finite dimensional Vector spaces, basis extension, co-ordinates, Dimension of a Vector space, Dimension of a subspace, Quotient space and Dimension of Quotientspace.

***UNIT –III (12 hrs) : Linear Transformations :***

Linear transformations, linear operators, Properties of L.T, sum and product of LTs, Algebra of Linear Operators, Range and null space of linear transformation, Rank and Nullity of linear transformations – Rank – Nullity Theorem.

***UNIT –IV (12 hrs) : Matrix :***

Matrices, Elementary Properties of Matrices, Inverse Matrices, Rank of Matrix, Linear Equations, Characteristic Roots, Characteristic Values & Vectors of square Matrix, Cayley – Hamilton Theorem.

***UNIT –V (12 hrs) : Inner product space :***

Inner product spaces, Euclidean and unitary spaces, Norm or length of a Vector, Schwartz inequality, Triangle in Inequality, Parallelogram law, Orthogonality, Orthonormal set, complete orthonormal set, Gram – Schmidt orthogonalisation process. Bessel's inequality and Parseval's Identity.

***Reference Books :***


1. Linear Algebra by J.N. Sharma and A.R. Vasista, published by Krishna Prakashan Mandir, Meerut- 250002.
2. Matrices by Shanti Narayana, published by S.Chand Publications.
3. Linear Algebra by Kenneth Hoffman and Ray Kunze, published by Pearson Education (low priced edition), New Delhi.
4. Linear Algebra by Stephen H. Friedberg et al published by Prentice Hall of India Pvt. Ltd. 4th Edition 2007.


***Suggested Activities***:

Seminar/ Quiz/ Assignments/ Project on "Applications of Linear algebra Through Computer Sciences"

**SEMESTER – VI, PAPER – VII-(A)**

**ELECTIVE-VII(A); LAPLACE TRANSFORMS**

**60 Hrs**

***UNIT – 1 (12 hrs) Laplace Transform I : -***

Definition of - Integral Transform – Laplace Transform Linearity, Property, Piecewise continuous Functions, Existence of Laplace Transform, Functions of Exponential order, and of Class A.

***UNIT – 2 (12 hrs) Laplace Transform II : -***

First Shifting Theorem, Second Shifting Theorem, Change of Scale Property, Laplace Transform of the derivative of f(t), Initial Value theorem and Final Value theorem.

***UNIT – 3 (12 hrs) Laplace Transform III : -***

Laplace Transform of Integrals – Multiplication by t, Multiplication by $t^n$ – Division by t. Laplace transform of Bessel Function, Laplace Transform of Error Function, Laplace Transform of Sine and cosine integrals.

***UNIT –4 (12 hrs) Inverse Laplace Transform I : -***

Definition of Inverse Laplace Transform. Linearity, Property, First Shifting Theorem, Second Shifting Theorem, Change of Scale property, use of partial fractions, Examples.

***UNIT –5 (12 hrs) Inverse Laplace Transform II : -***

Inverse Laplace transforms of Derivatives–Inverse Laplace Transforms of Integrals – Multiplication by Powers of 'P'– Division by powers of 'P'– Convolution Definition – Convolution Theorem – proof and Applications – Heaviside's Expansion theorem and its Applications.

***Reference Books :-***


1. Laplace Transforms by A.R. Vasistha and Dr. R.K. Gupta Published by Krishna Prakashan Media Pvt. Ltd. Meerut.
2. Fourier Series and Integral Transforms by Dr. S. Sreenadh Published by S.Chand and Co., Pvt. Ltd., New Delhi.
3. Laplace and Fourier Transforms by Dr. J.K. Goyal and K.P. Gupta, Published by Pragathi Prakashan, Meerut.
4. Integral Transforms by M.D. Raising hania, - H.C. Saxsena and H.K. Dass Published by S. Chand and Co., Pvt.Ltd., New Delhi.


***Suggested Activities***:

Seminar/ Quiz/ Assignments

**SEMESTER – VI, PAPER – VII-(B)**

**ELECTIVE–VII-(B); NUMERICAL ANALYSIS**

**60 Hrs**

***UNIT- I: (10 hours)***

**Errors in Numerical computations :** Errors and their Accuracy, Mathematical Preliminaries, Errors and their Analysis, Absolute, Relative and Percentage Errors, A general error formula, Error in a series approximation.

***UNIT – II: (12 hours)***

**Solution of Algebraic and Transcendental Equations**: The bisection method, The iteration method, The method of false position, Newton Raphson method, Generalized Newton Raphson method. Muller's Method

***UNIT – III: (12 hours) Interpolation - I***

**Interpolation :** Errors in polynomial interpolation, Finite Differences, Forward differences, Backward differences, Central Differences, Symbolic relations, Detection of errors by use of Differences Tables, Differences of a polynomial

***UNIT – IV: (12 hours) Interpolation - II***

Newton's formulae for interpolation. Central Difference Interpolation Formulae, Gauss's central difference formulae, Stirling's central difference formula, Bessel's Formula, Everett's Formula.

***UNIT – V : (14 hours) Interpolation - III***

Interpolation with unevenly spaced points, Lagrange's formula, Error in Lagrange's formula, Divided differences and their properties, Relation between divided differences and forward differences, Relation between divided differences and backward differences Relation between divided differences and central differences, Newton's general interpolation Formula, Inverse interpolation.

***Reference Books :***


1. Numerical Analysis by S.S.Sastry, published by Prentice Hall of India Pvt. Ltd., New Delhi. (Latest Edition)
2. Numerical Analysis by G. Sankar Rao published by New Age International Publishers, New – Hyderabad.
3. Finite Differences and Numerical Analysis by H.C Saxena published by S. Chand and Company, Pvt. Ltd., New Delhi.
4. Numerical methods for scientific and engineering computation by M.K.Jain, S.R.K.Iyengar, R.K. Jain.


***Suggested Activities***:
Seminar/ Quiz/ Assignments

**SEMESTER – VI, PAPER – VII-(C)**

**ELECTIVE– VII-(C) : NUMBER THEORY**

***UNIT-I (12 hours)***

Divisibility – Greatest Common Divisor – Euclidean Algorithm – The Fundamental Theorem of Arithmetic

***UNIT-II (12 hours)***

Congruences – Special Divisibility Tests - Chinese Remainder Theorem- Fermat's Little Theorem – Wilson's Theorem – Residue Classes and Reduced Residue Classes – Solutions of Congruences

***UNIT-III (12 hours)***

Number Theory from an Algebraic Viewpoint – Multiplicative Groups, Rings and Fields

***UNIT-IV (12 hours)***

Quadratic Residues - Quadratic Reciprocity – The Jacobi Symbol

***UNIT-V (12 hours)***

Greatest Integer Function – Arithmetic Functions – The Moebius Inversion Formula

**Reference Books:**


1. "Introduction to the Theory of Numbers" by Niven, Zuckerman & Montgomery (John Wiley & Sons)
2. "Elementary Number Theory" by David M. Burton.
3. Elementary Number Theory, by David, M. Burton published by 2nd Edition (UBS Publishers).
   Introduction to Theory of Numbers, by Davenport H., Higher Arithmetic published by 5th Edition (John Wiley & Sons) Niven,Zuckerman & Montgomery.(Camb, Univ, Press)
4. Number Theory by Hardy & Wright published by Oxford Univ, Press.
5. Elements of the Theory of Numbers by Dence, J. B & Dence T.P published by Academic Press.

## SEMESTER – VI, CLUSTER – A, PAPER – VIII-A-1

## Cluster Elective- VIII-A-1: INTEGRAL TRANSFORMS

**60 Hrs**

***UNIT – 1 (12 hrs) Application of Laplace Transform to solutions of Differential Equations : -***

Solutions of ordinary Differential Equations.
Solutions of Differential Equations with constants co-efficient
Solutions of Differential Equations with Variable co-efficient

***UNIT – 2 (12 hrs) Application of Laplace Transform : -***

Solution of simultaneous ordinary Differential Equations.
Solutions of partial Differential Equations.

***UNIT – 3 (12 hrs) Application of Laplace Transforms to Integral Equations : -***

***Definitions :*** Integral Equations-Abel's, Integral Equation-Integral Equation of Convolution Type, Integro Differential Equations.Application of L.T. to Integral Equations.

***UNIT –4 (12 hrs) Fourier Transforms-I : -***

Definition of Fourier Transform – Fourier's in Transform – Fourier cosine Transform – Linear Property of Fourier Transform – Change of Scale Property for Fourier Transform – sine Transform and cosine transform shifting property – modulation theorem.

***UNIT – 5 (12 hrs) Fourier Transform-II : -***

Convolution Definition – Convolution Theorem for Fourier transform – parseval's Indentify – Relationship between Fourier and Laplace transforms – problems related to Integral Equations.

***Finte Fourier Transforms : -***

Finte Fourier Sine Transform – Finte Fourier Cosine Transform – Inversion formula for sine and cosine Transforms only statement and related problems.

***Reference Books :-***


1. Integral Transforms by A.R. Vasistha and Dr. R.K. Gupta Published by Krishna Prakashan Media Pvt. Ltd. Meerut.
2. A Course of Mathematical Analysis by Shanthi Narayana and P.K. Mittal, Published by S. Chand and Company pvt. Ltd., New Delhi.
3. Fourier Series and Integral Transforms by Dr. S. Sreenadh Published by S.Chand and Company Pvt. Ltd., New Delhi.
4. Lapalce and Fourier Transforms by Dr. J.K. Goyal and K.P. Gupta, Published by Pragathi Prakashan, Meerut.
5. Integral Transforms by M.D. Raising hania, - H.C. Saxsena and H.K. Dass Published by S.Chand and Company pvt. Ltd., New Delhi.


***Suggested Activities***:

Seminar/ Quiz/ Assignments

**SEMESTER – VI: PAPER – VIII-A-2**

**ELECTIVE – VIII-A-2: ADVANCED NUMERICAL ANALYSIS**

**60 Hrs**

***Unit – I (10 Hours)***

**Curve Fitting:** Least – Squares curve fitting procedures, fitting a straight line, nonlinear curve fitting, Curve fitting by a sum of exponentials.

***UNIT- II : (12 hours)***

**Numerical Differentiation:** Derivatives using Newton's forward difference formula, Newton's backward difference formula, Derivatives using central difference formula, stirling's interpolation formula, Newton's divided difference formula, Maximum and minimum values of a tabulated function.

***UNIT- III : (12 hours)***

**Numerical Integration:** General quadrature formula on errors, Trapozoidal rule, Simpson's 1/3 – rule, Simpson's 3/8 – rule, and Weddle's rules, Euler – Maclaurin Formula of summation and quadrature, The Euler transformation.

***UNIT – IV: (14 hours)***

**Solutions of simultaneous Linear Systems of Equations:** Solution of linear systems – Direct methods, Matrix inversion method, Gaussian elimination methods, Gauss-Jordan Method ,Method of factorization, Solution of Tridiagonal Systems,. Iterative methods. Jacobi's method, Gauss-siedal method.

***UNIT – V (12 Hours)***

**Numerical solution of ordinary differential equations:** Introduction, Solution by Taylor's Series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge – Kutta methods.

***Reference Books :***


1. Numerical Analysis by S.S.Sastry, published by Prentice Hall India (Latest Edition).
2. Numerical Analysis by G. Sankar Rao, published by New Age International Publishers, New – Hyderabad.
3. Finite Differences and Numerical Analysis by H.C Saxena published by S. Chand and Company, Pvt. Ltd., New Delhi.
4. Numerical methods for scientific and engineering computation by M.K.Jain, S.R.K.Iyengar, R.K. Jain.


***Suggested Activities***:

Seminar/ Quiz/ Assignments

**SEMESTER – VI, CLUSTER-B, PAPER – VIII-B-1**

**Cluster Elective – VIII-B-1 : PRINCIPLES OF MECHANICS**

**60 Hrs**

***Unit – I : (10 hours)***

D'Alembert's Principle and Lagrange's Equations : some definitions – Lagrange's equations for a Holonomic system – Lagrange's Equations of motion for conservative, nonholonomic system.

***Unit – II: (10 hours)***

Variational Principle and Lagrange's Equations: Variatonal Principle – Hamilton's Principle – Derivation of Hamilton's Principle from Lagrange's Equations – Derivation of Lagrange's Equations from Hamilton's Principle – Extension of Hamilton's Principle – Hamilton's Principle for Non-conservative, Non-holonomic system – Generalised Force in Dynamic System – Hamilton's Principle for Conservative, Non-holonomic system – Lagrange's Equations for Non-conservative, Holonomic system - Cyclic or Ignorable Coordinates.

***Unit –III: (15 hours)***

Conservation Theorem, Conservation of Linear Momentum in Lagrangian Formulation – Conservation of angular Momentum – conservation of Energy in Lagrangian formulation.

***Unit – IV: (15 hours)***

Hamilton's Equations of Motion: Derivation of Hamilton's Equations of motion – Routh's procedure – equations of motion – Derivation of Hamilton's equations from Hamilton's Principle – Principle of Least Action – Distinction between Hamilton's Principle and Principle of Least Action.

***Unit – V: (10 hours)***

Canonical Transformation: Canonical coordinates and canonical transformations – The necessary and sufficient condition for a transformation to be canonical – examples of canonical transformations – properties of canonical transformation – Lagrange's bracket is canonical invariant – poisson's bracket is canonical invariant - poisson's bracket is invariant under canonical transformation – Hamilton's Equations of motion in poisson's bracket – Jacobi's identity for poisson's brackets.

***Reference Text Books :***


1. Classical Mechanics by C.R.Mondal Published by Prentice Hall of India, New Delhi.
2. A Text Book of Fluid Dynamics by F. Charlton Published by CBS Publications, New Delhi.
3. Classical Mechanics by Herbert Goldstein, published by Narosa Publications, New Delhi.
4. Fluid Mechanics by T. Allen and I.L. Ditsworth Published by (McGraw Hill, 1972)
5. Fundamentals of Mechanics of fluids by I.G. Currie Published by (CRC, 2002)
6. Fluid Mechanics : An Introduction to the theory, by Chia-shun Yeh Published by (McGraw Hill, 1974)
7. Introduction to Fluid Mechanics by R.W Fox, A.T Mc Donald and P.J. Pritchard Published by (John Wiley and Sons Pvt. Ltd., 2003)

## SEMESTER – VI, CLUSTER-B, PAPER – VIII-B-2

### Cluster Elective–VIII-B-2 : FLUID MECHANICS

**60 Hrs**

**Unit – I : (10 hours)**

Kinematics of Fluids in Motion – Real fluids and Ideal fluids – Velocity of a Fluid at a point – Streamlines and pthlines – steady and Unsteady flows – the velocity potential – The Vorticity vector – Local and Particle Rates of Change – The equation of Continuity – Acceleration of a fluid – Conditions at a rigid boundary – General Analysis of fluid motion.

**Unit – II : (10 hours)**

Equations of motion of a fluid- Pressure at a point in fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two inviscid immiscible fluids – Euler's equations of motion – Bernoulli's equation – Worked examples.

**Unit – III : (10 hours)**

Discussion of the case of steady motion under conservative body forces - Some flows involving axial symmetry – Some special two-dimensional flows – Impulsive motion – Some further aspects of vortex motion.

**Unit – IV : (15 hours)**

Some Two – dimensional Flows, Meaning of two-dimensional flow – Use of Cylindrical polar coordinates – The stream function – The complex potential for two-dimensional, Irrotational, Incompressible flow – Uniform Stream – The Milne-Thomson Circle theorem – the theorem of Blasius.

**Unit – V : (15 hours)**

Viscous flow,Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid element – The rate of strain quadric and principal stresses – Some further properties of the rate of strain quadric – Stress analysis in fluid motion – Relations between stress and rate of strain – the coefficient of viscosity and laminar flow - The Navier-Stokes equations of motion of a viscous fluid.

***Reference Text Books :***


1. A Text Book of Fluid Dynamics by F. Charlton Published by CBS Publications, New Delhi.
2. Classical Mechanics by Herbert Goldstein, published by Narosa Publications, New Delhi.
3. Fluid Mechanics by T. Allen and I.L. Ditsworth published by (McGraw Hill, 1972)
4. Fundamentals of Mechanics of fluids by I.G. Currie published by (CRC, 2002)
5. Fluid Mechanics, An Introduction to the theory by Chia-shun Yeh published by (McGraw Hill, 1974)
6. Fluids Mechanics by F.M White published by (McGraw Hill, 2003)
7. Introduction to Fluid Mechanics by R.W Fox, A.T Mc Donald and P.J. Pritchard published by (John Wiley and Sons Pvt. Ltd., 2003

## SEMESTER – VI, CLUSTER-C, PAPER – VIII-C-1

## Cluster Elective–VIII-C-1: GRAPH THEORY

**60 Hrs**

***UNIT – I (12 hrs) Graphs and Sub Graphs :***

Graphs , Simple graph, graph isomorphism, the incidence and adjacency matrices, sub graphs, vertex degree, Hand shaking theorem, paths and connection, cycles.

***UNIT – II (12 hrs)***

Applications, the shortest path problem, Sperner's lemma.

***Trees :***

Trees, cut edges and Bonds, cut vertices, Cayley's formula.

***UNIT – III (12 hrs) :***

Applications of Trees - the connector problem.

***Connectivity***

Connectivity, Blocks and Applications, construction of reliable communication Networks,

***UNIT – IV (12 hrs):***

***Euler tours and Hamilton cycles***

Euler tours, Euler Trail, Hamilton path, Hamilton cycles , dodecahedron graph, Petersen graph, hamiltonian graph, closure of a graph.

***UNIT – V (12 hrs)***

Applications of Eulerian graphs, the Chinese postman problem, Fleury's algorithm - the travelling salesman problem.

***Reference Books :***


**1.** Graph theory with Applications by J.A. Bondy and U.S.R. Murthy published by Mac. Millan Press

**2.** Introduction to Graph theory by S. Arumugham and S. Ramachandran, published by scitech Publications, Chennai-17.

**3.** A Text Book of Discrete Mathamatics by Dr. Swapan Kumar Sankar, published by S.Chand & Co. Publishers, New Delhi.

**4.** Graph theory and combinations by H.S. Govinda Rao published by Galgotia Publications.

**SEMESTER – VI, CLUSTER-C, PAPER – VIII-C-2**

**Cluster Elective -VIII-C-2: APPLIED GRAPH THEORY**

**60 Hrs**

***UNIT – I (12 hrs) :***

***Matchings***

Matchings – Alternating Path, Augmenting Path - Matchings and coverings in Bipartite graphs, Marriage Theorem, Minimum Coverings.

***UNIT –II (12 hrs) :***

Perfect matchings, Tutte's Theorem, Applications, The personal Assignment problem -The optimal Assignment problem, Kuhn-Munkres Theorem.

***UNIT –III (12 hrs) :***

***Edge Colorings***

Edge Chromatic Number, Edge Coloring in Bipartite Graphs - Vizing's theorem.

***UNIT –IV (12 hrs) :***

Applications of Matchings, The timetabling problem.

***Independent sets and Cliques***

Independent sets, Covering number , Edge Independence Number, Edge Covering Number - Ramsey's theorem.

***UNIT –V (12 hrs) :***

Determination of Ramsey's Numbers – Erdos Theorem, Turan's theorem and Applications, Sehur's theorem. A Geometry problem.

***Reference Books :-***


1. Graph theory with Applications by J.A. Bondy and U.S.R. Murthy, published by Mac. Millan Press.
2. Introduction to graph theory by S. Arumugham and S. Ramachandran published by SciTech publications, Chennai-17.
3. A text book of Discrete Mathematics by Dr. Swapan Kumar Sarkar, published by S. Chand Publishers.
4. Graph theory and combinations by H.S. Govinda Rao, published by Galgotia Publications.

# PHYSICS

(For Mathematics Combinations)

**Paper V: Electricity, Magnetism& Electronics**
**(For Maths Combinations)**
**V Semester**

**Work load: 60 hrs per semester** **4hrs/week**

**UNIT-I (12 hrs)**

1. **Electric field intensity and potential:**
   Gauss's law statement and its proof- Electric field intensity due to (1) Uniformly charged sphere and (2) an infinite conducting sheet of charge. Electrical potential – equipotential surfaces- potential due to i) a point charge, ii)charged spherical shell and uniformly charged sphere.
2. **Dielectrics:**
   Electric dipolemoment and molecular polarizability- Electric displacement D, electric polarization P – relation between D, E and P- Dielectric constant and susceptibility. Boundary conditions at the dielectric surface.

**UNIT-II (12 hrs)**

3. **Electric and magnetic fields**
   Biot-Savart's law, explanation and calculation of B due to long straight wire, a circular current loop and solenoid – Lorentz force – Hall effect – determination of Hall coefficient and applications.
4. **Electromagnetic induction**
   Faraday's law-Lenz's law- Self and mutual inductance, coefficient of coupling, calculation of self inductance of a long solenoid, energy stored in magnetic field.Transformer - energy losses - efficiency.

**UNIT-III (12 hrs)**

5. **Alternating currents and electromagnetic waves**
   Alternating current - Relation between current and voltage in LR and CR circuits,vector diagrams, LCR series and parallel resonant circuit, Q – factor, power in ac circuits.
6. **Maxwell's equations**
   Idea of displacement current - Maxwell's equations (integral and differential forms) (no derivation), Maxwell's wave equation (with derivation), Transverse nature of electromagnetic waves.Poynting theorem (statement and proof), production of electromagnetic waves (Hertz experiment).

**UNIT-IV (12 hrs)**

7. **Basic electronics:**
   PN juction diode, Zener diode, Tunnel diode, I-V characteristics, PNP and NPN transistors, CB, CE and CC configurations – Relation between$\alpha$, $\beta$ and $\gamma$ - transistor (CE) characteristics -Determination of hybrid parameters, Transistor as an amplifier.

**UNIT-V: (12 hrs)**

**8. Digital electronics**

Number systems - Conversion of binary to decimal system and vice versa.Binary addition and subtraction (1's and 2's complement methods).Laws of Boolean algebra - De Morgan's laws-statement and proof, Basic logic gates, NAND and NOR as universal gates, exclusive-OR gate, Half adder and Full adder, Parallel adder circuits.

**REFERENCE BOOKS**

1. BSc Physics, Vol.3, Telugu Akademy, Hyderabad.
2. Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
3. Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand& Co.,
4. Principles of Electronics, V.K. Mehta, S.Chand& Co.,
5. Digital Principles and Applications, A.P. Malvino and D.P.Leach, Mc GrawHill Edition.

**Practical Paper V:Electricity, Magnetism & Electronics**

**Work load: 30 hrs** **2 hrs/week**

**Minimum of 6 experiments to be done and recorded**

1. Figure of merit of a moving coil galvonometer.
2. LCR circuit series/parallel resonance, Q factor.
3. Determination of ac-frequency –sonometer.
4. Verification of Kirchoff's laws and maximum power transfer theorem.
5. Field along the axis of a circular coil carrying current.
6. PN Junction Diode Characteristics
7. Zener Diode Characteristics
8. Transistor CE Characteristics- Determination of hybrid parameters
9. Logic Gates-OR,AND,NOT and NAND gates. Verification of Truth Tables.
10. Verification of De Morgan's Theorems.

**Suggested student activities**

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

**Examples**

Seminars - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.

Group discussion - A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment - Few problems may be given to the students from the different units and asked them to solve.

Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.

Study project - Web based study of different satellites and applications.

**Domain skills:**

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

***** Documental evidence is to be maintained for the above activities.**

**Paper VI: Modern Physics**
**(For Maths Combinations)**
**V Semester**

**Work load: 60 hrs per semester** **4 hrs/week**

**UNIT-I (12 hrs)**

**1. Atomic and molecular physics**

Introduction –Drawbacks of Bohr's atomic model- Sommerfeld's elliptical orbits-relativistic correction (no derivation).Vector atom model and Stern-Gerlach experiment - quantum numbers associated with it. L-S and j- j coupling schemes.Zeeman effect and its experimental arrangement.

Raman effect, hypothesis, Stokes and Anti Stokes lines. Quantum theory of Raman effect. Experimental arrangement – Applications of Raman effect.

**UNIT-II (12 hrs)**

**2. Matter waves & Uncertainty Principle**

Matter waves, de Broglie's hypothesis - wavelength of matter waves, Properties of matter waves - Davisson and Germer experiment – Phase and group velocities.

Heisenberg's uncertainty principle for position and momentum (x and p), & energy and time (E and t). Experimental verification - Complementarity principle of Bohr.

**UNIT-III (12 hrs)**

**3. Quantum (wave) mechanics**

Basic postulates of quantum mechanics-Schrodinger time independent and time dependent wave equations-derivations. Physical interpretation of wave function. Eigen functions, Eigen values. Application of Schrodinger wave equation to particle in one dimensional infinite box.

**UNIT-IV(12 hrs)**

**4. General Properties of Nuclei**

Basic ideas of nucleus -size, mass, charge density (matter energy), binding energy, angular momentum, parity, magnetic moment, electric moments. Liquid drop model and Shell model (qualitative aspects only) - Magic numbers.

**5. Radioactivity decay:**

Alpha decay: basics of α-decay processes. Theory of α-decay, Gamow's theory, Geiger Nuttal law.β-decay, Energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.

**UNIT-V (12 hrs)**

**6. Crystal Structure**

Amorphous and crystalline materials, unit cell, Miller indices, reciprocal lattice, types of lattices, diffraction of X-rays by crystals, Bragg's law, experimental techniques, Laue's method and powder diffraction method.

**7. Superconductivity:**

Introduction - experimental facts, critical temperature - critical field - Meissner effect – Isotope effect - Type I and type II superconductors - BCS theory (elementary ideas only) - applications of superconductors.

**REFERENCE BOOKS**

1. BSc Physics, Vol.4, Telugu Akademy, Hyderabad
2. Molecular Structure and Spectroscopy by G. Aruldhas. Prentice Hall of India, New Delhi.
3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
4. Modern Physics by G. Aruldhas & P. Rajagopal. Eastern Economy Edition.
5. Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
6. Quantum Mechanics, Mahesh C Jain, Eastern Economy Edition.
7. Nuclear Physics, Irving Kaplan, Narosa publishing House.
8. Nuclear Physics, D.C.Tayal, Himalaya Publishing House.
9. Elements of Solid State Physics, J.P.Srivastava, Prentice Hall of India Pvt., Ltd.
10. Solid State Physics, A.J. Dekker, McMillan India.

**Practical Paper VI:Modern Physics**

**Work load: 30 hrs** **2 hrs/week**

**Minimum of 6 experiments to be done and recorded**

1. e/m of an electron by Thomson method.
2. Determination of Planck's Constant (photocell).
3. Verification of inverse square law of light using photovoltaic cell.
4. Study of absorption of α-rays.
5. Study of absorption of β-rays.
6. Determination of Range of β-particles.
7. Determination of M & H.
8. Analysis of powder X-ray diffraction pattern to determine properties of crystals.
9. Energy gap of a semiconductor using junction diode.
10. Energy gap of a semiconductor using thermister.
11. Thevinin Norton Theorems/Construction of Ohm Meter
12. L-R & C-R Circuits
13. L & II Filters (Bridge Rectifier)
14. L-D-R Characteristics

Note: For all the above 8 practical papers the book "B.Sc Practical Physics" by C.L. Arora Published by S.Chand & Co, New – Delhi may be followed.

**NOTE: Problems should be solved at the end of every chapter of all units.**

**Suggested student activities**

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

**Examples**

Seminars - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.

Group discussion - A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment - Few problems may be given to the students from the different units and asked them to solve.

Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.

Study project - Web based study of different satellites and applications.

**Domain skills:**

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

***** Documental evidence is to be maintained for the above activities.**

## Paper–VII-(A) Elective(Electronics)

**Semester –VI**

**Elective Paper –VII-(A):Analog and Digital Electronics**

**No. of Hours per week: 04** **Total Lectures:60**

**Unit-I (14 Hours)**

1. FET-Construction, Working, characteristics and uses; MOSFET-enhancement MOSFET, depletion MOSFET, construction and working , drain characteristics of MOSFET, applications of MOSFET
2. Photo electric devices: Structure and operation, characteristics, spectral response and application of LDR, LEDand LCD

**Unit-II (10Hours)**

3. Operational Amplifiers: Characteristics of ideal and practical Op-Amp (IC 741), Basic differential amplifiers, Op-Amp supply voltage, IC identification, Internal blocks of Op-Amp, its parameter off set voltages and currents, CMRR, slew rate, concept of virtualground.

**Unit-III (10 Hours)**

4. Applications of Op-Amp: Op-Amp as voltage amplifier, Inverting amplifier, Non-inverting amplifier, voltage follower, summing amplifier, difference amplifier, comparator, integrator, differentiator.

**Unit-IV(14 Hours)**

5. Data processing circuits: Multiplexers, De-multiplexers, encoders, decoders, Characteristics for Digital ICs -RTL, DTL, TTL, ECL CMOS (NAND & NOR Gates).
6. IC 555 Timer -Its pin diagram,internal architecture, Application as astablemultivibrator and mono stable multivibrator.

**Unit-V (12 Hours)**

7. Sequential digital circuits:Flip-flops, RS, Clocked SR, JK, D, T, Master-Slave, Flip- flop, Conversion of Flip flops.
8. Code Converters: Design of code converter, BCD to 7 segment, binary/BCD to gray, gray to binary/BCD, design of counters using state machine.

**Reference Books**


1. Digital Electronics by G.K.Kharate Oxford University Press
2. Unified Electronics by Agarwal and Agarwal.
3. Op- Amp and Linear ICs by Ramakanth A Gayekwad, 4th edition PHI
4. Digital Principles and Applications by Malvino and Leach, TMH, 1996, 4th edition.
5. Digital Circuit design by Morris Mano,PHI
6. Switching Theory and Logic design by A.AnandKumar ,PHI
7. operations amplifier by SV Subramanyam.

**Elective Paper-VII Practical: Analog and Digital Electronics 2hrs/Week**

Minimum of 6 experiments to be done and recorded

1) Characteristics of FET
2) Characteristics of MOSFET
3) Characteristics of LDR
4) Characteristics of Op-amp.(IC741)
5) Op-Amp as amplifier/inverting amplifier
6) Op-Amp as integrator/differentiator
7) Op-Amp as summing amplifier/difference amplifier
8) IC 555 as astable multivibrator
9) IC 555 as monostable amplifier
10) Master slave flip-flop
11) JK flip-flop

**Semester –VI**
**Cluster Electives VIII-A**
**Paper – VIII-A-1: Introduction to Microprocessors and Microcontrollers**

**No. of Hours per week: 04** **Total Lectures:60**

**Unit – I (10Hours)**

1. Introduction to microcontrollers: General purpose of computer systems, architecture of embedded system, classification, applications and purposes, challenges and designs, operational and non operational quality attributes, elemental description of embedded processors and micro controllers

**Unit –II (10Hours)**

2. Microprocessors: Organisation of microprocessor based system, 8085 microprocessor, its pin diagram and architecture, concept of data bus, and address bus, 8085 programming, instruction classification, stacks and its implementation, hardware and software interrupts.

**Unit– III (15Hours)**

3. 8051 microcontroller :Introduction , block diagram, assembly language programming, programme counter, ROM memory, data types and directives, flag bits PSW register, jump, loop and call constructions
4. 8051 I/O Programming: Introduction to I/O port programming, pin out diagram, I/O port pin programming, bit manipulation, addressing modes, accessing memory, arithmetic and logic instructions.

**Unit – IV (13 Hours)**

5. Timers: Programming of 8051 timers, counter programming, interrupts, external hardware interrupts**,** serial communication interrupts, interrupt priority.
6. Embedded system programming: Structure of programming, infinite loop, compiling, linking locating, down loading and debugging.

**Unit –V (12Hours)**

7. Embedded system design and development: Embedded system development environment, file type generated after cross compilation, dissembler, decompiler, simulator, emulator and debugging.
8. Embedded product life cycle: Embedded product development life cycle, trends in embedded industry.

**Reference Books**


1)Embedded Systems.. Architecture, programming and design, R Kamal, 2008, TMH
2) The 8051 micro controller and embedded systems using Assembly and C, M.A.Mazidi, J.G.Mazidi and R.D.McKinlay, second Ed., 2007 pearson Education India
3) Introduction to embedded systems K.V. Shibu, 1st edition, 2009 McGraw Hill
4) Micro Controllers in practice, I Susnea and Mitescu,2005,springer

**Elective Paper-VIII-A-1 Practical: Introduction to Microprocessors and Microcontrollers 2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's.
5. Program to glow first four LED then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
9. To toggle '1234' as '1324' in the seven segment LED.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.

**Semester –VI**

**Cluster Elective Paper VIII-A-2: Computational Methods and Programming**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12hrs)**

1. Fundamentals of C language: C character set-Identifiers and Keywords-Constants -Variables-Data types-Declarations of variables-Declaration of storage class-Defining symbolic constants- Assignment statement.
2. Operators: Arithmetic operators-Relational operators-Logic operators-Assignment operators- Increment and decrement operators-Conditional operators.

**UNIT-II (12hrs)**

3. Expressions and I/O Statements: Arithmetic expressions-Precedence of arithmetic operators-Type converters in expressions-Mathematical (Library) functions - Data input and output-The getchar and putchar functions-Scanf-Printf simple programs.
4. Control statements: If -Else statements -Switch statements - The operators - GO TO - While, Do - While, FOR statements - BREAK and CONTINUE statements.

**UNIT-III (12hrs)**

5. Arrays: One dimensional and two dimensional arrays - Initialization - Type declaration - Inputting and outputting of data for arrays - Programs of matrices addition, subtraction and multiplication
6. User defined functions: The form of C functions - Return values and their types - Calling a function - Category of functions. Nesting of functions. Recursion. ANSI C functions- Function declaration. Scope and life time of variables in functions.

**UNIT-IV (12hrs)**

7. Linear and Non - Linear equations: Solution of Algebra and transcendental equations-Bisection, Falsi position and Newton-Rhapson methods-Basic principles-Formulae-algorithms
8. Simultaneous equations: Solutions of simultaneous linear equations-Guass elimination and Gauss Seidel iterative methods-Basic principles-Formulae – Algorithms.

**UNIT-V (12hrs)**

9. Interpolations: Concept of linear interpolation-Finite differences-Newton's and Lagrange's interpolation formulae-principles and Algorithms
10. Numerical differentiation and integration: Numerical differentiation-algorithm for evaluation of first order derivatives using formulae based on Taylor's series-Numerical integration-Trapezoidal and Simpson's 1/3 rule- Formulae-Algorithms.

**Reference books:**


1. Introductory methods of Numerical Analysis: Sastry
2. Numerical Methods: Balaguruswamy
3. Programming in ANSI C (TMH) : Balaguruswamy
4. Programming with 'C'- Byron Gottafried, Tata Mc Graw Hill

**Elective PaperVIII-A-2: Practical:**
**Computational Methods and Programming** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Write a program that reads an alphabet from keyboard and display in the reverse order.
2. Write a program to read and display multiplication of tables.
3. Write a program for converting centigrade to Fahrenheit temperature and Fahrenheit temperature centigrade.
4. Write a program to find the largest element in an array.
5. Write a program based on percentage calculation, the grade by entering the subject marks. (If percentage > 60 I class, if percentage between 50&60 II class, if percentage between 35&50 III class, if percentage below 35 fail).
6. Write a program for generation of even and odd numbers up to 100 using while, do-while and for loop.
7. Write a program to solve the quadratic equation using Bisection method.
8. Write a program for integration of function using Trapezoidal rule.
9. Write a program for solving the differential equation using Simpson's 1/3rd rule.

**Semester –VI**

**Cluster Elective Paper –VIII-A-3 :Electronic Instrumentation**

**No. of Hours per week: 04** **Total Lectures:60**

**Unit – I (12Hours)**

1. Basic of measurements: Instruments accuracy , precision , sensitivity , resolution range, errors in measurement, Multimeter , principles of measurement of dc voltage and dc currents, ac current and resistance, specifications of multimeter and their significance.

**Unit -11 (10 Hours)**

2. Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedence and sensitivity, principles of voltage measurement (block diagram only), specification of an electronic voltmeter/multimeter and their significance.

**Unit– III (14 Hours)**

3. CRO :Block diagram of basic CRO, construction of CRT, electron gun, electrostatic focusing and acceleration(only explanation) , time base operation, synchronization, front panel controls, specifications of CRO and their significance.

Applications CRO: Measurement of voltage ,dc and ac frequency , time period, special features of dual trace, digital storage oscilloscope, block diagram and principle of working.

**Unit – IV (12 Hours)**

4. Digital Multimeter: Block diagram, working, frequency and period measurement using universal counter, frequency counter ,accuracy and resolution.
5. Digital instruments: Principle and working of digital instruments, characteristics of a digital meter, working principle of digital voltmeter.

**Unit – V (12 Hours)**

6. Signal generators: Block diagram explanation, specifications of low frequency signal generators, pulse generator, function generator-working, Brief idea for testing, specifications. Distortion factor meter, wave analysis.
7. Bridges: Block diagram, working of basic LCR bridge – specifications – block diagram and working.

**Reference Books**


1. A text book in electrical technology by B.L.Thereja (S.Chand&Co)
2. Digital circuits and systems by Venugopal 2011 (Tata Mcgraw Hill)
3. Digital Electronics by Subratha Ghoshal 2012 (Cengage Learning)

**Elective Paper-VIII-A-3: Practical:**
**Electronic Instrumentation** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Study the loading effect of a multimeter by measuring voltage across alow and high resistance.
2. Study the limitations of a multimeter for measuring high frequency voltageand currents.
3. Measurement of voltage, frequency, time period and phase angle using CRO.
4. Measurement of time period and frequency using universal counter/frequency counter.
5. Measurement of rise, fall and delay times using a CRO.
6. Measurement of distortion of a RF signal generator using distortion factor meter.
7. Measurement of R, L and C using a LCR bridge/ universal bridge.

**Semester –VI**

**Elective Paper –VII-(B): Materials Science**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12 hrs)**

1.Materials and Crystal Bonding: Materials, Classification, Crystalline, Amorphous, Glasses; Metals, Alloys, Semiconductors, Polymers, Ceramics, Plastics, Bio-materials, Composites, Bulk and nanomaterials. Review of atomic structure – Interatomic forces – Different types of chemical bonds – Ioniccovalent bond or homopolar bond – Metallic bond – Dispersion bond – Dipole bond – Hydrogen bond – Binding energy of a crystal.

**UNIT-II (12 hrs)**

2. Defects and Diffusion in Materials: Introduction – Types of defects - Point defects- Line defects- Surface defects- Volume defects- Production and removal of defects- Deformation- irradiation- quenching- annealing- recovery - recrystallization and grain growth. Diffusion in solids- Fick's laws of diffusion.

**UNIT-III(12 hrs)**

3. Mechanical Behavior of Materials: Different mechanical properties of engineering materials – Creep – Fracture – Technological properties – Factors affecting mechanical properties of a material – Heat treatment - Cold and hot working – Types of mechanical tests – Metal forming process – Powder – Misaligning – Deformation of metals.

**UNIT-IV (12 hrs)**

4. Magnetic Materials: Dia-, Para-, Ferri- and Ferromagnetic materials, Classical Langevin theory of dia magnetism, Quantum mechanical treatment of paramagnetism. Curie's law, Weiss's theory of ferromagnetism, Ferromagnetic domains. Discussion of B-H Curve. Hysteresis and energy Loss.

**UNIT-V (12 hrs)**

5. Dielectric Materials: Dielectric constant, dielectric strength and dielectric loss, polarizability, mechanism of polarization, factors affecting polarization, polarization curve and hysteresis loop, types of dielectric materials, applications; ferroelectric, piezoelectric and pyroelectric materials, Clausius -Mosotti equation.

**Reference books**


1. Materials Science by M.Arumugam, Anuradha Publishers. 1990, Kumbakonam.
2. 2.Materials Science and Engineering V.Raghavan, Printice Hall India Ed. V 2004. New Delhi.
3. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
4. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

**Elective Paper-VII-B Practical:**
**Materials Science** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. Measurement of magnetic susceptibility of solids.
3. Determination of coupling coefficient of a piezoelectric crystal.
4. Measurement of the dielectric constant of a dielectric Materials
5. Study the complex dielectric constant and plasma frequency of metal using surface plasmon
6. resonance (SPR)
7. Study the hysteresis loop of a Ferroelectric Crystal.
8. Study the B-H curve of 'Fe' using solenoid and determine energy loss from hysteresis.

**Semester –VI :Cluster Electives – VIII-B**
**Cluster Elective Paper VIII-B-1 :Fundamentals of Nanoscience**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12hrs)**

**1. Background and history:** Emergence of Nanoscience with special reference to Feynman and Drexler; Role of particle size; Spatial and temporal scale; Concept of confinement, strong and weak confinement with suitable example; Development of quantum structures, Basic concept of quantum well, quantum wire and quantum dot.

Finite size Zero, One and Two Dimensional Nanostructures, Concept of Surface and Interfacial Energies. Physics of the solid state – size dependence of properties, crystal structures, Lattice vibrations, Energy bands:- Insulators Semiconductors and conductors.

**UNIT-II (12hrs)**

**2. Classification of Nanomaterials:** Inorganic nanomaterials: carbon nanotubes and cones, Organic nanomaterials: dendrimers, micelles, liposomes, block copolymers; Bionanomaterials: Biomimtric, bioceramic and nanotherapeutics; Nanomaterials for molecular electronics and optoelectronics.

**UNIT-III (12hrs)**

**3. Macromolecules:** Classification of polymers, chemistry of polymerization, chain polymerization, step polymerization, coordination polymerization. Molecular weight of polymers-number average and weight average molecular weight, degree of polymerization, determination of molecular weight of polymers by viscometry, Osmometry and light scattering methods.Kinetics of free radical polymerization, derivation of rate law.Preparation and application of polyethylene, PVC, Teflon.

**UNIT-IV (12hrs)**

**4. Molecular & Nanoelectronics:**Semiconductors, Transition from crystal technology to nanotechnology. Tiny motors, Gyroscopes and accelerometers. Nano particle embedded wrinkle resistant cloth, Transparent Zinc Oxide sun screens.Bio-systems, Nanoscale processes in environment. Nanoscale structures, Novel phenomena and Quantum control and quantum computing. Single electron transistors, Quantum dots, Quantum wires.

**UNIT-V (12hrs)**

**5. Biomaterials:** Implant materials: Stainless steels and its alloys, Ti and Ti based alloys, Ceramic implant materials; Hydroxyapatite glass ceramics, Carbon Implant materials, Polymeric Implant materials, Soft tissue replacement implants, Sutures, Surgical tapes and adhesives, heart valve implants, Artificial organs, Hard Tissue replacement Implants, Internal Fracture Fixation Devices, Wires, Pins, and Screws, Fracture Plates.

**Reference Books**

1. T. Pradeep: Textbook of Nanoscience and Nanotechnology Chapter (McGraw-Hill Professional, 2012), Access Engineering.
2. C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, "The Chemistry of Nanomaterials :Synthesis, Properties and Applications", Wiley-VCH, 2006.
3. C. Breachignac P. Houdy M. Lahmani, "Nanomaterials and Nanochemistry", Springer, 2006.
4. Guozhong Cao, "Nanostructures and Nanomaterials: Synthesis, Properties, and Applications", World Scientific Publishing Private, Ltd., 2011.
5. Zhong Lin Wang, "Characterization of Nanophase Materials", Wiley-VCH, 2004.
6. Carl C. Koch, "Nanostructured Materials: Processing, Properties and Potential Applications", William Andrew Publishing Norwich, 2006.

**Elective Paper- VIII-B-1: Practical:**
**Fundamentals of Nanoscience** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Determination of the Band Gap of Semiconductor Nanoparticles.
2. Surface Enhanced Raman Scattering Activity of Silver Nanoparticles
3. Conversion of Gold Nanorods into Gold Nanoparticles
4. Bimetallic Nanoparticles
5. Processing and Development of Nanoparticle gas sensor
6. Magnetic separation/identification studies of nanoparticles
7. Harvesting light using nano-solar cells
8. Nano-Forensic analysis to identify, individualize and evaluate evidence using nanophase materials
9. Comparison of the performance of nanoparticles based conductive adhesives and conventional non conductive adhesives.
10. Electrodeposition and corrosion behavior of nanostructured composite film
11. Photocatalytic activity of nanomaterials

**Semester –VI**

**Cluster Elective Paper –VIII-B-2: Synthesis and Characterization of Nanomaterials**

**No. of Hours per week: 04** **Total Lectures:60**

**Unit-I (12 hrs)**

**1. Nanomaterials synthesis**: Synthesis and nanofabrication, Bottom-Up and Top-Down approach with examples. Chemical precipitation methods, sol-gel method, chemical reduction, hydrothermal, process. Physical Mehtods- ball milling, Physical Vapour deposition (PVD), Sputtering, ChemicalVapor deposition (CVD), pray pyrolysis, Biological methods-Synthesis using micro organisms and bacteria, Synthesis using plant extract, use of proteins and DNA templates.

**Unit-II (12 hrs)**

**2. Classification of materials:** Types of materials, Metals, Ceramics (Sand glasses) polymers, composites, semiconductors.Metals and alloys- Phase diagrams of single component, binary and ternary systems, diffusion, nucleation and growth. Diffusional and diffusionless transformations.Mechanical properties.Metallic glasses. Preparation, structure and properties like electrical, magnetic, thermal and mechanical, applications.

**UNITS-III (12 hrs)**

**3. Glasses**: The glass transition - theories for the glass transition, Factors that determine the glass-transition temperature. Glass forming systems and ease of glass formation, preparation of glass materials.Applications of Glasses: Introduction: Electronic applications, Electrochemical applications, optical applications, Magnetic applications.

**UNITS-IV (12 hrs)**

**4. Liquid Crystals**: Mesomorphism of anisotropic systems, Different liquid crystalline phase and phase transitions, Thermal and electrical properties of liquid crystals, Types Liquid Crystals displays, few applications of liquid crystals.

**UNITS-V (12 hrs)**

**5. Characterization Methods:** XRD, SEM, TEM, AFM, XPS and PL characterization techniques for nano materials.Electrical and mechanical properties, Optical properties by IR and Raman Spectroscopy.

**References books**

1. Encyclopedia of Nanotechnology by M.Balakrishna Rao and K.Krishna Reddy, Vol.I to X, Campus books.
2. Nano: The Essentials-Understanding Nanoscinece & Nanotechnology by T.Pradeep; Tata Mc. Graw Hill
3. Nanotechnology in Microelectronics & Optoelectronics, J.M Martine Duart, R.J Martin Palma, F. Agullo Rueda, Elsevier
4. Nanoelectronic Circuit Design, N.K Jha, D Chen, Springer
5. Handbook of Nanophysics- Nanoelectronics & Nanophotonics, K.D Sattler, CRC Press
6. Organic Electronics-Sensors & Biotechnology- R. Shinar & J. Shinar, McGraw-Hill

**Cluster Elective Paper- VIII-B-2: Practical:**
**Synthesis and Characterization of Nanomaterials 2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Synthesis of nanocrystalline films of II-VI compounds doped with rare earths by chemical process.
2. Synthesis of Alkaline earth aluminates in nanocrystalline form by combustion synthesis.
3. Preparation of surface conducting glass plate by spray pyrolysis method
4. Preparation of surface conducting glass plate by chemical route
5. Fabrication of micro fluidic nanofilter by polymerisation reaction
6. Absorption studies on the nanocrystalline films and determination of absorption coefficient.
7. Determination of band gap from the absorption spectra using Tauc's plots.
8. Study of Hall effect in semiconductors and its application in nanotechnology.
9. Measurement of electrical conductivity of semiconductor film by Four Probe method and study of temperature variation of electrical conductivity.

**Semester –VI**

**Cluster Elective Paper –VIII-B-3: Applications of Nanomaterials and Devices**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12 hrs)**

**1. Optical properties:** Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures and charging of nanostructure.Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures.

**UNIT-II (12 hrs)**

**2. Electrical transport:**

Carrier transport in nanostrcutures.Hall effect, etermination of carrier mobility and carrier concentration; Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level and surface defects.

**UNIT-III (12 hrs)**

**3. Applications:**Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron transfer devices (no derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructures lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage.Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

**UNIT-IV(12 hrs)**

**4. Nanoelectronics:**Introduction, Electronic structure of Nanocrystals,Tuning the Band gap of Nanoscale semiconductors, Excitons, Quantumdot, Single electron devices, Nanostructured ferromagnetism,Effect of bulk nanostructuring of magnetic properties, Dynamics of nanomagnets, Nanocarbon ferromagnets, Giant and colossal magneto-resistance, Introduction of spintronics, Spintronics devices and applications.

**UNIT-V (12 hrs)**

**5. Nanobiotechnology and Medical application:**Introduction, Biological building blocks- size of building blocks and nanostructures, Peptide nanowires and protein nanoparticles, DNA double nanowires, Nanomaterials in drug delivery and therapy, Nanomedicine, Targeted gold nanoparticles for imaging and therapy.

**Reference books:**

1. 1.C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. 2.S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company).
3. K.K. Chattopadhyay and A.N. Banerjee, Introduction to Nanoscience & Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

**Cluster Elective Paper-VIII-B-3: Practical:**
**Applications of Nanomaterials and Devices 2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
7. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.
8. Fabricate a pn-diode by diffusing Al over the surface of n-type Si and study its I-V characteristics.

**Semester –VI**
**Elective Paper –VII-C: Renewable Energy**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12 hrs)**

**1. Introduction to Energy:** Definition and units of energy, power, Forms of energy, Conservation of energy, second law of thermodynamics, Energy flow diagram to the earth. Origin and time scale of fossil fuels, Conventional energy sources, Role of energy in economic development and social transformation.

**2. Environmental Effects:** Environmental degradation due to energy production and utilization, air and water pollution, depletion of ozone layer, global warming, biological damage due to environmental degradation. Effect of pollution due to thermal power station, nuclear power generation, hydroelectric power stations on ecology and environment.

**UNIT-II (12 hrs)**

**3. Global Energy Scenario:** Energy consumption in various sectors, projected energy consumption for the next century, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear and hydroelectric power, impact of exponential rise in energy usage on global economy.

**4. Indian Energy Scene:** Energy resources available in India, urban and rural energy consumption, energy consumption pattern and its variation as a function of time, nuclear energy - promise and future, energy as a factor limiting growth, need for use of new and renewable energy sources.

**UNIT-III (12 hrs)**

**5.Solar energy:** Solar energy, Spectral distribution of radiation, Flat plate collector, solar water heating system, Applications, Solar cooker. Solar cell, Types of solar cells, Solar module and array, Components of PV system, Applications of solar PV systems.

**6. Wind Energy:** Introduction, Principle of wind energy conversion, Components of wind turbines, Operation and characteristics of a wind turbine, Advantages and disadvantages of wind mills, Applications of wind energy.

**UNIT-IV (12 hrs)**

**7. Ocean Energy:** Introduction, Principle of ocean thermal energy conversion, Tidal power generation, Tidal energy technologies, Energy from waves, Wave energy conversion, Wave energy technologies, advantages and disadvantages.

**8. Hydrogen Energy:** History of hydrogen energy - Hydrogen production methods - Electrolysis of water, Hydrogen storage options – Compressed and liquefied gas tanks, Metal hydrides; Hydrogen safety - Problems of hydrogen transport and distribution - Uses of hydrogen as fuel.

**UNIT-V (12 hrs)**

**9. Bio-Energy**

Energy from biomass – Sources of biomass – Different species – Conversion of biomass into fuels – Energy through fermentation – Pyrolysis, gasification and combustion – Aerobic and anaerobic bio-conversion – Properties of biomass – Biogas plants – Types of plants – Design and operation – Properties and characteristics of biogas.

**References:**

1. Solar Energy Principles, Thermal Collection &Storage, S.P.Sukhatme: Tata McGraw Hill Pub., New Delhi.
2. Non-Conventional Energy Sources, G.D.Rai, New Delhi.
3. Renewable Energy, power for a sustainable future, Godfrey Boyle, 2004,
4. The Generation of electricity by wind, E.W. Golding.
5. Hydrogen and Fuel Cells: A comprehensive guide, Rebecca Busby, Pennwell corporation (2005)
6. Hydrogen and Fuel Cells: Emerging Technologies and Applications, B.Sorensen, Academic Press (2012).
7. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub., 2009.
8. Fundamentals of Renewable Energy Resources byG.N.Tiwari, M.K.Ghosal, Narosa Pub., 2007.

**Elective Paper-VII-C: Practical: Renewable Energy 2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Preparation of copper oxide selective surface by chemical conversion method.
2. Performance testing of solar cooker.
3. Determination of solar constant using pyrheliometer.
4. Measurement of I-V characteristics of solar cell.
5. Study the effect of input light intensity on the performance of solar cell.
6. Study the characteristics of wind.

**Semester –VI**
**Cluster Electives –VIII-C**
**Elective Paper –VIII-C-1: Solar Thermal and Photovoltaic Aspects**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12 hrs)**

**1. Basics of Solar Radiation:** Structure of Sun, Spectral distribution of extra terrestrial radiation, Solar constant, Concept of Zenith angle and air mass, Definition of declination, hour angle, solar and surface azimuth angles; Direct, diffuse and total solar radiation, Solar intensity measurement – Thermoelectric pyranometer and pyrheliometer.

**2. Radiative Properties and Characteristics of Materials:** Reflection, absorption and transmission of solar radiation through single and multi covers; Kirchoff's law – Relation between absorptance, emittance and reflectance; Selective Surfaces - preparation and characterization, Types and applications; Anti-reflective coating.

**UNIT-II (14 hrs)**

**3. Flat Plate Collectors (FPC) :** Description of flat plate collector, Liquid heating type FPC, Energy balance equation, Efficiency, Temperature distribution in FPC, Definitions of fin efficiency and collector efficiency, Evacuated tubular collectors.

**4. Concentrating Collectors:** Classification, design and performance parameters; Definitions of aperture, rim-angle, concentration ratio and acceptance angle; Tracking systems; Parabolic trough concentrators; Concentrators with point focus.

**Unit-III (14 hrs)**

**5. Solar photovoltaic (PV) cell:** Physics of solar cell –Type of interfaces, homo, hetero and schottky interfaces, Photovoltaic Effect, Equivalent circuit of solar cell, Solar cell output parameters, Series and shunt resistances and its effect on cell efficiency; Variation of efficiency with band-gap and temperature.

**6. Solar cell fabrication:** Production of single crystal Silicon: Czokralski (CZ) and Float Zone (FZ) methods, Silicon wafer fabrication, Wafer to cell formation, Thin film solar cells, Advantages, CdTe/CdS cell formation, Multi-junction solar cell; Basic concept of Dye-sensitized solar cell, Quantum dot solar cell.

**UNIT-IV (8 hrs)**

**Solar PV systems:** Solar cell module assembly – Steps involved in the fabrication of solar module, Module performance, I-V characteristics, Modules in series and parallel, Module protection – use of Bypass and Blocking diodes, Solar PV system and its components, PV array, inverter, battery and load.

**UNIT-V (12 hrs)**

**Solar thermal applications:** Solar hot water system (SHWS), Types of SHWS, Standard method of testing the efficiency of SHWS; Passive space heating and cooling concepts, Solar desalinator and drier, Solar thermal power generation.

**Solar PV applications**: SPV systems; Stand alone, hybrid and grid connected systems, System installation, operation and maintenances; Field experience; PV market analysis and economics of SPV systems.

**Reference Books:**

1. Solar Energy Utilization, G. D. Rai, Khanna Publishers
2. Solar Energy- Fundamentals, design, modeling and applications, G.N. Tiwari, Narosa Pub., 2005.
3. Solar Energy-Principles of thermal energy collection & storage, S.P. Sukhatme, Tata Mc-Graw Hill Publishers, 1999.
4. Solar Photovoltaics- Fundamentals, technologies and applications, Chetan Singh Solanki, PHI Learning Pvt. Ltd.,
5. Science and Technology of Photovoltaics, P. Jayarama Reddy, BS Publications, 2004.

**Cluster Elective Paper- VIII-C-1: Practical:**
**Solar Thermal and Photovoltaic Aspects** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Measurement of direct solar radiation using pyrheliometer.
2. Measurement of global and diffuse solar radiation using pyranometer.
3. Measurement of emissivity, reflectivity and transsivity.
4. Measurement of efficiency of solar flat plate collector.
5. Performance testing of solar air dryer unit.
6. Effect of tilt angle on the efficiency of solar photovoltaic panel.
7. Study on solar photovoltaic panel in series and parallel combination.

**Semester - VI**

**Cluster Elective Paper –VIII-C-2 :Wind, Hydro and Ocean Energies**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I**

**1. Introduction:** Wind generation, meteorology of wind, world distribution of wind, wind speed variation with height, wind speed statistics, Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics.

2. Wind Measurements:Eolian features, biological indicators, rotational anemometers, other anemometers, wind measurements withballoons.

**UNIT-II**

3. Wind Energy Conversion System:Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element andcombine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip losscorrection.

4. Design of Wind Turbine: Wind turbine design considerations; Methodology; Theoretical simulation of wind turbinecharacteristics; Test methods.

**UNIT-III**

5. Wind Energy Application: Wind pumps: Performance analysis, design concept and testing; Principle of wind energy generation; Standalone, grid connected and hybrid applications of wind energy conversion systems, Economics of wind energy utilization; Wind energy in India; Environmental Impacts of Wind farms.

**UNIT-IV**

6. Small Hydropower Systems: Overview of micro, mini and small hydro systems; Hydrology; Elements of pumps and turbine; Selection and design criteria of pumps and turbines; Site selection; Speed and voltage regulation; Investment issues load management and tariff collection; potential of small hydro power in India. Wind and hydro based stand-alone hybrid power systems.

**UNIT-V**

7.Ocean Thermal, Tidal and Wave Energy Systems: Ocean Thermal - Introduction, Technology process, Working principle, Resource and site requirements, Location of OCET system, Electricity generation methods from OCET, Advantages and disadvantages, Applications of OTEC,

8. Tidal Energy - Introduction, Origin and nature of tidal energy, Merits and limitations, Tidal energy technology, Tidal range power, Basic modes of operation of tidal systems. Wave Energy – Introduction, Basics of wave motion, Power in waves, Wave energy conversion devices, Advantages and disadvantages, Applications of wave energy.

**Reference Books:**

1. Dan Charis, Mick Sagrillo, LanWoofenden, "Power from the Wind", New Society Pub., 2009.
2. Erich Hau, "Wind Turbines-Fundaments, Technologies, Applications, Economics", 2ndEdition, Springer Verlag, BerlinHeidelberg, NY, 2006.
3. Joshue Earnest, Tore Wizelius, Wind Power and Project Developmen", PHI Pub., 2011.
4. T. Burton, D. Sharpe, N. Jenkins, E. Bossanyi, Wind Energy Handbook, John Wiley Pub., 2001.
5. Paul Gipe, "Wind Energy Basics", Chelsea Green Publications, 1999.
6. Khan, B.H., "Non-Conventional Energy Resources", TMH, 2nd Edition, New Delhi, 2009.
7. Tiwari, G.N., and Ghosal, M.K, Renewable Energy Resources – Basic Principles and applications, Narosa Publishing House,2007.

**Cluster Elective Paper- VIII-C-2 Practical:**
**Wind, Hydro and Ocean Energies** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Estimation of wind speed using anemometer.
2. Determination of characteristics of a wind generator
3. Study the effect of number and size of blades of a wind turbine on electric power output.
4. Performance evaluation of vertical and horizontal axes wind turbine rotors.
5. Study the effect of density of water on the output power of hydroelectric generator.
6. Study the effect of wave amplitude and frequency on the wave energy generated.

**Semester - VI**

**Cluster Elective Paper –VIII-C-3 :Energy Storage Devices**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12 hr)**

**1. Energy Storage:**Need of energy storage; Different modes of energy storage, Flywheel storage, Electrical and magnetic energy storage: Capacitors,electromagnets; Chemical Energy storage: Thermo-chemical, photo-chemical, bio-chemical,electro-chemical, fossil fuels and synthetic fuels. Hydrogen for energy storage.

**UNIT-II (12 hrs)**

**2. Electrochemical Energy Storage Systems:**Batteries: Primary, Secondary, Lithium, Solid-state and molten solvent batteries; Leadacid batteries; Nickel Cadmium Batteries; Advanced Batteries. Role of carbon nano-tubes inelectrodes.

**UNIT-III (12 hrs)**

**3. Magnetic and Electric Energy Storage Systems:**Superconducting Magnet Energy Storage(SMES) systems; Capacitor and battery:Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor(EDLC), principle of working, structure, performance and application.

**UNIT-IV (12 hrs)**

**4. Fuel Cell:** Fuel cell definition, difference between batteries and fuel cells, fuel cell components, principle and working of fuel cell, performance characteristics,efficiency, fuel cell stack, fuel cell power plant: fuel processor, fuel cell powersection, power conditioner, Advantages and disadvantages.

**UNIT-V (12 hrs)**

**5. Types of Fuel Cells:** Alkaline fuel cell, polymer electrolyte fuel cell, phosphoric acid fuel cell,molten carbonate fuel cell; solid oxide fuel cell,proton exchange membrane fuel cell, problems with fuel cells, applications of fuel cells.

**REFERENCE BOOKS**


1. J. Jensen and B. Squrensen, Fundamentals of Energy Storage, John Wiley, NY, 1984.
2. M. Barak, Electrochemical Power Sources: Primary and Secondary Batteries by, P. Peregrinus,IEE,1980.
3. P.D.Dunn, Renewable Energies, Peter Peregrinus Ltd, London, 1986.
4. B.Viswanathan and M. A. Scibioh, Fuel Cells-Principles and Applications, University Press, 2006.
5. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, NewYork, 1989.

**Cluster Elective Paper –VIII-C-3: Practical:**
**Energy Storage Devices** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Study of charge and discharge characteristics of storage battery.
2. Study of charging and discharging behavior of a capacitor.
3. Determination of efficiency of DC-AC inverter and DC-DC converters
4. Study of charging characteristics of a Ni-Cd battery using solar photovoltaic panel.
5. Performance estimation of a fuel cell.
6. Study of effect of temperature on the performance of fuel cell.

# PHYSICS

(For Non-Mathematics Combinations)

**Paper V : Electricity, Magnetism& Electronics**
**(For Non-Maths Combinations)**
**V Semester**

**Work load: 60 hrs per semester** **4 hrs/week**

**UNIT-1(15 hrs)**

**1. Electric field and potential**

Coulomb's law – electric field and intensity of electric field –intensity of electric field due to i) a point charge–electric dipole and dipole moment. Electric lines of force, Electric flux. Gauss's law statement and its proof-applications of Gauss Law to (1) Uniformly charged sphere (2) an infinite conducting sheet of charge (No Derivation- qualitative ideas only). Electrical potential – equi-potential surfaces- potential due to i) a point charge, ii)charged spherical shell. Equi-potential surfaces with examples.

**UNIT-II(10 hrs)**

**2. Capacitance and dielectrics**

Derivation of expression for capacity due to i) a parallel plate capacitor with and without dielectric, ii) a spherical capacitor. Energy stored in a capacitor, electric capacitance. Electric dipole moment Di-electrics with examples, effect of electric field-electric displacement D, electric polarization P, permeability &susceptibility (Definitions only) – relation between D,E and P. Dipolemoment of heart.

**UNIT-III (10 hrs)**

**3. Current electricity**

Current and current density, drift velocity expression, Kirchhoff's laws – statement and explanation and application to Wheatstone bridge, sensitivity of Wheatstone bridge, Carey-Foster's bridge- experimental measurement of temperature coefficient of resistance- strain gauge-piezoelectric transducers (applications only)

**UNIT-IV (15 hrs)**

**5. Electromagnetism**

Magnetic induction B, magnetic flux – Biot–Savart's law, magnetic induction due to (i) a long straight conductor carrying current (ii) on the axis of a circular coil carrying current (iii) solenoid, (No derivation-qualitative treatment only) Ampere's law – derivation of expression for the force on (i) charged particles and (ii) current carrying conductor in the magnetic field, Hall effect and its importance-electromagnetic pumping.

Faraday's law of electromagnetic induction, Lenz's law - Construction, theory and working of a Moving Coil Ballistic Galvanometer, application of B.G. damping correction, Self induction, Mutual induction and their units- Electromagnetic measurement of blood flow.

**UNIT-V(12 hrs)**

**6. Basic Electronics**

PN junction diode, Zener diode and its V-I characteristics, half and full wave rectifiers(semiconductor type) (working qualitative ideas only).Bridge type full wave rectifier. Action of filters- Land π type. PNP and NPN transistors and characteristics, Configurations Transistor configurations – CE transistor characteristics – h-parameters – Transistor as an amplifier.

Number system, conversion of binary to decimal and vice versa, De Morgans's theorems statements - logic gates – verification of truth tables, NAND and NOR gates as universal gates, Half and Full adders.

**REFERENCE BOOKS**

1. B.Sc., Physics, Vol.3, Telugu Academy, Hyderabad
2. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath – S. Chand & Co.
3. Electricity and Magnetism, Brijlal and Subramanyam. RatanPrakashanMandir.
4. Physics for Biology & Premedical Students –DN Burns & SG MacDonald, Addison Wiley.
5. Principles of Electronics, V.K. Mehta, S.Chand & Co.,
6. Digital Principles and Applications, A.P. Malvino and D.P.Leach, Mc GrawHill Edition.

**Practical Paper V: Electricity, Magnetism& Electronics**

**Work load: 30 hrs** **2 hrs/week**

**Minimum of 6 experiments to be done and recorded**

1. Figure of merit of a moving coil galvonometer.
2. LCR circuit series/parallel resonance, Q factor.
3. Determination of ac-frequency –sonometer.
4. Verification of Kirchoff's laws and maximum power transfer theorem.
5. Field along the axis of a circular coil carrying current.
6. PN Junction Diode Characteristics
7. Zener Diode Characteristics
8. Transistor CE Characteristics- Determination of hybrid parameters
9. Logic Gates- OR, AND,NOT and NAND gates. Verification of Truth Tables.
10. Verification of De Morgan's Theorems.

**Suggested student activities**
Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

**Examples**
Seminars - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion - A topic from one of the units is given to a group of students and asked to discuss and debate on it.
Assignment - Few problems may be given to the students from the different units and asked them to solve.
Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
Study project - Web based study of different satellites and applications.

**Domain skills:**
Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

***** Documental evidence is to be maintained for the above activities.**

**Paper VI: Modern Physics& Medical Physics**
**(For Non-Maths Combinations)**
**V Semester**

**Work load: 60 hrs per semester** **4 hrs/week**

**UNIT-1(10 hrs)**

***1. Spectroscopy***

Introduction - Zeeman effect - Experimental verification – Paschen Back effect – Stark effect – Explanations (elementary ideas only) - Raman effect, hypothesis, classical and quantum theory of Raman effect. Experimental arrangement for Raman effect and its application.

**UNIT-II (12 hrs)**

***1.Fundamentals of quantum mechanics***

Photoelectric effect – Explanation through demonstration, Einstein's Photoelectric equation – its verification by Millikan's experiment –theory of Compton effect ( no derivation) and its experimental verification – Bohr's theory of Hydrogen atom – Derivation of expression for energy levels and spectral series of Hydrogen atom, atomic excitation, Frank Hertz experiment.

**UNIT-III (10 hrs)**

**3. Matter Waves and uncertainty principle**

Dual nature of radiation- de Broglie's theory of matter waves, expression for wavelength, properties of matter waves, Davisson and Germer experiment on electron diffraction – Discussion of results, Wave velocity and group velocity.

Heisenberg's uncertainty principle for position and momentum (x and p), energy and time (E and t).Experimental illustrations of uncertainty principal, Complementary principle of Bohr.

**UNIT-IV: (12 hrs)**

**4. Radioactivity and radiation protection**

The nature of radioactive emissions, the law of Radioactive decay, derivation, decay constant, Half life and mean life periods - derivations, units of radio activity, Carbon and Uranium dating (explanation) - Age of earth and rocks, Radioactive isotopes as tracers, radio cardiography. Principles of radiation protection– protective materials-radiation effects – somatic, genetic stochastic & deterministic effect, Natural radioactivity, Biological effects of radiation, Radiation monitors**.**

**UNIT-V (16 hrs)**

**6. Crystal Structure**

Amorphous and crystalline materials, unit cell, Miller indices, reciprocal lattice, types of lattices, diffraction of X-rays by crystals, Bragg's law, experimental techniques, Laue's method and powder diffraction method.

**7. Superconductivity:**

Introduction - experimental facts, critical temperature - critical field - Meissner effect – Isotope effect - Type I and type II superconductors - BCS theory (elementary ideas only) - applications of superconductors.

**REFERENCE BOOKS**

1. B.Sc Physics, Vol.4, Telugu Academy, Hyderabad.
2. Molecular Structure and Spectroscopy by G. Aruldhas. Prentice Hall of India, New Delhi.
3. Physics for Biology & Premedical Students –D.N. Burns & SG Mac Donald, Addison Wiley.
4. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
5. Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978)
6. Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
7. Physics of Radiation Therapy : F M Khan - Williams and Wilkins, Third edition (2003)
8. Physics of the human body, Irving P. Herman, Springer (2007).
9. The Physics of Radiology-H E Johns and Cunningham.

**Practical Paper VI: Modern Physics& Medical Physics**

**Work load: 30 hrs** **2 hrs/week**

**Minimum of 6 experiments to be done and recorded**

1. e/m of an electron by Thomson method.
2. Determination of Planck's Constant (photocell).
3. Verification of inverse square law of light using photovoltaic cell.
4. Study of absorption of α-rays.
5. Study of absorption of β-rays.
6. Determination of Range of β-particles.
7. Determination of M & H.
8. Analysis of powder X-ray diffraction pattern to determine properties of crystals.
9. Energy gap of a semiconductor using junction diode.
10. Energy gap of a semiconductor using thermister.

**Suggested student activities**
Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

**Examples**
Seminars - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion - A topic from one of the units is given to a group of students and asked to discuss and debate on it.
Assignment - Few problems may be given to the students from the different units and asked them to solve.
Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
Study project - Web based study of different satellites and applications.

**Domain skills:**
Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

***** Documental evidence is to be maintained for the above activities.**

Note: For all the above 8 practical papers the book "B.Sc Practical Physics" by C.L.Arora, Published by S.Chand& Co, New – Delhi may be followed.

**NOTE: Problems should be solved at the end of every chapter of all units.**

**Elective VII (A): (Electronics)**
**Semester –VI**
**Elective Paper –VII-(A) :Analog and Digital Electronics**

**No. of Hours per week: 04** **Total Lectures:60**

**Unit-I (14 Hours)**

1. FET-Construction, Working, characteristics and uses; MOSFET-enhancement MOSFET, depletion MOSFET, construction and working , drain characteristics of MOSFET, applications of MOSFET
2. Photo electric devices: Structure and operation, characteristics, spectral response and application of LDR, LEDand LCD

**Unit-II (10 Hours)**

3. Operational Amplifiers: Characteristics of ideal and practical Op-Amp (IC 741), Basic differential amplifiers, Op-Amp supply voltage, IC identification, Internal blocks of Op-Amp, its parameter off set voltages and currents, CMRR, slew rate, concept of virtualground.

**Unit-III (10 Hours)**

4. Applications of Op-Amp: Op-Amp as voltage amplifier, Inverting amplifier, Non-inverting amplifier, voltage follower, summing amplifier, difference amplifier, comparator, integrator, differentiator.

**Unit-IV(14 Hours)**

5. Data processing circuits: Multiplexers, De-multiplexers, encoders, decoders, Characteristics for Digital ICs -RTL, DTL, TTL, ECL CMOS (NAND & NOR Gates).
6. IC 555 Timer -Its pin diagram,internal architecture, Application as astablemultivibrator and mono stable multivibrator.

**Unit-V (12 Hours)**

7. Sequential digital circuits:Flip-flops, RS, Clocked SR, JK, D, T, Master-Slave, Flip- flop, Conversion of Flip flops.
8. Code Converters: Design of code converter, BCD to 7 segment, binary/BCD to gray, gray to binary/BCD,design of counters using state machine.

**Reference Books**


1. Digital Electronics by G.K.Kharate Oxford University Press
2. Unified Electronics by Agarwal and Agarwal.
3. Op- Amp and Linear ICs by Ramakanth A Gayekwad, 4th edition PHI
4. Digital Principles and Applications by Malvino and Leach, TMH, 1996, 4th edition.
5. Digital Circuit design by Morris Mano,PHI
6. Switching Theory and Logic design by A.AnandKumar ,PHI
7. operations amplifier by SV Subramanyam.

**Elective Paper-VII-A : Practical:**
**Analog and Digital Electronics** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1) Characteristics of FET
2) Characteristics of MOSFET
3) Characteristics of LDR
4) Characteristics of Op-amp.(IC741)
5) 5)Op-Amp as amplifier/inverting amplifier
6) Op-Amp as integrator/differentiator
7) Op-Amp as summing amplifier/difference amplifier
8) IC 555 as astable multivibrator
9) IC 555 as monostable amplifier
10) Master slave flip-flop
11) JK flip-flop

**Semester –VI**
**Cluster Elective Paper –VIII-A-1:**
**Introduction to Microprocessors and Microcontrollers**

**No. of Hours per week: 04** **Total Lectures:60**

**Unit – I (10Hours)**

1. Introduction to microcontrollers: General purpose of computer systems,architecture of embedded system, classification, applications and purposes, challenges and designs, operational and non operational quality attributes, elemental description of embedded processors and micro controllers

**Unit –II (10Hours)**

2. Microprocessors: Organisation of microprocessor based system, 8085 microprocessor, its pin diagram and architecture, concept of data bus, and address bus, 8085 programming, instruction classification, stacks and its implementation, hardware and software interrupts.

**Unit– III (15Hours)**

3. 8051 microcontroller: Introduction , block diagram, assembly language programming, programme counter, ROM memory, data types and directives, flag bits PSW register, jump, loop and call constructions
4. 8051 I/O Programming: Introduction to I/O port programming, pin out diagram, I/O port pin programming, bit manipulation, addressing modes, accessing memory, arithmetic and logic instructions.

**Unit – IV (13 Hours)**

5. Timers: Programming of 8051 timers, counter programming, interrupts, external hardware interrupts**,** serial communication interrupts, interrupt priority.
6. Embedded system programming: Structure of programming, infinite loop, compiling, linking locating, down loading and debugging.

**Unit –V (12Hours)**

7. Embedded system design and development: Embedded system development environment, file type generated after cross compilation, dissembler, decompiler, simulator, emulator and debugging.
8. Embedded product life cycle: Embedded product development life cycle, trends in embedded industry.

**Reference Books**


1) Embedded Systems.. Architecture, programming and design, R Kamal, 2008, TMH
2) The 8051 micro controller and embedded systems using Assembly and C, M.A.Mazidi, J.G.Mazidi and R.D.McKinlay, second Ed., 2007 pearson Education India
3) Introduction to embedded systems K.V. Shibu, 1st edition, 2009 McGraw Hill
4) Micro Controllers in practice, I Susnea and Mitescu,2005,springer

**Cluster Elective Paper-VIII-A-1: Practical:**
**Introduction to Microprocessors and Microcontrollers 2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's.
5. Program to glow first four LED then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
9. To toggle '1234' as '1324' in the seven segment LED.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.

**Semester –VI**

**Cluster Elective Paper –VIII-A-2 : Computational Methods and Programming**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12hrs)**

1. Fundamentals of C language: C character set-Identifiers and Keywords-Constants -Variables-Data types-Declarations of variables-Declaration of storage class-Defining symbolic constants- Assignment statement.
2. Operators: Arithmetic operators-Relational operators-Logic operators-Assignment operators- Increment and decrement operators-Conditional operators.

**UNIT-II (12hrs)**

3. Expressions and I/O Statements: Arithmetic expressions-Precedence of arithmetic operators-Type converters in expressions-Mathematical (Library) functions - Data input and output-The getchar and putchar functions-Scanf - Printf simple programs.
4. Control statements: If -Else statements -Switch statements - The operators - GO TO - While, Do - While, FOR statements - BREAK and CONTINUE statements.

**UNIT-III (12hrs)**

5. Arrays: One dimensional and two dimensional arrays - Initialization - Type declaration - Inputting and outputting of data for arrays - Programs of matrices addition, subtraction and multiplication
6. User defined functions: The form of C functions - Return values and their types-Calling a function - Category of functions. Nesting of functions. Recursion. ANSI C functions- Function declaration. Scope and life time of variables in functions.

**UNIT-IV (12hrs)**

7. Linear and Non - Linear equations: Solution of Algebra and transcendental equations-Bisection, Falsi position and Newton-Rhapson methods-Basic principles-Formulae-algorithms
8. Simultaneous equations: Solutions of simultaneous linear equations-Guass elimination and Gauss Seidel iterative methods-Basic principles-Formulae – Algorithms.

**UNIT-V (12hrs)**

9. Interpolations: Concept of linear interpolation-Finite differences-Newton's and Lagrange's interpolation formulae-principles and Algorithms
10. Numerical differentiation and integration: Numerical differentiation-algorithm for evaluation of first order derivatives using formulae based on Taylor's series-Numerical integration-Trapezoidal and Simpson's 1/3 rule-Formulae-Algorithms.

**Reference books:**

1. Introductory methods of Numerical Analysis: Sastry
2. Numerical Methods: Balaguruswamy
3. Programming in ANSI C (TMH) : Balaguruswamy
4. Programming with 'C'- Byron Gottafried, Tata Mc Graw Hill

**Cluster Elective Paper-VIII-A-2: Practical:**
**Computational Methods and Programming 2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Write a program that reads an alphabet from keyboard and display in the reverse order.
2. Write a program to read and display multiplication of tables.
3. Write a program for converting centigrade to Fahrenheit temperature and Fahrenheit temperature centigrade.
4. Write a program to find the largest element in an array.
5. Write a program based on percentage calculation, the grade by entering the subject marks. (If percentage > 60 I class, if percentage between 50&60 II class, if percentage between 35&50 III class, if percentage below 35 fail).
6. Write a program for generation of even and odd numbers up to 100 using while, do-while and for loop.
7. Write a program to solve the quadratic equation using Bisection method.
8. Write a program for integration of function using Trapezoidal rule.
9. Write a program for solving the differential equation using Simpson's $1/3^{rd}$ rule.

**Semester –VI**

**Cluster Elective Paper –VIII-A-3 :Electronic Instrumentation**

**No. of Hours per week: 04** **Total Lectures:60**

**Unit – I (12Hours)**

1. Basic of measurements: Instruments accuracy , precision , sensitivity , resolution range, errors in measurement, Multimeter , principles of measurement of dc voltage and dc currents, ac current and resistance, specifications of multimeter and their significance.

**Unit -11 (10 Hours)**

2. Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedence and sensitivity, principles of voltage measurement (block diagram only), specification of an electronic voltmeter/multimeter and their significance.

**Unit– III (14 Hours)**

3. CRO :Block diagram of basic CRO, construction of CRT, electron gun, electrostatic focusing and acceleration(only explanation) , time base operation, synchronization, front panel controls, specifications of CRO and their significance.

Applications CRO: Measurement of voltage ,dc and ac frequency , time period, special features of dual trace, digital storage oscilloscope, block diagram and principle of working.

**Unit – IV (12 Hours)**

4. Digital Multimeter: Block diagram, working, frequency and period measurement using universal counter, frequency counter ,accuracy and resolution.
5. Digital instruments: Principle and working of digital instruments, characteristics of a digital meter, working principle of digital voltmeter.

**Unit – V (12 Hours)**

6. Signal generators: Block diagram explanation, specifications of low frequency signal generators, pulse generator, function generator-working, Brief idea for testing, specifications. Distortion factor meter, wave analysis.
7. Bridges: Block diagram, working of basic LCR bridge – specifications – block diagram and working.

**Reference Books**


1. A text book in electrical technology by B.L.Thereja (S.Chand&Co)
2. Digital circuits and systems by Venugopal 2011 (Tata Mcgraw Hill)
3. Digital Electronics by SubrathaGhoshal 2012 (Cengage Learning)

**Cluster Elective Paper-VIII-A-3: Practical:**
**Electronic Instrumentation** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Study the loading effect of a multimeter by measuring voltage across alow and high resistance.
2. Study the limitations of a multimeter for measuring high frequency voltageand currents.
3. Measurement of voltage, frequency, time period and phase angle using CRO.
4. Measurement of time period and frequency using universal counter/frequency counter.
5. Measurement of rise, fall and delay times using a CRO.
6. Measurement of distortion of a RF signal generator using distortion factor meter.
7. Measurement of R, L and C using a LCR bridge/ universal bridge.

**Semester –VI**

**Elective Paper – VII-(B): Materials Science**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12 hrs)**

1.Materials and Crystal Bonding: Materials, Classification, Crystalline, Amorphous, Glasses; Metals, Alloys, Semiconductors, Polymers, Ceramics, Plastics, Bio-materials, Composites, Bulk and nanomaterials. Review of atomic structure – Interatomic forces – Different types of chemical bonds – Ioniccovalent bond or homopolar bond – Metallic bond – Dispersion bond – Dipole bond – Hydrogenbond – Binding energy of a crystal.

**UNIT-II (12 hrs)**

2. Defects and Diffusion in Materials: Introduction – Types of defects - Point defects- Line defects- Surface defects- Volume defects- Production and removal of defects- Deformation- irradiation- quenching- annealing- recovery - recrystallization and grain growth. Diffusion in solids- Fick's laws of diffusion.

**UNIT-III(12 hrs)**

3. Mechanical Behavior of Materials: Different mechanical properties of engineering materials – Creep – Fracture – Technological properties – Factors affecting mechanical properties of a material – Heat treatment - Cold and hot working – Types of mechanical tests – Metal forming process – Powder – Misaligning – Deformation of metals.

**UNIT-IV (12 hrs)**

4. Magnetic Materials: Dia-, Para-, Ferri- and Ferromagnetic materials, Classical Langevin theory of dia magnetism, Quantum mechanical treatment of paramagnetism. Curie's law, Weiss's theory of ferromagnetism, Ferromagnetic domains. Discussion of B-H Curve. Hysteresis and energy Loss.

**UNIT-V (12 hrs)**

5. Dielectric Materials: Dielectric constant, dielectric strength and dielectric loss, polarizability, mechanism of polarization, factors affecting polarization, polarization curve and hysteresis loop, types of dielectric materials, applications; ferroelectric, piezoelectric and pyroelectric materials, Clausius -Mosotti equation.

**Reference books**


1. Materials Science by M.Arumugam, Anuradha Publishers. 1990, Kumbakonam.
2. Materials Science and Engineering V.Raghavan, Printice Hall India Ed. V 2004. New Delhi.
3. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
4. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

**Elective Paper-VII-B: Practical:**
**Materials Science** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. Measurement of magnetic susceptibility of solids.
3. Determination of coupling coefficient of a piezoelectric crystal.
4. Measurement of the dielectric constant of a dielectric Materials
5. Study the complex dielectric constant and plasma frequency of metal using surface plasmon
6. resonance (SPR)
7. Study the hysteresis loop of a Ferroelectric Crystal.
8. Study the B-H curve of 'Fe' using solenoid and determine energy loss from hysteresis.

**Semester –VI**
**Cluster Electives VIII-B**
**Cluster Elective Paper –VIII-B-1 :Fundamentals of Nanoscience**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12hrs)**

**1. Background and history:** Emergence of Nanoscience with special reference to Feynman and Drexler; Role of particle size; Spatial and temporal scale; Concept of confinement, strong and weak confinement with suitable example; Development of quantum structures, Basic concept of quantum well, quantum wire and quantum dot.

Finite size Zero, One and Two Dimensional Nanostructures, Concept of Surface and Interfacial Energies. Physics of the solid state – size dependence of properties, crystal structures, Lattice vibrations, Energy bands:- Insulators Semiconductors and conductors.

**UNIT-II (12hrs)**

**2. Classification of Nanomaterials:** Inorganic nanomaterials: carbon nanotubes and cones, Organic nanomaterials: dendrimers, micelles, liposomes, block copolymers; Bionanomaterials: Biomimtric, bioceramic and nanotherapeutics; Nanomaterials for molecular electronics and optoelectronics.

**UNITS-III (12hrs)**

**3. Macromolecules:** Classification of polymers, chemistry of polymerization, chain polymerization, step polymerization, coordination polymerization. Molecular weight of polymers-number average and weight average molecular weight, degree of polymerization, determination of molecular weight of polymers by viscometry, Osmometry and light scattering methods. Kinetics of free radical polymerization, derivation of rate law. Preparation and application of polyethylene, PVC, Teflon.

**UNIT-IV (12hrs)**

**4. Molecular & Nanoelectronics:** Semiconductors, Transition from crystal technology to nanotechnology. Tiny motors, Gyroscopes and accelerometers. Nano particle embedded wrinkle resistant cloth, Transparent Zinc Oxide sun screens. Bio-systems, Nanoscale processes in environment. Nanoscale structures, Novel phenomena and Quantum control and quantum computing. Single electron transistors, Quantum dots, Quantum wires.

**UNIT-V (12hrs)**

**5. Biomaterials:** Implant materials: Stainless steels and its alloys, Ti and Ti based alloys, Ceramic implant materials; Hydroxyapatite glass ceramics, Carbon Implant materials, Polymeric Implant materials, Soft tissue replacement implants, Sutures, Surgical tapes and adhesives, heart valve implants, Artificial organs, Hard Tissue replacement Implants, Internal Fracture Fixation Devices, Wires, Pins, and Screws, Fracture Plates.

**Reference Books**

1. T. Pradeep: Textbook of Nanoscience and Nanotechnology Chapter (McGraw-Hill Professional, 2012), Access Engineering.
2. C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, "The Chemistry of Nanomaterials :Synthesis, Properties and Applications", Wiley-VCH, 2006.
3. C. Breachignac P. Houdy M. Lahmani, "Nanomaterials and Nanochemistry", Springer, 2006.
4. Guozhong Cao, "Nanostructures and Nanomaterials: Synthesis, Properties, and Applications", World Scientific Publishing Private, Ltd., 2011.
5. Zhong Lin Wang, "Characterization of Nanophase Materials", Wiley-VCH, 2004.
6. Carl C. Koch, "Nanostructured Materials: Processing, Properties and Potential Applications", William Andrew Publishing Norwich, 2006.

**Elective Paper- VIII-B-1: Practical:**
**Fundamentals of Nanoscience** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Determination of the Band Gap of Semiconductor Nanoparticles.
2. Surface Enhanced Raman Scattering Activity of Silver Nanoparticles
3. Conversion of Gold Nanorods into Gold Nanoparticles
4. Bimetallic Nanoparticles
5. Processing and Development of Nanoparticle gas sensor
6. Magnetic separation/identification studies of nanoparticles
7. Harvesting light using nano-solar cells
8. Nano-Forensic analysis to identify, individualize and evaluate evidence using nanophase materials
9. Comparison of the performance of nanoparticles based conductive adhesives and conventional non conductive adhesives.
10. Electrodeposition and corrosion behavior of nanostructured composite film
11. Photocatalytic activity of nanomaterials

**Semester –VI**
**Cluster Elective Paper –VIII-B-2 :**
**Synthesis and Characterization of Nanomaterials**

**No. of Hours per week: 04** **Total Lectures:60**

**Unit-I (12 hrs)**

**1. Nanomaterials synthesis**: Synthesis and nanofabrication, Bottom-Up and Top-Down approach with examples. Chemical precipitation methods, sol-gel method, chemical reduction, hydrothermal, process. Physical Mehtods- ball milling, Physical Vapour deposition (PVD), Sputtering, ChemicalVapor deposition (CVD), pray pyrolysis, Biological methods- Synthesis using micro organisms and bacteria, Synthesis using plant extract, use of proteins and DNA templates.

**Unit-II (12 hrs)**

**2. Classification of materials:** Types of materials, Metals, Ceramics (Sand glasses) polymers, composites, semiconductors. Metals and alloys- Phase diagrams of single component, binary and ternary systems, diffusion, nucleation and growth. Diffusional and diffusionless transformations. Mechanical properties. Metallic glasses. Preparation, structure and properties like electrical, magnetic, thermal and mechanical, applications.

**UNITS-III (12 hrs)**

**3. Glasses**: The glass transition - theories for the glass transition, Factors that determine the glass-transition temperature. Glass forming systems and ease of glass formation, preparation of glass materials. Applications of Glasses: Introduction: Electronic applications, Electrochemical applications, optical applications, Magnetic applications.

**UNITS-IV (12 hrs)**

**4. Liquid Crystals**: Mesomorphism of anisotropic systems, Different liquid crystalline phase and phase transitions, Thermal and electrical properties of liquid crystals, Types Liquid Crystals displays, few applications of liquid crystals.

**UNITS-V (12 hrs)**

**5. Characterization Methods:** XRD, SEM, TEM, AFM, XPS and PL characterization techniques for nano materials. Electrical and mechanical properties, Optical properties by IR and Raman Spectroscopy.

**References books**

1. Encyclopedia of Nanotechnology by M.Balakrishna Rao and K.Krishna Reddy, Vol.I to X, Campus books.
2. Nano: The Essentials-Understanding Nanoscinece & Nanotechnology by T.Pradeep; Tata Mc. Graw Hill
3. Nanotechnology in Microelectronics & Optoelectronics, J.M Martine Duart, R.J Martin Palma, F. Agullo Rueda, Elsevier
4. Nanoelectronic Circuit Design, N.K Jha, D Chen, Springer
5. Handbook of Nanophysics- Nanoelectronics & Nanophotonics, K.D Sattler, CRC Press
6. Organic Electronics-Sensors & Biotechnology- R. Shinar & J. Shinar, McGraw-Hill

**Cluster Elective Paper-VIII-B-2: Practical:**
**Synthesis and Characterization of Nanomaterials 2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Synthesis of nanocrystalline films of II-VI compounds doped with rare earths by chemical process.
2. Synthesis of Alkaline earth aluminates in nanocrystalline form by combustion synthesis.
3. Preparation of surface conducting glass plate by spray pyrolysis method
4. Preparation of surface conducting glass plate by chemical route
5. Fabrication of micro fluidic nanofilter by polymerisation reaction
6. Absorption studies on the nanocrystalline films and determination of absorption coefficient.
7. Determination of band gap from the absorption spectra using Tauc's plots.
8. Study of Hall effect in semiconductors and its application in nanotechnology.
9. Measurement of electrical conductivity of semiconductor film by Four Probe method and study of temperature variation of electrical conductivity.

**Semester –VI**

**Cluster Elective Paper –VIII-B-3 :Applications of Nanomaterials and Devices**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12 hrs)**

**1. Optical properties:** Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures and charging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures.

**UNIT-II (12 hrs)**

**2. Electrical transport:**

Carrier transport in nanostrcutures. Hall effect, Determination of carrier mobility and carrier concentration; Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level and surface defects.

**UNIT-III (12 hrs)**

**3. Applications:** Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron transfer devices (no derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructures lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage.Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

**UNIT-IV(12 hrs)**

**4. Nanoelectronics:** Introduction, Electronic structure of Nanocrystals,Tuning the Band gap of Nanoscale semiconductors, Excitons, Quantumdot, Single electron devices, Nanostructured ferromagnetism, Effect of bulk nanostructuring of magnetic properties, Dynamics of nanomagnets, Nanocarbon ferromagnets, Giant and colossal magneto-resistance, Introduction of spintronics, Spintronics devices and applications.

**UNIT-V (12 hrs)**

**5. Nanobiotechnology and Medical application:** Introduction, Biological building blocks- size of building blocks and nanostructures, Peptide nanowires and protein nanoparticles, DNA double nanowires, Nanomaterials in drug delivery and therapy, Nanomedicine, Targeted gold nanoparticles for imaging and therapy.

**Reference books:**

1. 1.C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. 2.S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company).
3. K.K. Chattopadhyay and A.N. Banerjee, Introduction to Nanoscience & Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

**Elective Paper- VIII-B-3: Practical:**
**Applications of Nanomaterials and Devices** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. 6. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
7. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.
8. Fabricate a pn-diode by diffusing Al over the surface of n-type Si and study its I-V characteristics.

**Semester –VI**
**Elective Paper –VII-(C) :Renewable Energy**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12 hrs)**

**1. Introduction to Energy:** Definition and units of energy, power, Forms of energy, Conservation of energy, second law of thermodynamics, Energy flow diagram to the earth. Origin and time scale of fossil fuels, Conventional energy sources, Role of energy in economic development and social transformation.

**2. Environmental Effects:** Environmental degradation due to energy production and utilization, air and water pollution, depletion of ozone layer, global warming, biological damage due to environmental degradation. Effect of pollution due to thermal power station, nuclear power generation, hydroelectric power stations on ecology and environment.

**UNIT-II (12 hrs)**

**3. Global Energy Scenario:** Energy consumption in various sectors, projected energy consumption for the next century, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear and hydroelectric power, impact of exponential rise in energy usage on global economy.

**4. Indian Energy Scene:** Energy resources available in India, urban and rural energy consumption, energy consumption pattern and its variation as a function of time, nuclear energy - promise and future, energy as a factor limiting growth, need for use of new and renewable energy sources.

**UNIT-III (12 hrs)**

**5.Solar energy:** Solar energy, Spectral distribution of radiation, Flat plate collector, solar water heating system, Applications, Solar cooker. Solar cell, Types of solar cells, Solar module and array, Components of PV system, Applications of solar PV systems.

**6. Wind Energy:** Introduction, Principle of wind energy conversion, Components of wind turbines, Operation and characteristics of a wind turbine, Advantages and disadvantages of wind mills, Applications of wind energy.

**UNIT-IV (12 hrs)**

**7. Ocean Energy:** Introduction, Principle of ocean thermal energy conversion, Tidal power generation, Tidal energy technologies, Energy from waves, Wave energy conversion, Wave energy technologies, advantages and disadvantages.

**8. Hydrogen Energy:**History of hydrogen energy - Hydrogen production methods - Electrolysis of water, Hydrogen storage options – Compressed and liquefied gas tanks, Metal hydrides; Hydrogen safety - Problems of hydrogen transport and distribution - Uses of hydrogen as fuel.

**UNIT-V (12 hrs)**

**9. Bio-Energy**

Energy from biomass – Sources of biomass – Different species – Conversion of biomass into fuels – Energy through fermentation – Pyrolysis, gasification and combustion – Aerobic and anaerobic bio-conversion – Properties of biomass – Biogas plants – Types of plants – Design and operation – Properties and characteristics of biogas.

**References:**

1. Solar Energy Principles, Thermal Collection &Storage, S.P.Sukhatme: Tata McGraw Hill Pub., New Delhi.
2. Non-Conventional Energy Sources, G.D.Rai, New Delhi.
3. Renewable Energy, power for a sustainable future, Godfrey Boyle, 2004,
4. The Generation of electricity by wind, E.W. Golding.
5. Hydrogen and Fuel Cells: A comprehensive guide, Rebecca Busby, Pennwell corporation (2005)
6. Hydrogen and Fuel Cells: Emerging Technologies and Applications, B.Sorensen, Academic
7. Press (2012).
8. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub., 2009.
9. Fundamentals of Renewable Energy Resources byG.N.Tiwari, M.K.Ghosal, Narosa Pub., 2007.

**Elective Paper-VII-C: Practical:**
**Renewable Energy** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Preparation of copper oxide selective surface by chemical conversion method.
2. Performance testing of solar cooker.
3. Determination of solar constant using pyrheliometer.
4. Measurement of I-V characteristics of solar cell.
5. Study the effect of input light intensity on the performance of solar cell.
6. Study the characteristics of wind.

**Semester –VI**
**Cluster Electives VIII-C**
**Cluster Elective Paper –VIII-C-1 :Solar Thermal and Photovoltaic Aspects**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12 hrs)**

**1. Basics of Solar Radiation:** Structure of Sun, Spectral distribution of extra terrestrial radiation, Solar constant, Concept of Zenith angle and air mass, Definition of declination, hour angle, solar and surface azimuth angles; Direct, diffuse and total solar radiation, Solar intensity measurement – Thermoelectric pyranometer and pyrheliometer.

**2. Radiative Properties and Characteristics of Materials:** Reflection, absorption and transmission of solar radiation throughsingle and multi covers; Kirchoff's law – Relation between absorptance, emittance and reflectance; Selective Surfaces - preparation and characterization, Types and applications; Anti-reflective coating.

**UNIT-II (14 hrs)**

**3. Flat Plate Collectors (FPC) :** Description of flat plate collector, Liquid heating type FPC, Energy balance equation,Efficiency, Temperature distribution in FPC, Definitions of fin efficiency and collector efficiency, Evacuated tubular collectors.

**4. Concentrating Collectors:** Classification, design and performance parameters; Definitions of aperture, rim-angle, concentration ratio and acceptance angle; Tracking systems; Parabolic trough concentrators; Concentrators with point focus.

**Unit-III (14 hrs)**

**5. Solar photovoltaic (PV) cell:** Physics of solar cell –Type of interfaces, homo, hetero andschottky interfaces, Photovoltaic Effect, Equivalent circuit of solar cell, Solar cell output parameters, Series and shunt resistances and its effect on cell efficiency; Variation of efficiency with band-gap and temperature.

**6. Solar cell fabrication:** Production of single crystal Silicon: Czokralski (CZ) and Float Zone (FZ) methods, Silicon wafer fabrication, Wafer to cell formation, Thin film solar cells, Advantages, CdTe/CdS cell formation, Multi-junction solar cell; Basic concept of Dye-sensitized solar cell, Quantum dot solar cell.

**UNIT-IV (8 hrs)**

**Solar PV systems:** Solar cell module assembly – Steps involved in the fabrication of solar module, Module performance, I-V characteristics, Modules in series and parallel, Module protection – use of Bypass and Blocking diodes, Solar PV system and its components, PV array, inverter, battery and load.

**UNIT-V (12 hrs)**

**Solar thermal applications:** Solar hot water system (SHWS), Types of SHWS, Standard method of testing the efficiency of SHWS; Passive space heating and cooling concepts, Solar desalinator and drier, Solar thermal power generation.

**Solar PV applications**: SPV systems; Stand alone, hybrid and grid connected systems, System installation, operation and maintenances; Field experience; PV market analysis and economics of SPV systems.

**Reference Books:**

1. Solar Energy Utilization, G. D. Rai, Khanna Publishers
2. Solar Energy- Fundamentals, design, modeling and applications, G.N. Tiwari, Narosa Pub., 2005.
3. Solar Energy-Principles of thermal energy collection & storage, S.P. Sukhatme, Tata Mc-Graw Hill Publishers, 1999.
4. Solar Photovoltaics- Fundamentals, technologies and applications, Chetan Singh Solanki, PHI Learning Pvt. Ltd.,
5. Science and Technology of Photovoltaics, P. Jayarama Reddy, BS Publications, 2004.

**Cluster Elective Paper- VIII-C-1: Practical:**
**Solar Thermal and Photovoltaic Aspects 2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Measurement of direct solar radiation using pyrheliometer.
2. Measurement of global and diffuse solar radiation using pyranometer.
3. Measurement of emissivity, reflectivity and transsivity.
4. Measurement of efficiency of solar flat plate collector.
5. Performance testing of solar air dryer unit.
6. Effect of tilt angle on the efficiency of solar photovoltaic panel.
7. Study on solar photovoltaic panel in series and parallel combination.

**Semester - VI**

**Cluster Elective Paper –VIII-C-2 :Wind, Hydro and Ocean Energies**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I**

**1. Introduction:** Wind generation, meteorology of wind, world distribution of wind, wind speed variation with height, wind speed statistics, Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics.

**2. Wind Measurements:** Eolian features, biological indicators, rotational anemometers, other anemometers, wind measurements with balloons.

**UNIT-II**

**3. Wind Energy Conversion System:** Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip loss correction.

**4. Design of Wind Turbine:** Wind turbine design considerations; Methodology; Theoretical simulation of wind turbine characteristics; Test methods.

**UNIT-III**

**5. Wind Energy Application:** Wind pumps: Performance analysis, design concept and testing; Principle of wind energy generation; Standalone, grid connected and hybrid applications of wind energy conversion systems, Economics of wind energy utilization; Wind energy in India; Environmental Impacts of Wind farms.

**UNIT-IV**

**6. Small Hydropower Systems:** Overview of micro, mini and small hydro systems; Hydrology; Elements of pumps and turbine; Selection and design criteria of pumps and turbines; Site selection; Speed and voltage regulation; Investment issues load management and tariff collection; potential of small hydro power in India. Wind and hydro based stand-alone hybrid power systems.

**UNIT-V**

**7.Ocean Thermal, Tidal and Wave Energy Systems:** Ocean Thermal - Introduction, Technology process, Working principle, Resource and site requirements, Location of OCET system, Electricity generation methods from OCET, Advantages and disadvantages, Applications of OTEC,

**8. Tidal Energy :** - Introduction, Origin and nature of tidal energy, Merits and limitations, Tidal energy technology, Tidal range power, Basic modes of operation of tidal systems. Wave Energy – Introduction, Basics of wave motion, Power in waves, Wave energy conversion devices, Advantages and disadvantages, Applications of wave energy.

**Reference Books:**

1. Dan Charis, Mick Sagrillo, LanWoofenden, "Power from the Wind", New Society Pub., 2009.
2. Erich Hau, "Wind Turbines-Fundaments, Technologies, Applications, Economics", 2ndEdition, Springer Verlag, BerlinHeidelberg, NY, 2006.
3. Joshue Earnest, Tore Wizelius, Wind Power and Project Developmen", PHI Pub., 2011.
4. T. Burton, D. Sharpe, N. Jenkins, E. Bossanyi, Wind Energy Handbook, John Wiley Pub., 2001.
5. Paul Gipe, "Wind Energy Basics", Chelsea Green Publications, 1999.
6. Khan, B.H., "Non-Conventional Energy Resources", TMH, 2nd Edition, New Delhi, 2009.
7. Tiwari, G.N., and Ghosal, M.K, Renewable Energy Resources – Basic Principles and applications, Narosa Publishing House,2007.

**Cluster Elective Paper- VIII-C-2: Practical:**
**Wind, Hydro and Ocean Energies** **2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Estimation of wind speed using anemometer.
2. Determination of characteristics of a wind generator
3. Study the effect of number and size of blades of a wind turbine on electric power output.
4. Performance evaluation of vertical and horizontal axes wind turbine rotors.
5. Study the effect of density of water on the output power of hydroelectric generator.
6. Study the effect of wave amplitude and frequency on the wave energy generated.

**Semester - VI**

**Cluster Elective Paper –VIII-C-3 :Energy Storage Devices**

**No. of Hours per week: 04** **Total Lectures:60**

**UNIT-I (12 hr)**

**1. Energy Storage:** Need of energy storage; Different modes of energy storage, Flywheel storage, Electrical and magnetic energy storage: Capacitors, electromagnets; Chemical Energy storage: Thermo-chemical, photo-chemical, bio-chemical, electro-chemical, fossil fuels and synthetic fuels. Hydrogen for energy storage.

**UNIT-II (12 hrs)**

**2. Electrochemical Energy Storage Systems:** Batteries: Primary, Secondary, Lithium, Solid-state and molten solvent batteries; Lead acid batteries; Nickel Cadmium Batteries; Advanced Batteries. Role of carbon nano-tubes in electrodes.

**UNIT-III (12 hrs)**

**3. Magnetic and Electric Energy Storage Systems:** Superconducting Magnet Energy Storage(SMES) systems; Capacitor and battery: Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor(EDLC), principle of working, structure, performance and application.

**UNIT-IV (12 hrs)**

**4. Fuel Cell:** Fuel cell definition, difference between batteries and fuel cells, fuel cell components, principle and working of fuel cell, performance characteristics, efficiency, fuel cell stack, fuel cell power plant: fuel processor, fuel cell power section, power conditioner, Advantages and disadvantages.

**UNIT-V (12 hrs)**

**5. Types of Fuel Cells:** Alkaline fuel cell, polymer electrolyte fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell; solid oxide fuel cell, proton exchange membrane fuel cell, problems with fuel cells, applications of fuel cells.

**REFERENCE BOOKS**

1. J. Jensen and B. Squrensen, Fundamentals of Energy Storage, John Wiley, NY, 1984.
2. M. Barak, Electrochemical Power Sources: Primary and Secondary Batteries by, P. Peregrinus,IEE,1980.
3. 3.P.D.Dunn, Renewable Energies, Peter Peregrinus Ltd, London, 1986.
4. B.Viswanathan and M. A. Scibioh, Fuel Cells-Principles and Applications, University Press, 2006.
5. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, NewYork, 1989.

**Cluster Elective Paper –VIII-C-3: Practical:**
**Energy Storage Devices 2hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Study of charge and discharge characteristics of storage battery.
2. Study of charging and discharging behavior of a capacitor.
3. Determination of efficiency of DC-AC inverter and DC-DC converters
4. Study of charging characteristics of a Ni-Cd battery using solar photovoltaic panel.
5. Performance estimation of a fuel cell.
6. Study of effect of temperature on the performance of fuel cell.

# BOTANY

## SEMESTER- V

## Paper-V: Cell Biology, Genetics and Plant Breeding

Total hours of teaching 60 hrs @ 3 hrs per week

**UNIT – I Cell Biology: (12hrs)**

1. Cell, the unit of life- Cell theory, Prokaryotic and eukaryotic cells; Eukaryotic cell components.
2. Ultra structure and functions of cell wall and cell membranes.
3. Chromosomes**:** morphology, organization of DNA in a chromosome (nucleosome model), Euchromatin and heterochromatin.

**UNIT – II Genetic Material: (12hrs)**

1. DNA as the genetic material: Griffith's and Avery's transformation experiment, Hershey – Chase bacteriophage experiment.
2. DNA structure (Watson & Crick model) and replication of DNA (semi-conservative)
3. Types of RNA (mRNA, tRNA, rRNA), their structure and function.

**UNIT – III Mendelian Inheritance: (12 hrs)**

1. Mendel's laws of Inheritance (Mono- and Di- hybrid crosses); backcross and test cross.
2. Chromosome theory of Inheritance.
3. Linkage: concept, complete and incomplete linkage, coupling and repulsion; linkage maps based on two and three factor crosses.
4. Crossing Over: concept & significance.

**UNIT – IV Plant Breeding: (12 hrs)**

1. Introduction and Objectives of plant breeding.
2. Methods of crop improvement: Procedure, advantages and limitations of Introduction, Selection, and Hybridization (outlines only).

**UNIT – V Breeding, Crop Improvement and Biotechnology: (12 hrs)**

1. Role of mutations in crop improvement.
2. Role of somaclonal variations in crop improvement.
3. Molecular breeding – use of DNA markers in plant breeding and crop improvement (RAPD, RFLP).

**Suggested activity**: Seminar, Debate, Quiz, observation of live cells and nucleus in Onion peels, observation of Meiotic nuclei in Maize pollen. Solving Genetics problems.

**Books for Reference:**

1. Old, R.W. and Primrose S.B. 1994, Principles of Gene Manipulation Blackwell Science, London 2. Grierson, D. and Convey S.N. 1989, Plant Molecular Biology, Blackie Publishers, New York.
2. Lea, P.J. and Leegood R.C. 1999, Plant Biochemistry and Molecular Biology, John Wiley and Sons, London.
3. Power C.B., 1984, Cell Biology, Himalaya Publishing Co. Mumbai
4. De. Robertis and De Robertis, 1998, Cell and Moleceular Biology, K.M. Verghese and Company.
5. Sinnott, E.W., L.C. Dunn & J. Dobshansky (1958) : Principles of Genetics (5th Edition) McGraw Hill Publishing Co., N.Y. Toronto, London.
6. Winchester, A.M. (1958) : Genetics(3rd Edition) Oxford & IBH Publishing House, Calcutta, Bombay, New Delhi.
7. Singleton, R.(1963) : Elementary Genetics, D. Van Nostrand Co., Ltd., Inc., N.Y. & Affiliated East West Press (P) Ltd., New Delhi.
8. Strickberger, M.W. (1976): Genetics(2nd Edition) MacMillan Publishing Co., Inc., N.Y., London
9. Watson, J.D. (1977): Molecular Biology of the Gene, W.A. Benjamin, Inc., Menlo Park- California, Reading-Massachusetts, London, Amsterdam, Don Mills, Ontario, Sydney.
10. Gardner,E.J & Snusted, D.P.(1984): Principles of Genetics (7thedition) John Wiley & Sons, N.Y. Chichester, Brisbane, Toronto, Singapore.
11. Lewin, B. (1985) Genes VII Wiley Eastern Ltd., New Delhi, Bombay, Calcutta, Madras, Hydrabad.
12. Allard R.W(1999): The Principles of Plant Breeding, John & Wiley and Sons.
13. Poelman J.M: Breeding Field Crops, Springer.
14. George Acquaah(2012):Principles of Plant Genetics & Breeding: Wiley-Blackwell.

## SEMESTER- V

**Practical Paper-V: CELL BIOLOGY, GENETICS AND PLANT BREEDING**

Total hours of teaching 30hrs @ 2hrs per week

**Suggested Laboratory Exercises:**

1. Study of the structure of cell organelles through photomicrographs.
2. Study of structure of plant cell through temporary mounts.
3. Study of various stages of mitosis using cytological preparation of Onion root tips.
4. Study of DNA packing by micrographs.
5. Study of effect of temperature & organic solvent on permeability of cell membrane.
6. Numerical problems solving Mendel' Laws of inheritance
7. Chromosome mapping using 3 point test cross data.
8. Hybridization techniques – emasculation, bagging (for demonstration only).
9. Field visit to a plant breeding research station.
10. Calorimetric estimation of DNA by diphenylamine method.

## SEMESTER- V

## PAPER-V: CELL BIOLOGY, GENETICS AND PLANT BREEDING

1. Perform the Experiment **A**. Perform squash on onion root tip, prepare the slide, identify at least one division stage. Write the procedure and draw the diagram of reported stage. 1 x 15 = 15marks

2. Give the experimental protocol of the experiments **B**
1 x 10 = 10 marks

3. Solving numerical problems on Mendelian in heritance **C,D**
2x 7 1/2 =15 marks

4. Record & Viva = 10 marks

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50 marks

A-Onion root squash technique
B- Estimation of DNA by diphenylamine method
C&D Numerical problems on Mendelian Inheritance.

## SEMESTER- V

## PAPER-VI: PLANT ECOLOGY& PHYTOGEOGRAPHY

Total hours of teaching 60 hrs @ 3 hrs per week

**UNIT – I. Elements of Ecology (12 hrs)**

1. Ecology: definition, branches and significance of ecology.
2. Climatic Factors: Light, Temperature, precipitation.
3. Edaphic Factor: Origin, formation, composition and soil profile.
4. Biotic Factor: Interactions between plants and animals.

**UNIT– II. Ecosystem Ecology (12 hrs)**

1. Ecosystem: Concept and components, energy flow, Food chain, Food web, Ecological pyramids.
2. Productivity of ecosystem-Primary, Secondary and Net productivity.
3. Biogeochemical cycles- Carbon, Nitrogen and Phosphorous.

**UNIT – II Population &Community Ecology (12 hrs)**

1. Population -definition, characteristics and importance, outlines – ecotypes.
2. Plant communities- characters of a community, outlines – Frequency, density, cover,
   life forms, competition.
3. Interaction between plants growing in a community.

**UNIT – IV Phytogeography (12 hrs)**

1. Principles of Phytogeography, Distribution (wides, endemic, discontinuous species)
2. Phytogeographic regions of India.
3. Phytogeographic regions of World.
4. Endemism – types and causes

**UNIT- V: Plant Biodiversity and its importance (12 hrs)**

1. Definition, levels of biodiversity-genetic, species and ecosystem.
2. Biodiversity hotspots- Criteria, Biodiversity hotspots of India.
3. Loss of biodiversity – causes and conservation (*In-situ* and *ex-situ* methods).
4. Seed banks - conservation of genetic resources and their importance

**Suggested activity** :Collection of different soils, studying their texture, observing polluted water bodies, student study projects, debates on man's activity on ecosystem and biodiversity conservation methods, visiting a nearest natural vegetation area. Visit to NGO, working in the field of biodiversity and report writing; to study Honey Bees and plants yielding honey.

**Books for Reference:**

1. Daubenmire, R.F. ( ): Plants & Environment (2nd Edn.,) John Wiley & Sons., New York
2. Puri, .G.S. (1960): Indian Forest Ecology (Vol.I & II) Oxford Book Co., New Delhi & Calcutta.
3. Billings, W.B. (1965): Plants and the Ecosystem Wadsworth Publishing Co., Inc., Belmont.
4. Misra, R. (1968): The Ecology work Book Oxford & INH Publishing Co., Calcutta
5. Odum E.P. (1971): Fundamentals of Ecology (2nd Edn.,) Saunders & Co., Philadelphia & Natraj Publishers, Dehradun.
6. Odum E.P. (1975): Ecology By Holt, Rinert & Winston.
7. Oosting, H.G. (1978): Plants and Ecosystem Wadworth Belmont.
8. Kochhar, P.L. (1975): Plant Ecology. (9th Edn.,) New Delhi, Bombay, Calcutta-226pp.,
9. Kumar, H.D. (1992): Modern Concepts of Ecology (7th Edn.,) Vikas Publishing Co., New Delhi.
10. Kumar H.D. (2000): Biodiversity & Sustainable Conservation Oxford & IBH Publishing Co Ltd. New Delhi.
11. Newman, E.I. (2000): Applied Ecology Blackwell Scientific Publisher, U.K.
12. Chapman, J.L&M.J. Reiss (1992): ecology (Principles & Applications). Cambridge University Press, U.K.
13. Cain, S.A . (1944): Foundations of Plant Geography Harper & Brothers, N.Y.
14. Mani, M.S (1974): Ecology & Biogeography of India Dr. W. Junk Publishers
15. The Haque Good, R. (1997): The Geography of flowering Plants (2nd Edn.) Longmans, Green & Co., Inc., London & Allied Science Publishers, New Delhi

**PRACTICAL PAPER-VI: PLANT ECOLOGY & PHYTOGEOGRAPHY**

Total hours of teaching 30 hrs @ 3 hrs per week

1. Study of instruments used to measure microclimatic variables; soil thermometer, maximum and minimum thermometer, anemometer, psychrometer, rain gauze, and lux meter.
2. Permeability (percolation; total capacity as well as rate of movement) of different soil samples.
3. Determination of soil pH
4. Study of morphological and anatomical adaptations of hydrophytes and xerophytes (4 each)
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method
6. Study of Phytoplankton and macrophytes from water bodies.
7. Study of species diversity index of vegetation.
8. Estimation of Primary Productivity of an ecosystem
9. To study field vegetation with respect to stratification, canopy cover and composition.
10. Study of plants included in agro forestry and social forestry.
11. To locate the hotspots, phyto geographical regions and distribution of endemic plants in the map of India.
12. The following practical should be conducted in the Field/lab with the help of photo-graphs, herbarium, Floras, Red data book- Study of endangered plants species, critically endangered plants species, vulnerable plant species and monotypic endemic genera of India.

## SEMESTER- VI: BOTANY PRACTICAL MODEL PAPER
## PAPER–VI: PLANT ECOLOGY & PHYTOGEOGRAPHY

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1. Study Project under supervision = 15 Marks

2. Record & Viva-Voce = 10 Marks

3. Experiment **A** = 10 Marks

4. Anatomical adaptations of **B** (Section cutting) = 10 Marks

5. Spotters **C&D** (2x2 1/2) = 5 Marks

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Total = 50 Marks

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1. Study Project of a surrounding Ecosystem (terrestrial or aquatic)(plant diversity, animal diversity, human activity, pollution levels, restoration efforts under supervision.
2. Presentation of the project work in Q & A session.
3. **A** -determination of soil porosity/PH/percolation/retaining capacity.
4. **B**- Xerophyte/Hydrophyte anatomical adaptations.
5. **C & D**-anemometer/rain gauze/lux meter.

**SEMESTER- VI**

**PAPER – VII – ELECTIVE [**(A) or (B) or (C)]

**Paper VII-(A): ORGANIC FARMING & SUSTAINABLE AGRICULTURE**

Total hours of teaching 60hrs @ 3hrs per week

**Unit - I: Concept of organic farming: (12hrs)**

1. Introduction: Farming, organic farming, concept and development of organic farming.
2. Principles of organic farming, types of organic farming, biodynamic farming.
3. Benefits of organic farming, need for organic farming, conventional farming v/s organic farming
4. Scope of organic farming; Andhra Pradesh, National and International status.
5. Agencies and institutions related to organic agriculture.
6. Requirements for organic farming, farm components for an organic farm.

**Unit - II: Organic plant nutrient management: (12hrs)**

1. Organic farming systems, soil tillage, land preparation and mulching.
2. Choice of varieties.
3. Propagation-seed, planting materials and seed treatments, water management
4. Green manuring, composting- principles, stages, types and factors, composting methods, Vermi composting
5. Bulky organic manures, concentrated organic manures, organic preparations, organic amendments and sludges.
6. Bio-fertilizers- types, methods of application, advantages and disadvantages, standards for organic inputs- fertilizers

**Unit-III: Organic plant protection: (12hrs)**

1. Plant protection- cultural, mechanical, botanical pesticides, control agents
2. Weed management
3. Standards for organic inputs- plant protection.

**Unit- IV: Organic crop production practices: (12hrs)**

1. Organic crop production methods- rice, coconut.
2. Organic crop production methods- vegetables- okra, amaranthus, cucurbits.
3. Livestock component in organic farming.
4. Sustainable Agriculture-Apiculture, Mushroom cultivation.

**Unit- V: Organic Certification (12hrs)**

1. Farm economy: Basic concept of economics- demand &supply, economic viability of a farm.
2. Basic production principles, reducing expenses, ways to increase returns, cost of production system. Benefit/ cost ratio, marketing, imports and exports.
3. Policies and incentives of organic production.
4. Farm inspection and certification.
5. Terrace farming.

**Books for Reference:**

1. Palaniappan SP &Anandurai K. 1999. Organic Farming–Theory and Practice. Scientific Publishers, Jodhpur
2. Joshi, M. 2014. New Vistas of Organic Farming 2nd Ed. Scientific Publishers, Jodhpur.
3. Farming system : Theory and Practice - S.A.Solaimalai
4. Organic Farming: Theory and Practice- S.P.Palaniappan and K.A. Annadurai
5. A hand book of Organic Farming by A.K.Sharma

**Suggested Activities:** Preparation of Vermicompost in small scale, observing sewage sludge disposal mechanisms in urban/semi urban areas, studying the usage, of green manures, neem oil, neem cake, pongamia oil in organic farming, livestock component in various farming methods, visiting an Apiculture center, drawing various terrace farming models

1. Study of different bio pesticides, weedicides, inorganic and organic fertilizers

2. Deficiency symptoms of nutrient deficiency symptoms (photographs)

3. Soil testing, liming, and fertilizing

4. Preparation of enriched Farm Yard Manure.

5. Study of composting methods.

6. Preparation of vermicompost.

7. Study of recycling of farm waste.

8. Study of methods of green manuring.

9. Study of steps in mushroom cultivation

10. Visit to urban waste recycling unit.

11. Study project report under supervision of lecturer – farm manure preparation/vermi-compost// /waste management// green manures/ mushroom cultivation / nutrient requirements of vegetables

**Expected domain skills to be achieved:** Performing Soil analysis, soil enrichment methods, composting procedure, recycling of wastes, use of waste materials in mushroom cultivation, understanding nutrient requirement of various crops, identifying various methods of keeping soil health

**PRACTICAL MODEL PAPER**

Paper-VII-(A) : Organic Farming and Sustainable Agriculture

Q1. Project report (A) - 15 marks

Viva-voce on study project -05 marks

Q2. Identify and write notes on B, C, D, and E (4x5) -20 marks

B- inorganic manures/bio-weedicides/bio-pesticides (photograph/ specimen)

C- Compost preparation method ( photograph/instrument)

D- Green manure type (plant specimen/photograph)

E- Waste recycling method (photograph/live specimen/institute /organization)

Q4. Field report - 05 marks

Q5. Record - 05 marks

TOTAL: 50 marks

**SEMESTER- VI**

**PAPER – VII – ELECTIVE**

**Paper VII-(B): Nursery, Gardening and Floriculture.**

Total hours of teaching 60hrs @ 3hrs per week

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**Unit I: Nursery**: **(12 hrs.)**

1. Definition, objectives, scope and building up of infrastructure for nursery.

2. Planning and seasonal activities - Planting - direct seeding and transplants.

3. Nursery Management and Routine Garden Operations.

**Unit III: Gardening** **(12 hrs.)**

1. Definition, objectives and scope - different types of gardening.

2. Landscape and home gardening - parks and its components, plant materials and design .

3. Computer applications in landscaping.

4. Gardening operations: soil laying, manuring, watering.

5. Landscaping Places of Public Importance: Landscaping highways and Educational Institutions)

6. Some Famous gardens of India.

**Unit III : Propagation methods (12 hrs.)**

1 Sowing/raising of seeds and seedlings, transplanting of seedlings.

2.Air-layering, cutting, selection of cutting ,propagule collecting season, treatment of cutting rooting medium and planting of cuttings - Hardening of plants.

3. Propagation of ornamental plants by rhizomes, corms tubers, bulbs and bulbils.

4. .Green house - mist chamber, shed root, shade house and glass house for propagation.

**Unit IV: Floriculture: ( 12 hrs.)**

1. Ornamental Plants: Flowering annuals; herbaceous, perennials; Divine vines; Shade and ornamental trees.
2. Ornamental bulbous and foliage plants; Cacti and succulents.
3. Ornamentals-palms.
4. Cultivation of plants in pots; Indoor gardening; Bonsai.

**Unit V: Commercial Floriculture ( 12 hrs.)**

1. Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life of flowers
2. Cultivation of Important cut flowers (Carnation, Aster, Dahlia, Gerbera, Anthuriams, Gladiolous, Marigold, Rose, Lilium)
3. Management of pests, diseases and harvesting.
4. Methods of harvesting.

**Books for Reference:**

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. institution)
4.Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

**Suggested Activities:** Raising a nursery, managing it, studying and drawing various land scaping designs, practicing layering methods, using shade nets to protect horticultural crops, practicing indoor gardening techniques, visiting florists and recording their methods of prolonging vase life of commercial cut flowers.

**SEMESTER- VI (Elective)**

**Practical Syllabus, Paper VII-(B): Nursery, Gardening and Floriculture**

Total hours of teaching 30hrs @ 2hrs per week

1. Tools, implements and containers used for propagation and nursery techniques.
2. Propagation by cutting, layering, budding and grafting
3. Seed propagation- preparation of portable trays, seed treatments, sowing and seedling production.
4. Identification and description of annuals, herbaceous perennials, climbers, creepers, foliage and flowering shrubs, trees, palms, ferns, ornamental grasses; cacti and succulents..
5. Planning and designing of gardens, functional uses of plants in the landscape
6. Preparation of land for lawn and planting.
7. Identification of commercially important flower crops and their varieties.
8. Propagation practices in flower crops, sowing of seeds and raising of seedlings of annuals.
9. Use of chemicals and other compounds for prolonging the vase life of cut flowers.
10. Grading, packing and marketing of cut flowers.
11. Visit to commercial nurseries and commercial tissue culture laboratory
12. Study project under supervision of lecturer – nursery/ornamental flowers/ plants/lawn designing/ landscape designing

**Expected domain skills to be achieved:** Ability to use a variety of garden tools and implements, proficiency in layering and grafting techniques (cleft grafting and bud grafting), land scape drawings using computers, raising of healthy nurseries of flowering plants, managing vase life of cut flowers etc.

**PRACTICAL MODEL PAPER**

Paper-VII-(B): Nursery, Gardening and Floriculture

| | |
|---|---|
| Q1. Project report (A) | - 15 marks |
| Viva-voce on study project | -05 marks |
| Q2. Identify and write notes on B, C, D, and E (4x5) | -20 marks |
| B- Tool/instrument/container used in nursery | |
| C-Seed propagation technique | |
| D- Plant used in lawn (plant specimen/photograph) | |
| E-ornamental flower (photograph/live specimen) | |
| Q4. Field report | - 05 marks |
| Q5. Record | - 05 marks |
| Total ---- | 50 marks |

**SEMESTER- VI**

**PAPER – VII – ELECTIVE**

**Paper VII-(C): Plant tissue culture and its biotechnological applications**

Total hours of teaching 60hrs @ 3hrs per week

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**Unit I: PLANT TISSUE CULTURE – 1 (12hrs)**

1. History of plant tissue culture research - basic principles of plant tissue callus culture, meristem culture, organ culture, Totipotency of cells, differentiation and dedifferentiation.
2. Methodology - sterilization (physical and chemical methods), culture media, Murashige and Skoog's (MS medium), phytohormones, medium for micro-propagation/clonal propagation of ornamental and horticulturally important plants.
3. Callus subculture maintenance, growth measurements, morphogenesis in callus culture – organogenesis, somatic embryogenesis.

**UNIT-II: Plant Tissue culture -2 (12hrs)**

1. Endosperm culture – Embryo culture -culture requirements – applications, embryo rescue technique.
2. Production of secondary metabolites.
3. Cryopreservation; Germ plasm conservation.

**Unit III: Recombinant DNA technology** (12**hrs)**

1. Restriction Endonucleases (history, types I-IV, biological role and application); concepts of restriction mapping.
2. Cloning Vectors: Prokaryotic(pUC 18, pBR322,Ti plasmid and Lambda phage, Eukaryotic Vectors (YAC and briefly PAC)
3. Gene cloning (Bacterial Transformation and selection of recombinant clones, PCR mediated gene cloning)
4. Construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by complementation technique, colony hybridization.

**Unit IV: Methods of gene transfer (12hrs)**

**1.** Methods of gene transfer- Agrobacterium-mediated, direct gene transfer by Electroporation, Microinjection, Micro projectile bombardment.

2. Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

**Unit V: Applications of Biotechnology (12 hrs)**

1. Applications of Plant Genetic Engineering – crop improvement, herbicide resistance, insect resistance, virus resistance.

2. Genetic modification – transgenic plants for pest resistant (Bt-cotton); herbicide resistance (Round Up Ready soybean); improved agronomic traits - flavrSavr tomato, Golden rice); Improved horticultural varieties (Moon dust carnations)

**Books for Reference:**

1. Pullaiah. T. and M.V.Subba Rao. 2009. Plant Tissue culture. Scientific Publishers, New Delhi.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology-Principles and Applications ofrecombinant DNA. ASM Press, Washington.
4. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. VikasPublicationHouse Pvt. Ltd., New Delhi. 5th edition.
5. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
6. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

**Suggested Activities**: In vitro initiation of callus on artificial medium, seminars on utilization of rDNA technology, debates on applications of Biotechnology (whether it is a boon or bane to the society) studying growth patterns, vegetative characteristics of Bt.cotton and identifying the features of its pest resistance

**SEMESTER- VI**
**PAPER – VII-(C) Elective**
**Practical Paper VII-(C): Plant Tissue Culture &Plant Biotechnology**
**Total hours of teaching 30hrs @ 2hrs per week**

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1. (a) Preparation of MS medium.
(b) Demonstration of in vitro sterilization methods and inoculation methods using leaf and nodal explants of Tobacco/ Datura/ Brassica etc.
2. Study of embryo and culture, micro propagation of Banana, somatic embryogenesis, artificial seeds through photographs.
3. Construction of restriction map of circular and linear DNA from the data provided.
4. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, and micro projectile bombardment.
5. Different steps involved in genetic engineering for production of Bt. cotton, Golden rice, Flavr Savr tomato through photographs.
7. Isolation of plasmid DNA.
8. Restriction digestion and gel electrophoresis of plasmid DNA (optional)

9. Field visit to a lab involved in tissue culture

10. Study project under supervision of lecturer – tissue culture/ genetic engineering

**Expected domain skills to be achieved**: Ability to prepare artificial nutrient media, preparing independently, applying various sterilization procedures for media, glassware and biological materials, in vitro propagation of Banana callus, morphogenesis--s, clonal propagation methods, isolation of plasmid DNA individually and as a group.

**PRACTICAL MODEL PAPER**

**Paper-VII-(C) : Plant Tissue Culture &Plant Biotechnology**

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Q1. Project report (A) - 15 marks
Viva-voce on study project -05 marks
Q2. Identify and write notes on B, C and D (3x4) -12 marks
B- Tool/instrument/container used in sterilization
C- Tool/instrument/container used in gene transfer
D- GM crops (Photographs)
Q3. Construct restriction map of circular and/ or linear DNA from the data provided – 08 marks
Q4. Field report - 05 marks
Q5. Record - 05 marks
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50 marks

**SEMESTER- VI**

**Paper VIII, CLUSTER ELECTIVE, Cluster-A,**

**Paper VIII-A-1 : PLANT DIVERSITY AND HUMAN WELFARE**

Total hours of teaching 60hrs @ 3hrs per week

**Unit- I: Plant diversity and its scope**: **(12hrs)**

i. Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agro biodiversity and cultivated plant taxa, wild taxa.

ii. Values and uses of biodiversity: Ethical and aesthetic values

iii. Methodologies for valuation, Uses of plants.

**Unit -II: Loss of biodiversity**: **(12hrs)**

i. Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agro biodiversity, projected scenario for biodiversity loss

ii. Management of plant biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

**Unit-III: Contemporary practices in resource management**: **(12hrs)**

i. Environmental Impact Assessment (EIA), Geographical Information System GIS, Participatory resource appraisal, Ecological footprint with emphasis on carbon footprint, Resource accounting;

ii. Solid and liquid waste management

**Unit -IV: Conservation of biodiversity (12hrs)**

i. Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation,

ii. Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.

**Unit- V: Role of plants in relation to Human Welfare (12hrs)**

i. Importance of forestry, their utilization and commercial aspects-

a) Avenue trees, b) ornamental plants of India. c) Alcoholic beverages through ages.

ii. Fruits and nuts: Important fruit crops their commercial importance. Wood, fiber and their uses.

**Suggested Readings:**

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

**Suggested activities:** Study of flora and its diversity in the college campus or local area,enumerating wild and exotic species(*Parthenium*,Water hyacinth etc.)

Project work on any one of the International organizations striving for preservation of biodiversity, study of conservation efforts of local people, and civic bodies, study of locally available fruits in different seasons, enumerating the avenue plantations and their diversity in your town/city

**Paper – VIII-A-1 : Practicals:** PLANT DIVERSITY AND HUMAN WELFARE

1) Study of plant diversity (flowering plants).

2) Study of exotic species- Identification and morphological characteristics.

3) Identification of forest trees through bark, wood, flowers, leaves and fruits.

4) Maceration, Study of wood (Tracheary elements, fibres).

5) Methods of preservation and canning of fruits.

6) Visit to the local ecosystem to study the plants.

7) Write up on the conservation efforts of International organizations.

8) Study of Solid and Liquid waste management systems in rural/urban areas.

**Domain skills expected to achieve**: Identification of exotic plant species, identification of forest trees based on the characteristics of bark, flowers and fruits, understanding the preservation methods of fresh and dry fruits, understanding the methods of safe disposal of biodegradable and non-biodegradable wastes

## SCHEME OF PRACTICAL EXAMINATION

PRACTICAL- VIII-A-1 : Cluster Elective (MODEL QUESTION PAPER)
PLANT DIVERSITY AND HUMAN WELFARE

Time: 3hrs Max. Marks: 50

I. Assign the plants **A, B and C** to their respective families, giving reasons, family name and classification-2 marks, important diagrams-3 marks. **15 marks**

II. Give the protocol of **D** **10 marks**

III. Comment on specimens **E, F and G** **3x3 = 9 marks**

IV. Report on Field visit **6 marks**
To study sources of firewood (10 plants), timber-yielding trees (10trees) and bamboos.

V. Viva-Voce **5 marks**

VI. Practical Record **5 marks**

**KEY**

A-Cultivated Plant
B- Wild Plant
C –Exotic plant
D- Preservation and canning of fruits, solid and liquid waste management systems in rural/urban areas
E. Bark/wood/fruit yielding plant
F. Nuts/ Alcoholic beverage plant
G. wood /Fibre yielding plant

**SEMESTER- VIII : CLUSTER ELECTIVE -A**

**Paper VIII-A-2 : ETHNOBOTANY AND MEDICINAL BOTANY**
**Total hours of teaching 60hrs @ 3hrs per week**

**Unit –I**: **Ethnobotany (12hrs)**

i. Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context

ii. Major and minor ethnic groups or Tribals of India, and their life styles.

iii. Plants used by the tribal populations: a) Food plants, b) intoxicants and beverages, c) Resins and oils and miscellaneous uses.

**Unit -II**: **Role of ethnobotany in modern Medicine**: **(12hrs)**

i. Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina*, *Trichopus zeylanicus*, *Artemisia annua, Withania somnifera.*

ii. Medico-ethnobotanical sources in India

iii. Significance of the following plants in ethno botanical practices (along with their habitat and morphology)

a) *Azadirachta indica*, b*) Ocimum sanctum*, c) *Vitex negundo*, d) *Gloriosa superba*, e) *Tribulus terrestris,* f) *Phyllanthus niruri ,* g) *Cassia auriculata,* h) *Indigofera tinctoria ,* i) *Senna auriculata* j).*Curcuma longa.*

*iv.* Role of ethnic groups in the conservation of plant genetic resources.

**Unit-III: Ethnobotany as a tool to protect interests of ethnic groups (12hrs)**

i. Sharing of wealth concept with few examples from India.

ii. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

**Unit -IV: History, Scope and Importance of Medicinal Plants. indigenous Medicinal Sciences (12hrs)**

i. Definition and Scope-**Ayurveda**: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments.

ii. **Siddha**: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine.

iii. **Unani**: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations (in brief).

**Unit -V: Conservation of endangered and endemic medicinal plants**: **(12hrs)**

i. Definition: endemic and endangered medicinal plants,
ii. Red list criteria
*iii. In situ* conservation: Biosphere reserves, sacred groves, National Parks
*iv. Ex situ* conservation: Botanical Gardens.

**Suggested Activities**: Studying plant utilization methods by tribal/rural/migrant populations for their beverages, food,medicinal and uses, seminars on role of ethnic groups in conservation of plant genetic resources, project work on traditional knowledge about plant medicines, study of indigenous medicinal sciences and their efficacy.

**Suggested Readings:**

1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981.
3) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4) S.K. Jain, 1990. Contributions of Indian ethnobotny.Scientific publishers, Jodhpur.
5) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
6) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah.
7. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
8. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.
9. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta
10. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today& Tomorrow's printers and publishers, New Delhi

**Cluster Elective VIII-A-2: Practical:**

ETHNOBOTANY AND MEDICINAL BOTANY

1. Ethnobotanical specimens as prescribed in theory syllabus
2. Detailed morphological and anatomical study of medicinally important part(s) of locally available plants (Minimum 8 plants) used in traditional medicine.
3. Field visits to identify and collect ethno medicinal plants used by local tribes/folklore.

**Domain skills expected to achieve**: Identification of various plant parts used as medicines by ethnic groups, understanding the difference between ancient wisdom and modern system of medicine, traditional medicine at the rescue of curing drug resistant maladies like malaria and viral diseases, understanding the role of spices in Indian kitchens, their therapeutic role

**PRACTICAL- VIII-A-2 Cluster Elective : MODEL QUESTION PAPER**

**Paper VIII-A-2: ETHNOBOTANY AND MEDICINAL BOTANY**

Time: 3 Hours Max. Marks- 50

I. Identify the specimen A- Give reasons (morphological and anatomical) and draw labeled sketches 15marks

II. Identify and write about the medicinal uses of B-and C- 2x5= 10 marks.

III. Comment on D and E. 2x 4=8 marks

IV. Report on Field visit: 7 marks

List to be prepared mentioning special features of plants used by tribal populations as Medicinal Plants & Spices. Write their botanical and common names, parts used and diseases/disorders for which they are prescribed.

V. Viva-voce 5 marks

VI. Record 5 marks

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Total = 50 marks

KEY

A-Plants given in unit II (i)

B-Plants used in Ayurvedic prearations (Amla in Chyavanprash, Senna in Laxatives)

C - - Do -

D. Photographs of National parks, Biosphere reserves and Botanical gardens.

E. Photograph of famous personalities in Ayurveda/Siddha medicine.

**SEMESTER- VI CLUSTER ELECTIVE, Paper VIII-A-3**

**Paper VIII-A-3: Pharmacognosy and Phytochemistry**

Total hours of teaching 60hrs @ 3hrs per week

**Unit-I: Pharmacognosy (12hrs)**

Definition, Importance, Classification of drugs - Chemical and Pharmacological, Drug evaluation methods

**Unit –II: Organoleptic and microscopic studies: (12hrs)**

Organoleptic and microscopic studies with reference to nature of active principles and common adulterants of *Alstonia scholaris* (bark), *Adhatoda vasica*(leaf), *Strychnos nuxvomica* (seed), R*auwolfia serpentina*(root) and *Zinziber officinalis* C*atharanthus roseus.*

**Unit-III: Secondary Metabolites: (12hrs)**

i. Definition of primary and secondary metabolites and their differences, major types - terpenes, phenolics, alkaloids, terpenoids, steroids.

ii. A brief idea about extraction of alkaloids.Origin of secondary metabolites – detailed account of acetate pathway, mevalonate pathway, shikimate pathway.

**UNIT-IV: Phytochemistry: (12hrs)**

Biosynthesis and sources of drugs:

(i) Phenols and phenolic glycosides : structural types, biosynthesis, importance of simple phenolic compounds, tannins, anthraquinones, coumarins and furanocoumarins, flavones and related flavonoid glycosides, anthocyanins, betacyanins, stilbenes, lignins and lignans).

(ii) Steroids, sterols, saponins, withanolides, ecdysones, cucurbitacins: Biosynthesis, commercial importance.

(iii) Alkaloids: Different groups, biosynthesis, bioactivity.

(v) Volatile oils, aromatherapy.

**UNIT-V: Enzymes, proteins and amino acids as drugs**: (**12hrs)**

i. Vaccines, toxins and toxoids, antitoxins, immune globulins, antiserums,

ii. Vitamins, Antibiotics – chemical nature, mode of action.

iii. Pharmacological action of plant drugs – tumor inhibitors, PAF antagonists, antioxidants, phytoestrogens and others.

iv. Role of different enzyme inhibitors.

**Suggested Activities**: Isolation techniques of active principles from various parts of popular medicinal plants, debates on the efficacy of plant medicines and palliative cure, volatile oils from plants-extraction methods, project work on crude drugs

**BOOKS FOR REFERENCE:**

1. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd. 2. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.

2. Gurdeep Chatwal, 1980. Organic chemistry of natural productis. Vol.I.Himalaya Publishing house.

3. Kalsi, P. S. and Jagtap, S., 2012. Pharmaceutical medicinal and natural product chemistry N.K. Mehra . Narosa Publishing House Pvt. Ltd. New Delhi.

4. Agarwal, O. P. 2002. Organic chemistry–Chemistry of organic natural products. Vol. II. Goel publishing house , Meerut.

5. Harborne, J. B. 1998. Phytochemical methods –a guide to modern techniques of plant analysis 3 rd edition, Chapman and Hall

6. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizome drugs. Bulletin No.1 Ministry of Health, Govt. of India.

**VIII-A-3: Pharmacognosy and Phytochemistry: PRACTICALS**

1. Physical and chemical tests for evaluation of unorganized drugs- Asaphoetida. Honey, Castor oil. Acacia
2. Identification of bark drugs – cinchona, cinnamom
3. Identification of fruit drugs – Cardamom, Coriander
4. Identification of root and rhizome drugs- Ginger, Garlic, Turmeric
5. Identification of whole plant – Aloes,Vinca, Punarnava
6. Herbarium of medicinal plants ( minimum of 20 platns)
7. Collection of locally available crude drugs from local venders (minimum of 20)

**Domain skills expected to achieve**: Identification of various plant parts used as medicines, extraction of active principles from them, isolation by chromatographic techniques, learning callus culture techniques for secondary metabolite enrichment and understanding ethno-pharmacological principles

**PRACTICAL: VIII-A-3 Cluster Elective: MODEL QUESTION PAPER**
**Pharmacognosy and Phytochemistry**

Time: 3hrs. Max. Marks=50

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I. Identify the given crude drugs **A& B** by morphological study and chemical tests. **10 marks**

II. Perform suitable chemical test and identify the given phytochemical **C** **10 marks**

III. Comment on D and E **2x5=10 marks**

IV. Herbarium and submission of drugs **10 marks**

IV. Viva-Voce **5 marks**

V. Practical Record **5 marks**

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**Total = 50 marks**

**KEY**

A-Flower/fruit drugs
B-Rhizome/whole plant drugs
C- Tannins/ phenolics/steroids/ isoprenoids /Asaphoetida/ Honey/ Castor oil/ Acacia
D. Column Chromatography/ Gas Chromatogram/HPLC (photograph/ instrument used for chemical analysis of drugs
E. photograh/instrument used for tissue culture

SEMESTER- VI

**CLUSTER ELECTIVE-B, PAPER–VIII-B-1**

**Paper VIII-B-1: Biological instrumentation and Methodology**

Total hours of teaching 60hrs @ 3hrs per week

**Unit -I: Imaging and related techniques**: **(12hrs)**

Principles of microscopy; Light microscopy; Fluorescence microscopy; Electron Microscopy (a) Flow cytometry (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

**Unit- II: pH and Centrifugation: (12 hrs)**

pH meter: Principles and instrumentation, Centrifugation: Principles, types of centrifuges, types of rotors, differential and density gradient centrifugation, application. Sonication, Freeze drying.

**Unit- III: Spectrophotometry: (12hrs)**

Principle involved in Spectrophotometer; Spectrophotometric techniques, Instrumentation: ultraviolet and visible spectrophotometry (single and double beam, double wavelength spectrophotometers), Infrared spectrometers - Luminometry and densitometry – principles and their applications - Mass Spectroscopy- principles of analysis, application in Biology.

**Unit- IV: Chromatography: (12hrs)**

Chromatographic techniques: Principle and applications – Column - thin layer –paper, affinity and gaschromatography - Gel filtration - Ion exchange and High performance liquid chromatography techniques– Examplesof application for each chromatographic system - Basic principles of electrophoresis.

**Unit-V:Preparation of molar, molal and normal solutions, buffers, the art of scientific writing (12hrs)**

Understanding the details on the label of reagent bottles.Molarity and normality of common acids and bases.Preparation of solutions.Dilutions.Percentage solutions.Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.

The art of scientific writing and presentation of scientific matter.Scientific writing and ethics.Writing references.Powerpoint presentation.Poster presentation.

Introduction to copyright-academic misconduct/plagiarism in scientific writing.

**Suggested Readings:**

1. Bajpai, P.K. 2006. Biological Instrumentation and methodology. S. Chand & Co. Ltd.
2. K. Wilson and J. Walker Eds. 2005. Biochemistry and Molecular Biology.
Cambridge University Press.
3. K. Wilson andKHGoulding. 1986. Principles and techniques of Practical
Biochemistry. (3 edn) Edward Arnold, London.

4. Dawson, C. (2002). Practical research methods.UBS Publishers, New Delhi.

5. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific

writing for agricultural research scientists – a training reference manual.

West Africa Rice Development Association, Hong Kong.

6. Ruzin, S.E. (1999). Plant micro technique and microscopy. Oxford

University Press, New York, U.S.A.

**Suggested activities**: Preparing various laboratory reagents, operating laboratory instruments, noting instrument readings, calculating results accurately, Skills on writing scientific articles, presentation of scientific results through tables, graphs, poster presentations and practicing power point presentations.

**Paper VIII-B-1: PRACTICAL SYLLABUS**

1. Microscopy – Light microscopy: principles, parts & function

2. Micrometry- principle and measurement of microscopic objects: Low power and high power.

3. Camera Lucida drawing with magnification and scale.

4. Principle and working of phase contrast microscope

5. Principle & operation of Centrifuge

6. Preparation of standard acid and alkali and their standardization.

b) Preparation of various solutions (normal, molar, and percent) and ppm/ppb by serial dilutions

7. Study of principle and working of pH meter and Measurement of pH of

Milk, Pepsi, Lemon juice etc. using pH paper and pH meter

8. Study of principle of Chromatography and separation of amino acids mixture By ascending Paper Chromatography

7. Principle & operation of Colorimeter

8. Principle & operation of Spectrophotometer

9. Chromosome banding, FISH, chromosome painting

9. Principle and technique of TLC (demonstration)

10. TLC separation of Amino acids from purified samples and biological materials (demonstration)

11 PCR - The Polymerase Chain Reaction (protocol) -demonstration

13. Study visit to an institute /laboratory

**Domain skills expected to achieve**:

Skill in operating laboratory equipment, their upkeep, and adept at various biological techniques. Ability to prepare molar, molal, normal solutions and solutions of different dilutions. Interpreting scientific results, and ability to present results in a scientific way through graphs, photographs, poster presentations and power point presentations.

**Paper VIII-B-1: Theory: Biological instrumentation and Methodology**

**PRACTICAL MODEL PAPER**

1. Perform the experiment (A). Write the protocol of the experiment 15 marks

2. Measure the pH of given sample (B) using pH paper and pH meter. Write the procedure and observation. 10 marks

3. Identify C, D, and E. Write the principle and use of them. 3X5 -15 marks

4. Viva voce on Field visit 05 marks

5. Record 05 marks

**Key**

A. Amino acid separation by paper chromatography
B. Milk, Pepsi, Lemon juice etc
C. Camera Lucida/ Micrometer/phase contrast microscope
D. Colorimeter/ Spectrophotometer
E. Chromosome banding, FISH, chromosome painting

(Cluster Electives –B)

**SEMESTER- VI, CLUSTER ELECTIVE -2-B**

**Paper VIII-B-2: Mushroom Culture and Technology**

Total hours of teaching 60hrs @ 3hrs per week

**Unit I: Introduction, history**: (12hrs)

Introduction - history - scope of edible mushroom cultivation, Types of edible mushrooms available in India –*Volvariellavolvacea*, *Pleurotuscitrinopileatus*, *Agaricusbisporus.* Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms.

**UNIT II:Pure culture-spawn preparation: (12hrs)**

Pure culture - preparation of medium (PDA and Oatmeal agar medium)sterilization - preparation of test tube slants to store mother culture – culturing of *Pleurotus* mycelium on Petriplates, preparation of mother spawn in saline bottle and polypropylene bag and their multiplication.

**Unit III: Cultivation Technology**: **(12hrs)**

Infrastructure: Substrates (locally available) Polythene bags, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, composting technology in mushroom production.

**Unit IV:Storage and nutrition : (12hrs)**

Short-term storage (Refrigeration - up to 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content – Vitamins.

**Unit V:FoodPreparation: (12hrs)**

Types of foods prepared from mushrooms;soup,cutlet omlette,samosa,pickles and curry .ResearchCentres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

**Suggested Readings:**

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.
5. Biswas, S., M. Datta and S.V. Ngachan. 2011. Mushrooms: A Manual For Cultivation. PHI learning private Ltd., New Delhi, India.
6. Chang, S. and P.G. Miles. 2004. Mushrooms: cultivation, nutritional value, medicinal effect, and environmental impact. CRC Press. USA.
7. Miles, P.G. and S. Chang. 1997. Mushroom Biology: Concise basics and current developments. World Scientific Publishing Co. Pte.Ltd. Singapore.

**Suggested activities**: Growing spawn on laboratory prepared medium in petriplates and maintaining, preparing compost and compost beds, packing of beds, spawning, maintaining moisture, picking, blanching and packing. Collecting naturally growing mushrooms and identifying them properly,visits to mushroom houses.

**Paper VIII-B-2: PRACTRICAL SYLLABUS**

1. Identification of different edible and poisonous mushrooms.
2. Microscopic and anatomical observations of different mushroom species.
3. Pure culture - preparation of medium (PDA and Oatmeal agar medium) sterilization.
4. Isolation and preparation of spawn under controlled conditions(preparation of mother spawn in saline bottle and polypropylene bag and their multiplication).
5. Types of Compost preparation and sterilization.
6. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves/waste.
7. Inoculation and spawning of compost.
8. Incubation and harvesting of mushrooms (collection, drying and preservation).
9. Diseases of mushrooms (photographs).
10. Post-harvest technology steps (photographs).
11. Study tour to mushroom cultivation farms
12. Project work – cultivation of paddy straw/ oyster/white button mushrooms.

**Domain skills expected to achieve:** Identification of different edible species, skill in media and substrate preparation, isolation of pure culture for spawn, compost preparation, and practices in growing methods of different cultivated mushrooms, Postharvest handling and packing

## SCHEME OF PRACTICAL EXAMINATION

**PAPER – VIII-B-2 (Cluster Elective): Mushroom Culture and Technology**

PRACTICAL- VIII-B-2: Cluster Elective (MODEL QUESTION PAPER)

Time: 3hrs Max. Marks: 50

| | | |
|---|---|---|
| I. | Prepare the culture medium for isolation of spawn and make the slants. Write the protocol for preparation of the medium (A) | 20 marks |
| II. | Write the protocol for preparation of compost (B) | 08 marks |
| III. | Comment on given specimens C, D and E | 3x4 = 12 marks |
| IV. | Report on Field visit | 05 marks |
| V. | Practical Record | 05 marks |
| | Total = | 50 marks |

**KEY**

A-PDA /Oatmeal agar medium
B- Paddy straw compost
C – Edible mushroom (Photograph)
D- Poisonous mushroom (Photograph)
E. Preservation technique (Photograph)

Cluster Electives - B

**III B.Sc.: Botany Syllabus Semester- VI, Theory: Cluster Elective –B-3**

**PAPER – VIII-B-3 (Cluster Elective)**

**Paper VIII-B-3: Internship/ Project Work preferably either in an Institute or Industry**

# ZOOLOGY

## ZOOLOGY SYLLABUS FOR V SEMESTER
## ZOOLOGY - PAPER - V
## ANIMAL BIOTECHNOLOGY

**Periods:60** **Max. Marks:100**

**Unit 1: Tools of Recombinant DNA technology - Enzymes and Vectors**

**Restriction modification systems:** Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering

**DNA modifying enzymes and their applications:** DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases

**Cloning Vectors:** Plasmid vectors:pBR and pUC series, Bacteriophage lambda and M13 based vectors, Cosmids, BACs, YACs,

**Unit 2 Techniques of Recombinant DNA technology**

**Cloning**: Use of linkers and adaptors

**Gene delivery:** Microinjection, electroporation, biolistic method (gene gun), liposome and viral-mediated delivery

**PCR:** Basics of PCR.

**DNA Sequencing**: Sanger's method of DNA sequencing- traditional and automated sequencing

**Hybridization techniques:** Southern, Northern and Western blotting,

**Genomic and cDNA libraries**: Preparation and uses

**UNIT 3 Animal Cell Technology**

**Cell culture media:** Natural and Synthetic

**Cell cultures:** primary culture, secondary culture, continuous cell lines; Protocols for Primary Cell Culture; Established Cell lines (common examples such as MRC, HeLa, CHO, BHK, Vero); Organ culture; Cryopreservation of cultures.

**Hybridoma Technology:** Cell fusion, Production of Monoclonal antibodies (mAb), Applications of mAb

**Stem cells:** Types of stem cells, applications

**Unit 4 Reproductive Technologies & Transgenic Animals**

**Manipulation of reproduction in animals:** Artificial Insemination, *In vitro* fertilization , super ovulation, Embryo transfer, Embryo cloning

**Transgenic Animals:** Strategies of Gene transfer; Transgenic - sheep, - fish; applications

**Unit 5 Applied Biotechnology**

**Industry:** Fermentation: Different types of Fermentation: Short notes on - Submerged & Solid state; batch, Fed batch & Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized; Downstream processing - Filtration, centrifugation, extraction, chromatography, spray drying and lyophilization

**Agriculture:** fisheries – monoculture in fishes, polyploidy in fishes; DNA fingerprinting

## ZOOLOGY PRACTICAL SYLLABUS FOR V SEMESTER
## ZOOLOGY - PAPER - V
## ANIMAL BIOTECHNOLOGY

**Periods: 24** **Max. Marks: 50**

Any SIX of the following:

1. Maintenance and storage of*E.coli* DH5 alpha cells.
2. Isolation of Plasmid DNA from *E.coli*
3. Preparation of genomic DNA from *E. coli*/animals/ human.
4. DNA quantification using agarose gel electrophoresis (by using lambda DNA as standard).
5. Restriction digestion of lambda (λ) DNA using EcoR1 and Hind III.
6. Preparation for insertion and vector for ligation.
7. Performance of ligation reaction using T4 DNA ligase.
8. Preparation of competent cells
9. Transformation of *E. coli* with plasmid DNA using CaCl2,
10. Selection of transformants on X-gal and IPTG
11. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting
12. Interpretation of sequencing gel electropherograms
13. Amplification of DNA by PCR
14.Packing and sterilization of glass and plastic wares for cell culture.
15,Preparation of culture media.

**SUGGESTED READING**


1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
5. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
6. Brown TA. (2007). Genomes-3. Garland Science Publishers
7. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.
8. Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994.BIOS Scientific Publishers Limited.
9. Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.
10. P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2003).
11. B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001)

## ZOOLOGY SYLLABUS FOR V SEMESTER

## ZOOLOGY - PAPER - VI

## ANIMAL HUSBANDRY

**Periods:60** **Max. Marks: 100**

**UNIT – I : 10 Hours**

General introduction to poultry farming. Principles of poultry housing. Poultry houses. Systems of poultry farming. Management of chicks, growers and layers. Management of Broilers.

**UNIT – II: 10 Hours**

Poultry feed management – Principles of feeding. Nutrient requirements for different stages of layers and broilers. Methods of feeding. Poultry diseases – viral, bacterial, fungal and parasitic (two each); symptoms, control and management.

**UNIT – III: 10 Hours**

Selection, care and handling of hatching eggs. Egg testing. Methods of hatching. Brooding and rearing. Sexing of chicks.

**UNIT- IV: 20 Hours**

Breeds of Dairy Cattle and Buffaloes – Definition of breed; Classification of Indian Cattle breeds, exotic breeds and Indian buffalo breeds. Systems of inbreeding and crossbreeding. Housing of dairy animals – Selection of site for dairy farm; systems of housing – loose, housing system. Conventional dairy barn. Cleaning and sanitation of dairy farm. Weaning of calf. Castration and dehorning. Deworming and Vaccination programme. Records to be maintained in a dairy farm.

**UNIT - V: 10 Hours**

Care and management of dairy animals - Care and management of calf, heifer, milk animal, dry and pregnant animal, bulls and bullocks.

## ZOOLOGY PRACTICAL SYLLABUS FOR V SEMESTER

## ZOOLOGY –PRACTICAL - VI

## ANIMAL HUSBANDRY

**Periods:24** **Max. Marks: 50**

1. Study of various breeds of layers and broilers (photographs)

2. Identification of disease causing organisms in poultry birds (as per theory)

3. Study of the anatomy of a poultry bird by way of dissecting a bird. (Demonstration)

4. Study of various activities in a poultry farm (layers and broilers) and submission of a report.

5. Study of various breeds of cattle (photographs/microfilms)

6. Study of various activities carried out in a dairy farm and submission of a report.

## ZOOLOGY SYLLABUS FOR VI SEMESTER
## ZOOLOGY –ELECTIVE PAPER:VII-(A)
## IMMUNOLOGY

**Periods:60** **Max. Marks:100**

**Unit - I**

**1.1 Overview of Immune system**

1.1.1 Introduction to basic concepts in Immunology

1.1.2 Innate and adaptive immunity

**1.2 Cells and organs of Immune system**

1.2.1 Cells of immune system

1.2.2 Organs of immune system

**Unit - II**

**2.1 Antigens**

2.1.1 Basic properties of antigens

2.1.2 B and T cell epitopes, haptens and adjuvants

2.1.3 Factors influencing immunogenicity

**Unit - III**

**3.1 Antibodies**

3.1.1 Structure of antibody

3.1.2 Classes and functions of antibodies

3.1.3 Monoclonal antibodies

**Unit - IV**

**4.1 Working of Immune system**

4.1.1 Structure and functions of major histocompatibility complexes

4.1.2 Exogenes and Endogenes pathways of antigen presentation and processing

4.1.3 Basic properties and functions of cytokines

**Unit - V**

**5.1 Immune system in health and disease**

5.1.1 Classification and brief description of various types of hyper sensitivities

5.1.2 Introduction to concepts of autoimmunity and immunodeficiency

**5.2 Vaccines**

5.2.1 General introduction to vaccines

5.2.2 Types of vaccines

## ZOOLOGY PRACTICAL SYLLABUS FOR VI SEMESTER
## ZOOLOGY - ELECTIVE PAPER – VII-(A)
## IMMUNOLOGY

**Periods: 24** **Max. Marks: 50**

1. Demonstration of lymphoid organs (as per UGC guidelines)
2. Histological study of spleen, thymus and lymph nodes (through prepared slides)
3. Blood group determination
4. Demonstration of
    a. ELISA
    b. Immunoelectrophoresis

## ZOOLOGY SYLLABUS FOR VI SEMESTER
## ZOOLOGY - ELECTIVE PAPER: VII-(B)
## CELLULAR METABOLISM AND MOLECULAR BIOLOGY

**Periods: 60** **Max. Marks:100**

### Unit I: Biomolecules

1.1 Carbohydrates - Classification of carbohydrates. Structure of glucose
1.2 Proteins - Classification of proteins. General properties of amino acids
1.3 Lipids - Classification of lipids
1.4 Nucleic acids - DNA – Structure and function; RNA - Structure, types and functions

### Unit II: Enzymes and Cellular Metabolism

2.1. Introduction to biocatalysis, Enzymes and their classification, Enzymekinetics. Mechanism of action.Inhibition and Regulation
2.2 Carbohydrate Metabolism - Glycolysis, Krebs Cycle, Gluconeogenesis,
2.3 Glycogen metabolism, Review of electron transport chain

### Unit - III : Cellular Metabolism and Cell Physiology

3.1 Lipid Metabolism - Biosynthesis and β oxidation of palmitic acid
3.2 Protein metabolism - Transamination, Deamination and Urea Cycle
3.3 Transport functions of plasma membrane – Active, passive and facilitated transport
3.4 Cell junctions – Tight junctions, desmosomes, gap junctions

### Unit - V: Gene Expression

3.1 Gene Expression in prokaryotes (Lac Operon)
3.2 Gene Expression in eukaryotes.
3.3 Transcription and Translation.

**ZOOLOGY PRACTICAL SYLLABUS FOR VI SEMESTER**
**ZOOLOGY - ELECTIVE PAPER: VII-(B)**
**CELLULAR METABOLISM AND MOLECULAR BIOLOGY**

**Periods: 24** **Max. Marks: 50**

1. Qualitative tests to identify functional groups of carbohydrates in given Solutions (Glucose, Fructose, Sucrose, Lactose)
2. Estimation of total protein in given solutions by Lowry's method.
3. Study of activity of salivary amylase under optimum conditions
4. Preparation of permanent slide to show the presence of Barr body in
   Human female blood cells or cheek cells
5. Mounting of salivary gland chromosomes of *Chiranomous*

SUGGESTED READINGS


1. J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition .W.H. Freeman and Co.
2. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IVEdition. W.H. Freeman and Co.
3. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper's Illustrated Karp, G. (2010), Cell and molecular biology : Concepts and experiments. VI edition. John Wiley and sons. Inc.
4. De Robertis, EDP and De Robertis EMF (2006). Cell and molecular biology. VIII edition. Lippincott Williams and Wilkins, Philadelphia Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

## ZOOLOGY SYLLABUS FOR VI SEMESTER
## ZOOLOGY - ELECTIVE PAPER: VII-(C)
## BIOINFORMATICS

**Periods: 60** **Max. Marks: 100**

**UNIT I - HISTORY, SCOPE AND IMPORTANCE** (10 hours)

Important contributions - aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - internet basics- HTML introduction to NCBI data model- Various file formats for biological sequences

**UNIT II - DATABASES - TOOLS AND THEIR USES** (15 hours)

Importance of databases - Biological databases-primary sequence databases; Composite sequence databases- Secondary databases- nucleic acid sequence databases - Protein sequence data bases - structure databases - bibliographic databases - specialized genomic resources- analysis packages

**UNIT III - SEQUENCE ALIGNMENT METHODS** (15 hours)

Sequence analysis of biological data-Significance of sequence alignment pair wise sequence alignment methods- Use of scoring matrices and gap penalties in sequence alignments- multiple sequence alignment methods - Tools and application of multiple sequence alignment.

**UNIT IV - PREDICTIVE METHODS USING DNA AND PROTEIN SEQUENCES** (10 hours)

Gene predictions strategies - protein prediction strategies - molecular visualization tools-phylogenetic analysis: Concept of trees- phylogenetic trees and multiple alignments.

**UNIT V - DRUG DISCOVERY PROCESS** (10 hours)

Discovering a drug - target identification and validation - identifying the lead compound - optimization of lead compound - chemical libraries.

## ZOOLOGY PRACTICAL SYLLABUS FOR VI SEMESTER
## ZOOLOGY –ELECTIVE PAPER: VII-(C)
## BIOINFORMATICS

**Periods: 24** **Max. Marks: 50**

1. Introduction to Computers.
2. Hands on experience on NCBI databases
3. Sequence alignment with BLASTA and FASTA
4. Construction of Phylogenetic tree.
5. Demonstration of Protein visualization (if software available)

## ZOOLOGY SYLLABUS FOR CLUSTER ELECTIVE VIII-A: VI SEMESTER

## MEDICAL DIAGNOSTICS

**Cluster Elective Paper: VIII-A-1**

### CLINICAL BIOCHEMISTRY

Hours 60 Marks 100

**UNIT – I: Basic Medical Laboratory Principles and Procedures: 10 Hours**

Introduction to clinical biochemistry. Glassware. Solutions and Reagents – Normal, Molar, percent, buffer solutions and indicators. Equipments and Instruments – Centrifuges, Hot air oven, Incubator, Water bath, Photometer, Spectrophotometer, Analyzers. Quality Control.

**UNIT – II: Clinical Biochemistry of Carbohydrates, Proteins & Lipids: 20 Hours**

Elementary classification and metabolism of carbohydrates. Properties of carbohydrates. Regulation of blood sugar and Diabetes. Glucose Tolerance Test. Glycosylated Haemoglobin. General classification of proteins. Structure of proteins. Summary of protein digestion and aminoacid metabolism. Determination of serum proteins. General lipid metabolism. Primary and Secondary Dyslipoproteinemias.

**UNIT – III: Clinical Biochemistry of Enzymes: 10 Hours**

Enzymes as catalysts. Enzyme specificity. Factors which affect enzyme activity. Coenzymes and Isoenzymes. Enzymes classification and nomenclature. Enzymes in clinical diagnosis. Use of enzymes as reagents. Laboratory determinations of enzymes – Clinical significance of SGOT, SGPT, S.ALP, S.ACP, Serum Amylase.

**UNIT- IV: Water & Mineral Metabolism and Acid-Base Balance: 10 Hours**

Body fluid distribution. Factors which influence the distribution of body water. Mineral metabolism. Importance of the trace elements. Flame photometry. Action of buffer systems. Disturbances in acid-base balance

**UNIT - V: Function Tests: 10 Hours**

Diseases of the kidneys. Creatine metabolism. Bile pigment metabolism. Disordered Bilirubin metabolism. Hepatic Jaundice and Post hepatic jaundice. Ischemic heart disease. Clinical significance of gastric analysis.

**SUGGESTED READINGS**


- Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
- Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology, II Edition, Bhalani Publishing House
- Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
- Guyton A.C. and Hall J.E. Textbook of Medical Physiology.
- Robbins and Cortan, Pathologic Basis of Disease, VIIIEdition.
- Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

**Cluster Elective Paper: VIII-A-2**

**HAEMATOLOGY**

Hours 60 Marks 100

**UNIT – I: Laboratory Preparation in Haematology: 10 Hours**

Introduction to practical. Basic requirements. Collection of blood. Anticoagulants and effects of anticoagulants on blood cell morphology. Effects of storage of blood.

**UNIT – II: Routine Haematology: 15 Hours**

Composition of blood. Haemoglobin synthesis. Various haemoglobins. Haemopoietic system of the body. Blood cell counts. Erythropoiesis, Leucopoiesis and development of blood corpuscles. Thrombopoiesis. Laboratory technique of haemocytometry. Clinical significance of Total erythrocyte count, total leucocyte count, differential count, erythrocyte sedimentation rate and platelet count.

**UNIT – III: Haemostasis and Haematological Diseases: 15 Hours**

General consideration of blood coagulation. Mechanism of coagulation. The fibrinolytic mechanism. Clinical significance of routine coagulation tests. Anaemia. Various types of anaemias – Iron deficiency anaemia, Aplastic anaemia, Perinicious anaemia, Sideroblastic anaemia and Sickel cell anaemia. Other haematological diseases – HDNB, Thalassaemia, Leukaemia. Parasitic infections of blood – structure and life cycle of Plasmodium vivax, types of malaria, Structure and life cycle of Wuchereria bancrofti.

**UNIT- IV: Automation in Haematology: 10 Hours**

General considerations. Blood cell counters. Flow through cytochemical differential counter. Automated coagulated systems.

**UNIT - V: Immunohaematology and Blood banking: 10 Hours**

Human Blood Group Systems. Inheritance of blood group systems. Blood transfusion.

**SUGGESTED READINGS**


- Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
- Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology, II Edition, Bhalani Publishing House
- Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
- Guyton A.C. and Hall J.E. Textbook of Medical Physiology.
- Robbins and Cortan, Pathologic Basis of Disease, VIIIEdition.
- Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

**Cluster Elective Paper: VIII-A-3**

**CLINICAL MICROBIOLOGY**

Hours 60 Marks 100

**UNIT – I: Introduction to Clinical Microbiology: 10 Hours**

Introduction to microbiology. Introduction to bacteriology. Classification of bacteria. Basic features of bacteria. Factors influencing the growth of bacteria. Morphology of bacteria. Normal bacterial flora of the body. Pathogenic microorganisms.

**UNIT – II: Clinical Bacteriology Laboratory & Staining methods: 15 Hours**

Requirements of a microbiological lab -– safe disposal strategies. Safetypractices to be followed in a microbiological laboratory. Sterilization and disinfection. Requirements in a microbiological lab. Microscopy. Automation in Bacteriology. Introduction to Staining. Gram Staining. Acid-Fast Staining. Capsule Staining. Transfer of bacteria.

**UNIT – III: Culturing of Microorganisms and Identification of Bacteria: 15 Hours**

Composition of culture media. Different types of culture media. Preparation of culture media. Inoculation of culture media. Culturing of anaerobes and different types of culture media used. Use, preparation and quality control of various culture media. Identification of bacteria – staining reactions, cultural characteristics and biochemical properties. Study of Gram Negative Bacteria – Bacilli and Cocci. Study of Gram Positive Bacteria – Gram positive Cocci, Anaerobic bacteria, study of genus – Bacillus and Corynebacterium. Study of Mycobacteria, Spirocahetes and Rickettsia. Basic sterilization principles - autoclaving.

**UNIT- IV: Clinical Mycology and Virology: 10 Hours**

Basic morphological classification of clinically important fungi. Parasitic fungi – Superficial Mycoses and Dermatophytes, Subcutaneous Mycoses, Intermediate Superficial Deep Mycoses and Deep or Systemic mycoses. Classification based on symptomatology. Some important viruses and related diseases (Measles viruses, Influenza viruses, Rotaviruses, PoliovirusesHerpes viruses, Rabies viruses, Hepatitis viruses. . General transmission routes for viruses.

**UNIT - V: Diagnostic Serology: 10 Hours**

General view of immune system. Antibodies. Harmful effect of immunity. Autoimmune diseases. Principles of Serodiagnostic tests - Flocculation test, Agglutination test, Slide agglutination test, Tube agglutination test, Complement test, Micro titration test, Precipitin test and ELISA.

**SUGGESTED READINGS**


- Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
- Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology, II Edition, Bhalani Publishing House
- Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
- Guyton A.C. and Hall J.E. Textbook of Medical Physiology.
- Robbins and Cortan, Pathologic Basis of Disease, VIIIEdition.
- Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

## ZOOLOGY PRACTICAL SYLLABUS
## CLUSTER ELECTIVE –VIII-A: VI SEMESTER
## MEDICAL DIAGNOSTICS

### PRACTICAL – 1 CLINICAL BIOCHEMISTRY

- Collection of blood specimen and serum preparation.
- Blood glucose and urine glucose estimation.
- LFT, Kidney Function and Cardiac Profile tests.
- Determination of serum proteins, SGOT, SGPT, S.ALP, S.ACP
- Determination of sodium, potassium and chlorides

### PRACTICAL – 2 HAEMATOLOGY & CLINICAL MICROBIOLOGY

- Routine haematological tests – Blood smear preparation, TC, DC, ESR, Platelet count.
- Determination of Haemoglobin.
- Determination of PCV.
- Determination of bleeding time.
- Determination of blood clotting time.
- Blood Grouping.
- Preparation of nutrient agar, culture plates and isolation of bacteria on nutrient agar plate.
- Study of permanent slides of *Candida albicans, Enterobacter sps, Pseudomonas, Salmonella sps, Shigella sps, Staphylococcusaureus*, *Streptococcus pyogenes* and *Vibrio cholera*.
- Staining methods – Albert's and Gram's staining methods.
- Hepatitis test and Pregnancy test using ELISA
- VDRL qualitative and quantitative test.
- WIDAL slide agglutination and tube agglutination test.

### PRACTICAL - III:PROJECT WORK

Associated with a Clinical Diagnostic Laboratory.

## ZOOLOGY SYLLABUS FOR CLUSTER ELECTIVE –VIII-B: VI SEMESTER AQUACULTURE

**Cluster Elective Paper: VIII-B-1**

**PRINCIPLES OF AQUACULTURE**

**Periods:60** **Max.Marks:100**

### Unit – I

**1.1 Introduction / Basics of Aquaculture**

1.1.1 Definition, Significance and History of Aquaculture

1.1.2 Present status of Aquaculture – Global and National scenario

1.1.3 Major cultivable species for aquaculture: freshwater, brackish water and marine.

1.1.4 Criteria for the selection of species for culture

### Unit – II

**2.1 Types of Aquaculture**

2.1.1 Freshwater, Brackishwater and Marine

2.1.2 Concept of Monoculture, Polyculture, Composite culture, Monosex culture and Integrated fish farming

**2.2Culture systems**

2.2.1 Ponds, Raceways, Cages, Pens, Rafts and water recirculating systems

**2.3Culture practices**

2.3.1Traditional, extensive, modified extensive, semi-intensive and intensive cultures of fish and shrimp.

### Unit – III

**3.1 Design and construction of aquafarms**

3.1.1Criteria for the selection of site for freshwater and brackish water pond farms

3.1.2 Design and construction of fish and shrimp farms

**3.2 Seed resources**

3.2.1 Natural seed resources and Procurement of seed for stocking: Carp and shrimp

**3.3 Nutrition and feeds**

3.3.1 Nutritional requirements of a cultivable fish and shellfish

3.3.2 Natural food and Artificial feeds and their importance in fish and shrimp culture

**Unit – IV**

**4.1Management of carp culture ponds**

4.1.1 Culture of Indian major carps: Pre-stocking management – Dewatering, drying, ploughing/desilting; Predators, weeds and algal blooms and their control, Liming and fertilization; Stocking management – Stocking density and stocking; Post-stocking management – Feeding, water quality, growth and health care; and Harvesting ofponds

**4.2Culture of giant freshwater prawn,** *Macrobrachium rosenbergii*

**Unit – V**

**5.1Culture of shrimp** (*Penaeus monodon* or *Litopenaeus vannamei*)

**5.2 Culture of pearl oysters**

**5.3 Culture of seaweeds-**species cultured, culture techniques, important by-products, prospects

**5.4 Culture of ornamental fishes –** Setting up and maintenance of aquarium; and breeding.

**REFERENCES BOOKS**

1. Bardach, JE *et al*. 1972. *Aquaculture – The farming and husbandry of freshwater and marine organisms*, John Wiley & Sons, New York.
2. Bose AN et al.1991. *Coastal aquaculture Engineering*. Oxford & IBH Publ.Co.Pvt.Ltd.
3. Chakraborty C & Sadhu AK. 2000. *Biology Hatchery and Culture Technology of Tiger Prawn and Giant Freshwater Prawn.* Daya Publ. House.
4. FAO. 2007. *Manual on Freshwater Prawn Farming*.
5. Huet J. 1986. *A text Book of Fish Culture*. Fishing News Books Ltd.
6. ICAR. 2006. *Hand Book of Fisheries and Aquaculture*. ICAR.
7. Ivar LO. 2007. *Aquaculture Engineering*. Daya Publ. House.
8. Jhingran V.G. 2007. *Fish and Fisheries of India*. Hindustan Publ. Corporation, India.
9. Landau M. 1992. *Introduction to Aquaculture*. John Wiley & Sons.
10. Lovell RT.1998. *Nutrition and Feeding of fishes*. Chapman & Hall.
11. Mcvey JP. 1983. *Handbook of Mariculture*. CRC Press.
12. MPEDA: *Handbooks on culture of carp, shrimp, etc.*
13. New MB. 2000. *Freshwater Prawn Farming*. CRC Publ.
14. Pillay TVR.1990. *Aquaculture- Principles and Practices*, Fishing News Books Ltd., London.
15. Pillay TVR & Kutty MN. 2005. *Aquaculture- Principles and Practices*. 2nd Ed. Blackwell
16. Rath RK. 2000. *Freshwater Aquaculture*. Scientific Publ.

14. Stickney RR. 1979. *Principles of Warmwater Fish Culture*, John Wiley & Sons
15. Wheaton FW. 1977. *Aquacultural Engineering*. John Wiley & Sons.

**Cluster Elective Paper: VIII-B-2**

**AQUACULTURE MANAGEMENT**

**Periods : 60** **Max.Marks : 100**

## Unit – I

**1.1Breeding and Hatchery Management**

1.1.1 Bundh Breeding and Induced breeding of carp by Hypophysation; and use of synthetic hormones

1.1.2Types of fish hatcheries; Hatchery management of Indian major carps

1.1.3 Breeding and Hatchery management of *Penaeus monodon*/ *Litopenaeus vannamei*

1.1.4 Breeding and Hatchery management of giant freshwater prawn.

## Unit – II

**2.1 Water quality Management**

2.1.1Water quality and soil characteristics suitable for fish and shrimp culture

2.1.2 Identification of oxygen depletion problems and control mechanisms in culture ponds

2.1.3 Aeration: Principles of aeration and Emergency aeration

2.1.4 Liming materials, Organic manures and Inorganic fertilizers commonly used and their implications in fish ponds

## Unit – III

**3.1 Feed Management**

3.1.1Live Foods and their role in shrimp larval nutrition.

3.1.2 Supplementary feeds: Principal foods in artificial diets; Types of feeds; Feed additives and Preservatives; role of probiotics.

3.1.3 Feed formulation and manufacturing; Feed storage

3.1.4 Feeding strategies: Feeding devices, feeding schedules and ration size; Feed evaluation- feed conversion efficiencies and ratios

## Unit – IV

**4.1 Disease Management**

4.1.1 Principles of disease diagnosis and health management;

4.1.2 Prophylaxis, Hygiene and Therapy of fish diseases

4.1.3 Specific and non-specific defense systems in fish; Fish immunization and vaccination

4.1.4Etiology, Symptoms, prophylaxis and therapy of common fish diseases in fish ponds

4.1.5Etiology, Symptoms, prophylaxis and therapy of common shrimp diseases in shrimp ponds

## Unit – V

### 5.1 Economics and Marketing

5.1.1 Principles of aquaculture economics – Capital costs, variable costs, cost-benefit analysis

5.1.2Fish marketing methods in India; Basic concepts in demand and price analysis

### 5.2 Fisheries Extension

5.1.3 Fisheries Training and Education in India; Role of extension in community development.

### 5.3 Fish Genetics

5.1.4 Genetic improvement of fish stocks – Hybridization of fish.

5.1.5 Gynogenesis, Androgenesis, Polyploidy, Transgenic fish, Cryopreservation of gametes, Production of monosex and sterile fishes and their significance in aquaculture.

**REFERENCE BOOKS**

1. Boyd CE. 1979. *Water Quality in Warm Water Fish Ponds*. Auburn University
2. Boyd, CE. 1982. *Water Quality Management for Pond Fish Culture.* Elsevier Sci. Publ. Co.
3. Chakraborty C & Sadhu AK. 2000. *Biology Hatchery and Culture Technology of Tiger Prawn and Giant*
*Freshwater Prawn*. Daya Publ. House
4. Conroy CA and Herman RL. 1968. *Text book of Fish Diseases*. TFH (Great Britain) Ltd, England.
5Halver J & Hardy RW. 2002. *Fish Nutrition*. Academic Press.
6. Ian C. 1984. *Marketing in Fisheries and Aquaculture*. Fishing News Books.
7. ICAR. 2006. *Handbook of Fisheries and Aquaculture*. ICAR.
8. Jhingran VG. 2007. *Fish and Fisheries of India.* Hindustan Publishing Corporation, India.
9. Jhingran VG & Pullin RSV. 1985. *Hatchery Manual for the Common, Chinese and Indian Major Carps*.
ICLARM, Philippines.
10. Kumar D. 1996. *Aquaculture Extension Services Review: India.* FAO Fisheries CircularNo. 906, Rome.
11. Lavens P & Sorgeloos P. 1996. *Manual on the Production and Use of Live Food for Aquaculture.* FAO
Fisheries Tech. Paper 361, FAO.
12. MPEDA. 1993. *Handbook on Aqua Farming - Live Feed. Micro Algal Culture.* MPEDA Publication
13. New MB. 1987. *Feed and Feeding of Fish and Shrimp. A Manual on the Preparation and Preservation of*
*Compound Feeds for Shrimp and Fish in Aquaculture.* FAO – ADCP/REP/87/26
14. Pandian TJ, Strüssmann CA & Marian MP. 2005. *Fish Genetics and Aquaculture Biotechnology.* Science Publ.
15.Pilley, TVR & Dill, WMA. 1979. *Advances in Aquaculture*. Fishing News Books, Ltd. England.
16. Pillay TVR & Kutty MN. 2005. *Aquaculture- Principles and Practices*. Blackwell.
17. Ray GL. 2006. *Extension, Communication and Management.* 6th Ed. Kalyani Publ. Delhi.
18. ReddyPVGK, AyyappanS, ThampyDM & Gopalakrishna 2005.*Text Book of Fish Genetics and Biotechnol.*
ICAR
19. Reichenbach KH. 1965. *Fish Pathology.* TFH (Gt. Britain) Ltd, England.
20.Shang YC. 1990. *Aquaculture Economic Analysis - An Introduction.* World Aquaculture Society, USA.
21. Singh B. 2006. *Marine Biotechnology and Aquculture* Development. Daya Publ. House
22.Stickney RR. 1979. *Principles of Warm waterAquaculture*. John-Willey & sons Inc.
23. Swain P, Sahoo PK & Ayyappan S. 2005. *Fish and Shellfish Immunology: An Introduction*. Narendra Publ.
24. Thomas PC, Rath SC & Mohapatra KD.2003.Breeding and Seed Production of Finfish and Shellfish. Daya Publ.

**Cluster Elective Paper: VIII-B-3**

**POSTHARVEST TECHNOLOGY**

**Periods : 60** **Max.Marks : 100**

## Unit – I

**1.1 Handling and Principles of fish Preservation**

1.1.1 Handling of fresh fish, storage and transport of fresh fish, post mortem changes (rigor mortis and spoilage), spoilage in marine fish and freshwater fish.

1.1.2 Principles of preservation– cleaning, lowering of temperature, rising of temperature, denudation, use of salt, use of fish preservatives, exposure to low radiation of gamma rays.

## Unit – II

**2.1 Methods of fish Preservation**

2.1.1 Traditional methods - sun drying, salt curing, pickling and smoking.

2.1.2 Advanced methods – chilling or icing, refrigerated sea water, freezing, canning, Irradiation and Accelerated Freeze drying (AFD).

## Unit – III

**3.1 Processing and preservation of fish and fish by-products**

3.1.1Fish products – fish minced meat, fish meal, fish oil, fish liquid (ensilage), fish protein concentrate, fish chowder, fish cake, fish sauce, fish salads, fish powder, pet food from trash fish, fish manure.

3.1.2 Fish by-products – fish glue, ising glass, chitosan, pearl essence, shark fins, fish leather and fish maws.

**3.2Seaweed Products**

3.2.1Preparation of agar, algin and carrageen. Use of seaweeds as food for humanconsumption, in diseasetreatment and preparation of therapeutic drugs.

## Unit – IV

**4.1Sanitation and Quality control**

4.2.1 Sanitation in processing plants - Environmental hygiene and Personal hygiene in processing plants.

4.2.2 Quality Control of fish and fishery products – pre-processing control, control during processing and control after processing.

**4.2 Regulatory affairs in industries**

## Unit – V

**5.1 Quality Assurance, Management and Certification**

5.1.1Seafood Quality Assurance and Systems: Good Manufacturing Practices (GMPs); Good Laboratory Practices (GLPs); Standard Operating Procedures (SOPs); Concept of Hazard Analysis and Critical Control Points (HACCP) in seafood safety.

5.1.2 National and International standards – ISO 9000: 2000 Series of Quality Assurance System, Codex Alimentarius.

**REFERENCE BOOKS**

1. Balachandran KK. 2001. *Post-harvest Technology of Fish and Fish Products*. Daya Publ.
2. Bond, et al. 1971. *Fish Inspection and Quality Control.* Fishing News Books, England.
3. Clucas IJ. 1981. *Fish Handling, Preservation and Processing in the Tropics*. Parts I, II. FAO.
4. Gopakumar K. (Ed.). 2002. *Text Book of Fish Processing Technology*. ICAR.
5. Govindan, TK.1985. *Fish Processing Technology,* Oxford-IBH.
6. Hall GM. (Ed). 1992. *Fish Processing Technology*. Blackie.
7. Huss HH, Jakobsen M & Liston J. 1991. *Quality Assurance in the Fish Industry.* Elsevier.
8. John DEV. 1985. *Food Safety and Toxicity*. CRC Press.
9. Krenzer R. 1971. *Fish Inspection and Quality Control.* Fishing News.
10. Larousse J & Brown BE. 1997. *Food Canning Technology*. Wiley VCH.
11. Nambudiri DD. 2006. *Technology of Fishery Products*. Fishing Chimes.
12. Regenssein JM & Regenssein CE.1991. *Introduction to Fish Technology*.VanNostrand Reinhold.
13. Rudolf K. 1969. *Freezing and Irradiation of Fish.* Fishing News (Books).
14. Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ.

**ZOOLOGY PRACTICLSYLLABUSCLUSTER ELECTIVE PAPER: VIII-B**

**VI SEMESTER**

## AQUACULTURE

**PRACTICAL: I**

**Periods : 24** **Max.Marks : 50**

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**Cultivable fishes**

1. Identification and study of important cultivable and edible fishes - Any ten
2. Identification and study of important cultivable and edible crustaceans - Any five
3. Identification and study of common aquarium fishes – Any five
4. General description and recording biometric data of a given fish.

**Diseases**

1. Identification and study of fish and shrimp diseases - Using specimens / pictures
2. External examination of the diseased fish – diagnostic features and procedure.
3. Autopsy of fish – Examination of the internal organs.
4. Determination of dosages of chemicals and drugs for treating common diseases.

**Pond Management**

1. Water Quality -Determination of temperature, pH, salinity in the pond water sample;
Estimation of dissolved oxygen, free carbondioxide, total alkalinity, total hardness, phosphates and nitrites.
2. Soil analysis – Determination of soil texture, pH, conductivity, available nitrogen, available
phosphorus and organic carbon.
3. Identification and study of common zooplankton, aquatic insects and aquatic weeds – Each 5

**PRACTICAL - II**

**Periods :24** **Max.Marks : 50**

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**Nutrition**

1. Identification and study of Live food organisms – Any five
2. Formulation and preparation of a balanced fish feed
3. Estimation of Proximate composition of aquaculture feeds – Proteins, carbohydrates, lipids,
moisture, ash content.
4. Gut content analysis to study artificial and natural food intake.

**Post harvest Technology**

1. Evaluation of fish/ fishery products for organoleptic, chemical and microbial quality.
2. Preparation of dried, cured and fermented fish products, examination of salt, protein, moisture in dried / cured products, examination of spoilage of dried / cured fish products, marinades, pickles, sauce.
3. Preparation of isinglass, collagen and chitosan from shrimp and crab shell. ?
4. Developing flow charts and exercises in identification of hazards – preparation of hazard
analysis worksheet, plan form and corrective action procedures in processing of fish.

**PRACTICAL - III**

**Project Work**

Visit to a fish breeding centre / fish farms and submit a project report
or
Visit to a feed manufacturing unit and submit a project report
or
Visit to a shrimp hatchery / shrimp farms and submit a project report
or
Visit to a shrimp processing unit and submit a project report

**ZOOLOGY SYLLABUS FOR CLUSTER ELECTIVE: VIII-C**
**VI SEMESTER**

## SERICULTURE

**Cluster Elective Paper: VIII-C-1**

**GENERAL SERICULTURE, MULBERRY CULTIVATION AND MANAGEMENT**

Hours 60 Marks 100

**Unit - I : Introduction**

1.1 Definition, history and present status of Sericulture
1.2 Types of silk worms and their food plants
1.3 Prospects of Sericulture in India - Sericulture industry in different states, employment, potential in mulberry and non mulberry Sericulture

**Unit - II : Morphology of mulberry plant**

2.1 Common varieties of mulberry used in India
2.2 Characters of root, stem and leaf
2.3 Anatomy of root, stem and leaf
2.4 Male and female reproductive organs, pollination, fertilization, development of seed.

**Unit - III : Requirements for mulberry cultivation**

3.1 Physical and chemical properties of soil and its nature
3.2 Soil moisture and water requirements
3.3 Climatic conditions - Temperature, photoperiod, humidity and rain fall

**Unit - IV : Mulberry management**

4.1 Land preparation - leveling and ploughing
4.2 Irrigation - drip, sprinkler or flood irrigation, weeding
4.3 Manuring - organic, inorganic and biofertilizers
4.4 Harvesting - leaf picking, shoot-leaf harvesting, branch cutting, leaf storage

**Unit - V : Diseases and pests of mulberry**

5.1 Fungal and bacterial diseases - Powdery mildew, red rust and leaf spot caused by fungi Mulberry wilt caused by bacteria Symptoms; mechanical and chemical control
5.2 Nematode and mycoplasm diseases - Mulberry root-knot and mulberry root rot (nematode
diseases), Mycoplasm and viral mulberry disease, Symptoms; mechanical and chemical control
5.3 Caterpillars - Bihar hairy caterpillar, semilooper
Bugs - Leaf hoppers and scale insects
Beetles - Girdle beetle, powder pest beetle

**Cluster Elective Paper: VIII-C-2**

## BIOLOGY OF MULBERRY SILK WORM AND SILKWORM REARING TECHNOLOGY

**Hours: 60** **Marks: 100**

**Unit - I : Morphology of silk worm**

1.1 Egg - External and internal morphology and colour changes
1.2 Larva - Mouth parts, legs, prolegs, spiracles, eyes, claspers, integumentary hair and sexual markings
1.3 Pupa – Male and female morphology and sexual dimorphism
1.4 Adult – Mouth parts, antennae, wings and external genitalia

**Unit - II : Anatomy and physiology of Mulberry silk worm**

2.1 Digestive system of larva - Structure and physiology of digestion
2.2 Silk glands of larva – Structure, development and mechanism of silk synthesis
2.3 Circulatory system of larva – Blood vessel, haemolymph and cells
2.4 Reproductive system of adult – Mechanism of egg development
2.5 Endocrine glands in larva and pupa, their secretions and hormonal control on development
2.6 Roll of pheromone in mating

**Unit - III : Silk worm rearing house and appliances**

3.1 Construction of ideal rearing house (CSB model)
3.2 Early age rearing appliances
3.3 Late age rearing appliances – Trays, ant wells, stands and racks, paraffin papers, rubber foam pads, nets, chopsticks and feathers
3.4 Mountages – Bamboo, plastic, nylon, balances (digital)

**Unit - IV : Disinfection and feeding appliances and silk worm technology**

4.1 Disinfection of ants, appliances
4.2 Disinfectant appliances – Sprayers and dusters
4.3 Feeding appliances – Leaf chamber, chopping knife, chopping board
4.4 Humidity and temperature measuring devices
4.5 Commercial races – Multivoltine, bivoltine and hybrid races
4.6 Seed collection, cards, loose eggs, incubation, hatching, brushing, rearing of early instars, rearing of late instars
4.7 Mounting and cocoon production
4.8 Harvesting and storage of cocoons

**Unit - V : Diseases of silk worms and their management**

5.1 Viral diseases – Nuclear polyhydrosis disease, infectious flacherie viral disease (symptoms, prevention, control and management)

5.2 Protozoan disease – Pebrine disease (symptoms, prevention, control and management)

5.3 Bacterial diseases – Septicemia,Toxicosis (symptoms, prevention, control and management)

5.4 Fungal diseases – Muscardine disease, aspergillosis (symptoms, prevention, control and management)

5.5 Pests – Tachinid fly, dermistid beetle (damage, control measures)

**Cluster Elective Paper: VIII-C-3**

**SILK TECHNOLOGY, SILK MARKETING AND EXTENSION**

Hours 60 Marks 100

**Unit - I : Cocoons**

1.1 Quality of cocoon, cocoon shell ratio, silk filament length, cocoon reelability and factors effecting reelability
1.2 Physical and chemical properties of fibre
1.3 Cocoon drying – Conventional and modern techniques
1.4 Cocoon sorting and preservation
1.5 Cocoon cooking

**Unit - II : Reeling, silk throwing and weaving**

2.1 Reeling appliances – Conventional and modern
2.2 Reeling operations
2.3 Rereeling
2.4 Raw silk testing and grading
2.5 Silk throwing and twisting
2.6 Silk weaving
2.7 Chemical processing of silk yarn and fabrics

**Unit - III : Sericulture and management**

3.1 Sericulture organisation at state and national levels – Development, research, training and policies
3.2 Role of national silk worm seed organisation in grainage
3.3 Sericulture services network – Basic seed facility, seed areas, grainages, nurseries, central research centers (CRCs), filature, silk exchanges and cocoon certification centers
3.4 Project formulation and role of credit co-operative and financing agencies in sericulture – NAARD, IDBI, Banks, IRDP etc.

**Unit - IV: Marketing organizations, Cocoon and Yarn marketing**

4.1 Sericulture marketing organisation for seed cocoon, raw silk and silk fabric
4.2 Traditional and regulated markets, their merits and limitations
4.3 Government intervention – Legislation and implication in marketing
4.4 Marketing institutions – Marketing boards, co-operatives and stabilization of price

**Unit - V : Cocoon and Yarn marketing**

5.1 Cocoon marketing – Gradation of seed and reeling cocoons, marketing of multivoltine, bivoltine and hybrid cocoons
5.2 Yarn marketing – Gradation of yarn, twisted and untwisted yarn
5.3 Feedback system – Surveys and types, merits and limitations
5.4 Silk export – Challenges and growth prospects

**ZOOLOGY PRACTICAL SYLLABUS FOR CLUSTER ELECTIVE –VIII-C**
**VI SEMESTER**
**SERICULTURE - PRACTICAL**

## PRACTICAL - I

1. Maps and records
   a. Preparation of a map showing extension of sericulture in the world
   b. Preparation of a map showing extension of sericulture in the India
   c. Graphical representation of cocoon and silk production by various silk worms in India

2. Moriculture
   a. Soil sampling and analysis of soil pH and moisture
   b. Preparation and study of sections of root, stem, and leaf of mulberry plant
   c. study of inflorescence, male and female reproductive parts

3. Mulberry diseases
   a. Collection, study and preservation of mulberry disease samples
   b. Microscopic preparation of mulberry fungi, virus, bacteria causing diseases

## PRACTICAL - II

1. Morphology of egg, last instar larva, pupa, adult, sexual dimorphism, mouth parts, antennae, legs, prolegs and wings
2. Dissection of digestive system of larva, silk gland of larva and reproductive system of adult
3. Study of various appliances
4. Microscopic preparation of pebrine causative agents in larva and adult by Giemsa stain
5. Study of one each of viral, bacterial, protozoan diseases and pests

## PRACTICAL - III

Project work

**SUGGESTED READING**

1. Text book of tropical sericulture. Publ., Japan Overseas Corporation volunteers – 1975
2. Silkworm rearing techniques in the tropics, Dr. S. Omura, Japan International Cooperation Agency – 1980
3. The natures and property of soils (9th edition) N.C. Brady (Mac Millan Pub. Co. Inc., New York)
4. Studies on soils of India, S.V. Govind Rajan and H.G. Gopala Rao (1970), Vikas Pub. House Pvt. Ltd., New Delhi
5. Manual on sericulture – Food and Agriculture Organisation, Rome – 1976
6. Handbook of practical sericulture : S.R. Ullal and M.N. Narasimhanna CSB, Bangalore – 1987
7. A guide for bivoltine sericulture – K. Sengupta, Director, CSR & TI, Mysore – 1989
8. Economics of sericulture under irrigated conditions : M.S. Jolly, CSR & TI, Mysore – 1982
9. China sericulture, 1972, FAO, Rome
10. Mulberry cultivation (Vol. I) written by Zheng Ting – Xing, Tan Yun – Fang, Huang Guang – Xian and Ma ben. Published by Oxford and IBH publishing Co. Pvt. Ltd., New Delhi, Bombay, Calcutta
11. Silk egg production (Vol. III) written by Wang Sang – Ming published by Oxford and IBH publishing Co. Pvt. Ltd., New Delhi, Bombay, Calcutta
12. Economics of silk industry, RC Rawlley, PS king and Sons ltd., London
13. Silk production processing and marketing – MM Nanavaty, VS Johari, Wiley Estern ltd., Ansari Road, New Delhi
14. Principles of sericulture – Hisao Aruga, Mohan Primlani for Oxford and IBH publishing co., Pvt., Ltd., New Delhi

# CHEMISTRY

**SEMESTER-V**
**Paper - V (INORGANIC, PHYSICAL & ORGANIC CHEMISTRY)**
**45 hrs (3 h/w)**

**INORGANIC CHEMISTRY**
**UNIT – I**
**Coordination Chemistry:** **8**h
IUPAC nomenclature - bonding theories - Review of Werner's theory and Sidgwick's concept of coordination - Valence bond theory - geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, crystal filed theory - splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes - low spin and high spin complexes - factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds - structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers.

**UNIT-II**
**1. Spectral and magnetic properties of metal complexes:** 4h
Types of magnetic behavior, spin-only formula, calculation of magnetic moments, experimental determination of magnetic susceptibility-Gouymethod.
**2. Stability of metal complexes:** 3h
Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

**ORGANIC CHEMISTRY**
**UNIT- III**
**Nitro hydrocarbons:** **3h**
Nomenclature and classification-nitro hydrocarbons, structure - Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes, reactivity -halogenation, reaction with HONO (Nitrous acid),Nef reaction and Mannich reaction leading to Micheal addition and reduction.

**UNIT – IV**

**Nitrogen compounds : 12h**

Amines (Aliphatic and Aromatic): Nomenclature, Classification into 1°, 2°, 3° Amines and Quarternary ammonium compounds. Preparative methods –
1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism).
Reduction of Amides and Schmidt reaction. Physical properties and basic character - Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline - comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophillic substitution of Aromatic amines – Bromination and Nitration. Oxidation of aryl and Tertiary amines, Diazotization.

**PHYSICAL CHEMISTRY**

**UNIT- V**

**Thermodynamics 15h**

The first law of thermodynamics-statement, definition of internal energy and enthalpy. Heat capacities and their relationship. Joule-Thomson effect-coefficient. Calculation of w, for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. State function. Temperature dependence of enthalpy of formation-Kirchoff s equation. Second law of thermodynamics. Different Statements of the law. Carnot cycle and its efficiency. Carnot theorem. Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes. Entropy changes in spontaneous and equilibrium processes.

**List of Reference Books**

1. Concise coordination chemistry by Gopalan and Ramalingam
2. Coordination Chemistry by Basalo and Johnson
3. Organic Chemistry by G.Mare loudan, Purdue Univ
4. Advanced Physical Chemistry by
5. Text book of physical chemistry by S Glasstone
6. Concise Inorganic Chemistry by J.D.Lee
7. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
8. A Text Book of Organic Chemistry by Bahl and Arun bahl
9. A Text Book of Organic chemistry by I L Finar Vol I
10. Advanced physical chemistry by Gurudeep Raj

**SEMESTER-V**
**Paper - VI (INORGANIC, ORGANIC & PHYSICAL CHEMISTRY)**
**45 hrs (3 h / w)**
**INORGANIC CHEMISTRY**

**UNIT-I**

**1. Reactivity of metal complexes:** 4h

Labile and inert complexes, ligand substitution reactions - $SN^1$ and $SN^2$,substitution reactions of square planar complexes - Trans effect and applications of trans effect.

**2.Bioinorganic chemistry:** 4h

Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and $Cl^-$. Metalloporphyrins – Structure and functions of hemoglobin, Myoglobin and Chlorophyll.

**PHYSICAL CHEMISTRY**
**UNIT-II**

**1. Chemical kinetics** **8h**

Rate of reaction - Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time half change. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

2. Photochemistry 5h

Difference between thermal and photochemical processes. Laws of photochemistry- Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield-Photochemical reaction mechanism- hydrogen- chlorine, hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Photosensitized reactions-energy transfer processes (simple example)

**ORGANIC CHEMISTRY**
**UNIT- III**

**Heterocyclic Compounds** **7h**

Introduction and definition: Simple five membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole - Aromatic character – Preparation from 1,4,- dicarbonyl compounds, Paul-Knorr synthesis.

Properties : Acidic character of pyrrole - electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions - Diels Alder reaction in furan.

Pyridine – Structure - Basicity - Aromaticity - Comparison with pyrrole - one method of preparation and properties - Reactivity towards Nucleophilic substitution reaction.

**UNIT-IV**

**Carbohydrates** **8h**

Monosaccharides: (+) Glucose (aldo hexose) - Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation) - Proof for the ring size (methylation, hydrolysis and oxidation reactions) - Pyranose structure (Haworth formula and chair conformational formula).

(-) Fructose (ketohexose) - Evidence of 2 - ketohexose structure (formation of pentaacetate, formation of cyanohydrin its hydrolysis and reduction by HI). Cyclic structure for fructose (Furanose structure and Haworth formula) - osazone formation from glucose and fructose – Definition of anomers with examples.

Interconversion of Monosaccharides: Aldopentose to Aldohexose (Arabinose to D- Glucose, D-Mannose) (Kiliani - Fischer method). Epimers, Epimerisation - Lobry de bruyn van Ekenstein rearrangement. Aldohexose to Aldopentose (D-Glucose to

D- Arabinose) by Ruff degradation. Aldohexose to Ketohexose

[(+) Glucose to (-) Fructose] and Ketohexose to Aldohexose (Fructose to Glucose)

**UNIT- V**

**Amino acids and proteins** **7h**

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples - Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.

**List of Reference Books**

1. Concise coordination chemistry by Gopalan and Ramalingam
2. Coordination Chemistry by Basalo and Johnson
3. Organic Chemistry by G.Mare loudan, Purdue Univ
4. Advanced Physical Chemistry by Atkins
5. Text book of physical chemistry by S Glasstone
6. Instrumentation and Techniques by Chatwal and Anand
7. Essentials of nano chemistry by pradeep
8. A Textbook of Physical Chemistry by Puri and Sharma
9. Advanced physical chemistry by Gurudeep Raj

**LABORATORY COURSE – V**
**Practical Paper – V Organic Chemistry**
**(at the end of semester V) 30 hrs (2 h / W)**

**Organic Qualitative Analysis: 50M**
Analysis of an organic compound through systematic qualitative procedure for functional group identification including the determination of melting point and boiling point with suitable derivatives.
Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic Primary Amines, Amides and Simple sugars.

**LABORATORY COURSE – VI**
**Practical Paper – VI Physical Chemistry**
**(at the end of semester V)**
**30 hrs (2 h/W)**

1. Determination of rate constant for acid catalyzed ester hydrolysis.

2. Determination of molecular status and partition coefficient of benzoicacid in Benzene and water.

3. Determination of Surface tension of liquid

4. Determination of Viscosity of liquid.

5. Adsorption of acetic acid on animal charcoal, verification of Freundlisch isotherm.

**SEMESTER-VI - Electives**
**ELECTIVE Paper – VII-(A) : ANALYTICAL METHODS IN CHEMISTRY**
**45hrs (3h / w)**

**UNIT-I**
**Quantitative analysis: 10h**

**a)** Importance in various fields of science, steps involved in chemical analysis**.** Principles of volumetric analysis :. Theories of acid-base, redox, complexometric, iodometric and precipitation titrations - choice of indicators for these titrations.

b) Principles of gravimetric analysis: precipitation, coagulation, peptization, coprecipitation, post recipitation, digestion, filtration and washing of precipitate, drying and ignition.

**UNIT-II**
**Treatment of analytical data**: **7h**

Types of errors, significant figures and its importance, accuracy - methods of expressing accuracy, error analysis and minimization of errors, precision - methods of expressing precision, standard deviation and confidence limit.

**UNIT-III**
**SEPARATION TECHNIQUES IN CHEMICAL ANALYSIS: 8h**

SOLVENT EXTRACTION : Introduction,principle,techniques,factors affecting solvent extraction, Batch extraction, continuous extraction and counter current extraction. Synergism., Application - Determination of Iron (III) ION EXCHANGE :Introduction,action of ion exchange resins,separation of inorganic mixtuers,applications, Solvent extraction: Principle and process,

**UNIT – IV 10h**

**Chromatography:** Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems, $R_f$ values, factors effecting $R_f$ values.

Paper Chromatography: Principles, $R_f$ values, experimental procedures, choice of paper and solvent systems, developments of chromatogram - ascending, descending and radial. Two dimensional chromatography, applications.

**UNIT -V 10h**

Thin layer Chromatography (TLC): Advantages. Principles, factors effecting $R_f$ values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of the chromatogram. Detection of the spots. Applications.

Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation technique. Applications

HPLC : Basic principles and applications.

**List of Reference Books**

1. Analytical Chemistry by Skoog and Miller
2. A textbook of qualitative inorganic analysis by A.I. Vogel
3. Nanochemistry by Geoffrey Ozin and Andre Arsenault
4. Stereochemistry by D. Nasipuri
5. Organic Chemistry by Clayden

**LABORATORY COURSE – VI**

**Practical Paper – VII-(A) (at the end of semester VI) 30hrs (2 h / W)**

**50M**

1. Identification of aminoacids by paper chromatography.
2. Determination of Zn using EDTA
3. Determination of Mg using EDTA

**SEMESTER-VI**

**ELECTIVE PAPER – VII-(B) : ENVIRONMENTAL CHEMISTRY**
**45 hrs (3 h / w)**

**UNIT-I**

**Introduction** **9h**

Concept of Environmental chemistry-Scope and importance of environment in now adays – Nomenclature of environmental chemistry – Segments of environment - Natural resources – Renewable Resources – Solar and biomass energy and Nonrenewable resources – Thermal power and atomic energy – Reactions of atmospheric oxygen and Hydological cycle.

**UNIT-II**

**Air Pollution** **9h**

Definition – Sources of air pollution – Classification of air pollution – Acid rain – Photochemical smog – Green house effect – Formation and depletion of ozone – Bhopal gas disaster – Controlling methods of air pollution.

**UNIT-III**

**Water pollution** **9h**

Unique physical and chemical properties of water – water quality and criteria for finding of water quality – Dissolved oxygen – BOD, COD, Suspended solids, total dissolved solids, alkalinity – Hardness of water – Methods to convert temporary hard water into soft water – Methods to convert permanent hard water into soft water – eutrophication and its effects – principal wastage treatment – Industrial waste water treatment.

**UNIT-IV**

**Chemical Toxicology** **9h**

Toxic chemicals in the environment – effects of toxic chemicals – cyanide and its toxic effects – pesticides and its biochemical effects – toxicity of lead, mercury, arsenic and cadmium.

**UNIT-V**

**Ecosystem and biodiversity** **9h**

**Ecosystem**

Concepts – structure – Functions and types of ecosystem – Abiotic and biotic components – Energy flow and Energy dynamics of ecosystem – Food chains – Food web – Tropic levels – Biogeochemical cycles (carbon, nitrogen and phosporus)

**Biodiversity**

Definition – level and types of biodiversity – concept - significance – magnitude and distribution of biodiversity – trends - biogeographical classification of india – biodiversity at national, global and regional level.

**List of Reference books**

1. Fundamentals of ecology by M.C.Dash
2. A Text book of Environmental chemistry by W. Moore and F.A. Moore
3. Environmental Chemistry by Samir k. Banerji

**LABORATORY COURSE – VI**

**Practical Paper – Elective VII B (at the end of semester VI) 30 hrs (2h/W)**

1.Determination of carbonate and bicarbonate in water samples (acidity and alkalinity)

2. Determination of hardness of water using EDTA

   a) Permanent hardness

   b) Temporary hardness

3. Determination of Acidity

4. Determination of Alkalinity

5. Determination of chlorides in water samples

**SEMESTER-VI**

**ELECTIVE PAPER – VII-(C) GREEN CHEMISTRY 45 hrs (3 h / w)**

**UNIT-I** **10h**

**Green Chemistry:** Introduction- Definition of green Chemistry, need of green chemistry, basic principles of green chemistry. Green synthesis- Evalution of the type of the reaction i) Rearrangements (100% atom economic), ii) Addition reaction (100% atom economic). Organic reactions by Sonication method: apparatus required examples of sonochemical reactions (Heck, Hundsdiecker and Wittig reactions).

**UNIT-II** **10h**

**Selection of solvent:**i) Aqueous phase reactions ii) Reactions in ionic liquids, Heckreaction, Suzuki reactions, epoxidation. iii) Solid supported synthesis

**Super critical $CO_2$**: Preparation, properties and applications, (decaffeination, dry cleaning)

**UNIT-III** **10h**

**Microwave and Ultrasound assisted green synthesis**: Apparatus required, examples of MAOS (synthesis of fused anthro quinones, Leukart reductive amination of ketones) - Advantages and disadvantages of MAOS. Aldol condensation-Cannizzaro reaction-Diels-Alder reactions-Strecker's synthesis

**UNIT-IV** **5h**

**Green catalysis:** Heterogeneous catalysis, use of zeolites, silica, alumina, supported catalysis- biocatalysis: Enzymes, microbes Phase transfer catalysis (micellar/surfactant)

**UNIT V** **10h**

Examples of green synthesis / reactions and some real world cases: 1. Green synthesis of the following compounds: adipic acid , catechol , disodium imino di acetate (alternative Strecker's synthesis) 2. Microwave assisted reaction in water – Hoffmann elimination – methyl benzoate to benzoic acid – oxidation of toluene and alcohols – microwave assisted reactions in organic solvents. Diels-Alder reactions and decarboxylation reaction. 3. Ultrasound assisted reactions – sonochemical Simmons –Smith reaction(ultrasonic alternative to iodine)

**Reference books:**

1. Green Chemistry Theory and Practice. P.T.Anatas and J.C. Warner
2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly

4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry (London)

5. Green Chemistry: Introductory Text, M.Lancaster

6. Principles and practice of heterogeneous catalysis, Thomas J.M.,Thomas M.J., John Wiley

7. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.M Srivastava, Narosa Publications

**LABORATORY COURSE – VII**

**Practical Paper – Elective VII C (at the end of semester VI) 30 hrs (2 h/W)**

1. Determination of specific reaction rate of hydrolysis for methyl acetate catalysed by hydrogen ion at room temperature.

2.Determination of molecular status and partition coefficient of benzoicacidin Benzene and water.
3. Surface tension and viscosity of liquids.
4. Adsorption of acetic acid on animal charcoal, verification of Freundlisch isotherm.

**CLUSTER ELECTIVES: Cluster Elective – I**
**Analytical and Physical**
**SEMESTER-VI**
**PAPER – VIII-A-1: POLYMER CHEMISTRY**

**45 hrs (3 h / w)**

**UNIT-I** **12h**

Introduction of polymers:

Basic definitions, degree of polymerization ,classification of polymers- Natural and Synthetic polymers, Organic and Inorganic polymers, Thermoplastic and Thermosetting polymers, Plastics, Elastomers , Fibers and Resins, Linear ,Branched and Cross Linked polymers, Addition polymers and Condensation Polymers, mechanism of polymerization. Free radical, ionic and Zeigler – Natta polymerization.

**UNIT-II** **10h**

Techniques of Polymerization : Bulk polymerization, solution polymerization, suspension and Emulsion polymerization.

Molecular weights of polymers: Number average and weight average molecular weights Determination of molecular weight of polymers by Viscometry , Osmometry and light scattering methods.

**UNIT-III** **6h**

Kinetics of Free radical polymerization, Glass Transition temperature(Tg) and Determination of Tg:

Free volume theory, WLF equation, factors affecting glass transition temperature (Tg).

**UNIT-IV** **9h**

Polymer additives:

Introduction to plastic additives – fillers, Plasticizers and Softeners , Lubricants and Flow Promoters, Anti aging additives , Flame Retardants , Colourants , Blowing agents , Cross linking agents ,Photo stabilizers , Nucleating agents.

**UNIT-V** **8h**

Polymers and their applications:

Preparation and industrial applications of Polyethylene, Polyvinyl chloride, Teflon, Polyacrylonitrile, Terelene , Nylon6.6 silicones.

**Reference Books:**

1. Seymour, R.B. & Carraher, C.E. *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.
2. Odian, G. *Principles of Polymerization*, 4th Ed. Wiley, 2004.
3. Billmeyer, F.W. *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
4. Ghosh, P. *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991.34
5. Lenz, R.W. *Organic Chemistry of Synthetic High Polymers.* Interscience Publishers, NewYork, 1967.

**SEMESTER-VI**

**PAPER – VIII-A-2: INSTRUMENTAL METHODS OF ANALYSIS**

**45 hrs (3 h / w)**

**UNIT – I**

**Introduction to spectroscopic methods of analysis: 4 h**

Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

**UNIT – II**

**Molecular spectroscopy: 8h**

*Infrared spectroscopy:*

Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.

**UNIT – III 10h**

*UV-Visible/ Near IR* – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters,laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).

**UNIT – IV**

**Separation techniques *Chromatography:*** Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis. 46 *Immunoassays and DNA techniques* **8h**

***Mass spectroscopy****:* Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray,electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation). **8h**

**UNIT – V**

**Elemental analysis: 10h**

**Mass spectrometry (electrical discharges).**

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence.

Excitation and getting sample into gas phase (flames, electrical discharges, plasmas),

Wavelength separation and resolution (dependence on technique), Detection of radiation

(simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

**NMR spectroscopy**: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spin coupling, Applications. **4h**

**Electroanalytical Methods: P**otentiometry & Voltammetry **4h**

**Radiochemical Methods 4h**

**X-ray analysis and electron spectroscopy (surface analysis)**

**Reference books:**

1. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. P.W. Atkins: Physical Chemistry.
4. G.W. Castellan: Physical Chemistry.
5. C.N. Banwell: Fundamentals of Molecular Spectroscopy.
6. Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
**7.** W.J. Moore: Physical Chemistry

**SEMESTER-VI**
**PAPER – VIII-A-3 :**
**ANALYSIS OF DRUGS, FOODS , DAIRY PRODUCTS & BIO-CHEMICAL ANALYSIS**
**45 hrs (3 h / w)**

**UNIT- I**

Analysis of the following drugs and pharmaceuticals preparations:
(Knowledge of molecular formula, structure and analysis)
Analysis of anlgesics and antipyretics like aspirin and paracetamol
Analysis of antimalerials like choloroquine .
Analysis of drugs in the treatment of infections and infestations :Amoxycillin., chloramphenicol, metronidazole, penicillin, tetracycline, cephalexin(cefalexin).
Anti tuberculous drug- isoniazid.

**UNIT - II**

Analysis of the following drugs and pharmaceuticals preparations:
(Knowledge of molecular formula, structure and analysis)
Analysis of antihistamine drugs and sedatives like: allegra, zyrtec(citirizine), alprazolam, trazodone, lorazepem, ambien(zolpidem), diazepam,

**UNIT - III**

Analysis of anti epileptic and anti convulsant drugs like phenobarbital and phenacemide.
Analysis of drugs used in case of cardiovascular drugs:atenolol, norvasc(amlodipine),
Analysis of lipitor(atorvastatin) a drug for the preventin of productin of cholesterol.
Analysis of diuretics like: furosemide (Lasix), triamterene
Analysis of prevacid(lansoprazole) a drug used for the prevention of production of acids in stomach.

**UNIT - IV**

Analysis of Milk and milk products: Acidity, total solids, fat, total nitrogen, protenines,lactose, phosphate activity, casein, choride. Analysis of food materials- Preservatives: Sodium carbonate, sodium benzoate sorbic acid Coloring matters, - Briliant blue FCF, fast green FCF, tertrazine, erytrhosine , sunset yellow FCF.
Flavoring agents - Vanilla , diacetyl, isoamyl acetate, limonene, ethylpropionate , allyl hexanoate and Adulterants in rice and wheat, wheat floo0r, sago,coconut oil, coffee powder, tea powder, milk..

**UNIT - V**

Clinical analysis of blood:Composition of blood,clinical analysis,trace elements in the body.Estimation of blood chlolesterol,glucose,enzymes,RBC & WBC ,Blood gas analyser.

REFERENCE BOOKS :

1.F.J.Welcher-Standard methods of analysis,
2.A.I.Vogel-A text book of quantitative Inorganic analysis-ELBS,
3.F.D.Snell & F.M.Biffen-Commercial methods of analysis-D.B.Taraporavala & sons,
4.J.J.Elving and I.M.Kolthoff- Chemical analysis - A series of monographs on analytical chemistry and its applications -- Inter Science- Vol I to VII.,
5.Aanalytical Agricultrual Chemistry by S.L.Chopra & J.S.Kanwar -- Kalyani Publishers

6. Quantitative analysis of drugs in pharmaceutical formulations by P.D.Sethi, CBS Publishers and Distributors, New Delhi
7. G.Ingram- Methods of organic elemental micro analysis- Chapman and Hall.,
8. H.Wincciam and Bobbles (Henry J)- Instrumental methods of analysis of food additives.,
9. H.Edward-The Chemical analysis of foods;practical treatise on the examination of food stuffs and the detection of adulterants,

10. The quantitative analysis of drugs- D.C.Garratt-Chapman & Hall.,

11. A text book of pharmaceutical analysis by K.A.Connors-Wiley-International.,

12. Comprehensive medicinal chemistry-Ed Corwin Hansch Vol 5,Pergamon Press.,

**LABORATORY COURSE – VIII**

**Practical Paper – VIII-A-1: (at the end of semester VI) 30 hrs (2 h / W)**

1. Preparation of Aspirin
2. Preparation of Paracetamol
3. Preparation of Acetanilide
4. Preparation of Barbutiric Acid
5. Preparation of Phenyl Azo β-naphthol

**LABORATORY COURSE – VIII**

**Practical Paper – VIII-A-2 (at the end of semester VI) 30 hrs (2 h / W)**

1.Green procedure for organic qualitative analysis: Detection of N, S andhalogens
2.Acetylation of $1^0$ amine by green method: Preparation of acetanilide
3. Rearrangement reaction in green conditions: Benzil-Benzilic acid rearrangement
4. Electrophilic aromatic substitution reaction: Nitration of phenol
5. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
6. Green oxidation reaction: Synthesis of adipic acid
7. Green procedure for Diels Alder reaction between furan and maleic anhydride

**List of Reference Books**

**1.** Green Chemistry Theory and Practice. P.T.Anatas and J.C. Warner
2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry (London)
5. Green Chemistry: Introductory Text, M.Lancaster
6. Principles and practice of heterogeneous catalysis, Thomas J.M.,Thomas M.J., John Wiley
7. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.M Srivastava, Narosa Publications

**VII-A-3 Practical:- Project Work**

**Cluster Elective –II**
**Fuels and Industrial Inorganic materials**

**PAPER – VIII-B-1 : FUEL CHEMISTRY AND BATTERIES 45 hrs (3 h / w)**

**UNIT –I** **12h**

Review of energy sources ( renewable and non-renewable) – classification of fuels and their calorific value. Coal: Uses of Coal (fuel and non fuel) in various industries , its composition , carbonization of coal - coal gas , producer gas and water gas – composition and uses – fractionation of coal tar – uses of coal tar based chemicals , requisites of a good metallurgical coke , coal gasification (Hydro gasification and catalytic gasification ) coal liquefaction and solvent refining.

**UNIT-II** **6h**

Petroleum and petrol chemical industry:

Composition of crude petroleum , refining and different types of petroleum products and their applications.

**UNIT-III** **10h**

Fractional distillation (principle and process) , cracking ( Thermal and catalytic cracking). Reforming petroleum and non petroleum fuels (LPG , CNG , LNG , biogas ) ,fuels derived from biomass , fuel from waste , synthetic fuels (gaseous and liquids) , clear fuels , petro chemicals : vinyl acetate , propylene oxide , isoprene , butadiene , toluene and its derivative xylene.

**UNIT-IV** **10h**

Lubricants: Classification of lubricants , lubricating oils(conducting and non conducting), solid and semi solid lubricants , synthetic lubricants. Properties of lubricants (viscosity index , cloud point , pore point) and their determination.

**UNIT-V** **7h**

**Batteries:**

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery.

Fuel cells, Solar cell and polymer cell.

**Reference books:**

1. E.Stochi : Industrial chemistry , Vol-1,Ellis Horwood Ltd.UK

2. P.C.Jain , M.Jain: Engineering chemistry, Dhanpat Rai &sons , Delhi.

3. B.K.Sharma: Industrial Chemistry , Goel Publishing house , Meerut.

**SEMESTER-VI**

**PAPER – VIII-B-2: INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE 45 hrs (3 h / w)**

**UNIT - I**

**Recapitulation of *s*- and *p*-Block Elements 8h**

Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity ( Pauling, Mulliken, and Alfred – Rochow scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

**UNIT – II**

**Silicate Industries 15h**

***Glass:*** Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

***Ceramics:*** Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

***Cements****:* Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

**UNIT – III 8h**

**Fertilizers:** Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

**UNIT – IV 8h**

**Surface Coatings:** Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

**UNIT – V** **6h**

**Alloys:**

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

**Chemical explosives:**

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

**Reference Books:**

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics,* Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain & M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* Vikas Publications, New Delhi.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

**SEMESTER-VI**

**PAPER – VIII-B-3 : ANALYSIS OF APPLIED INDUSTRIAL PRODUCTS**

**45 hrs (3 h / w)**

**UNIT-I**

Analysis of soaps: moisture and volatile matter,cobined alkali,total fatty matter, free alkali, total fatty acid, sodium silicate and chlorides.

Analysis of paints :Vehicle and pigments ,Barium Sulphate ,total lead, lead chromate,iron pigments, zinc chromate

**UNIT- II**

Analysis of oils:saponification value,iodine value,acid value,ester value, bromine value, acetyl value.

Analysis of industrial solvents like benzene,acetone,methanol and acetic acid., Determination of methoxyl and N-methyl groups.,

**UNIT-III**

Analysis of fertilizers: urea,NPK fertilizer,super phosphate,

Analysis of DDT,BHC,endrin,endosulfone,malathion,parathion.,

Analysis of starch,sugars,cellulose and paper,

**UNIT -IV**

Gas analysis: carbon dioxide, carbon monoxide, oxygen, hydrogen, saturated hydro carbon, unsaturated hydrocarbons, nitrogen, octane number, cetane number Analysis of Fuel gases like: water gas,producer gas,kerosene (oil) gas. Ultimate analysis :carbon, hydrogen,nitrogen,oxygen,phosphorus and sulfur.,

**UNIT - V**

Analysis of Complex materials:

**Analysis of cement**- loss on ignition, insoluble residu, total silica, sesqui oxides, lime, magnesia, ferric oxide, sulphuric anhydrid.

**Analysis of glasses** - Determinaiton of silica, sulphuur, barium, arsinic, antimony, total $R_2O_3$, calcium, magnesium,
total alkalies,aluminium,chloride,floride

**SUGGESTED BOOKS:**

1.F.J.Welcher-Standard methods of analysis,

2.A.I.Vogel-A text book of quantitative Inorganic analysis-ELBS,

3.H.H.Willard and H.Deal- Advanced quantitative analysis- Van Nostrand Co,

4.F.D.Snell & F.M.Biffen-Commercial methods of analysis-D.B.Taraporavala & sons,

5.J.J.Elving and I.M.Kolthoff- Chemical analysis - A series of monographs on analytical chemistry and its applications -- Inter Science- Vol I to VII.,

6.G.Z.Weig - Analytical methods for pesticides,plant growth regulators and food additives - Vols I to VII,

7.Aanalytical Agricultrual Chemistry by S.L.Chopra & J.S.Kanwar -- Kalyani Publishers

8.Mannual of soil, plant, water and fertilizer analysis, R.M.Upadhyay and N.Lharma,Kalyani Publishers

**LABORATORY COURSE – VIII**

**Practical Paper – VIII-B-1: (at the end of semester VI) 30 hrs (2 h / W)**

1. Preparation of Aspirin
2. Preparation of Paracetamol
3. Preparation of Acetanilide
4. Preparation of Barbutiric Acid
5. Preparation of Phenyl Azo β-naphthol

**LABORATORY COURSE – VIII**

**Practical Paper – VIII-B-2: (at the end of semester VI) 30 hrs (2 h / W)**

1.Green procedure for organic qualitative analysis: Detection of N, S andhalogens
2.Acetylation of $1^0$ amine by green method: Preparation of acetanilide
3. Rearrangement reaction in green conditions: Benzil-Benzilic acid rearrangement
4. Electrophilic aromatic substitution reaction: Nitration of phenol
5. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
6. Green oxidation reaction: Synthesis of adipic acid
7. Green procedure for Diels Alder reaction between furan and maleic anhydride

**List of Reference Books**

1. Green Chemistry Theory and Practice. P.T.Anatas and J.C. Warner
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3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry (London)
5. Green Chemistry: Introductory Text, M.Lancaster
6. Principles and practice of heterogeneous catalysis, Thomas J.M.,Thomas M.J., John Wiley
7. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.M.Srivastava, Narosa Publications

## VII-A-3 Practical:- Project Work / Intern Ship

**Cluster Elective –III**
**ORGANIC**
**PAPER – VIII-C-1 : ORGANIC SPECTROSCOPIC TECHNIQUES**
**45 hrs (3 h / w)**

**UNIT-I** **10h**

**NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY**

Nuclear spin, Principles of NMR-Classical and Quantum Mechanical methods, Magnetic moment and Spin angular momentum. Larmour Frequency. Instrumentation. Relaxation-spin-spin & spin lattice relaxation. Shielding constants, Chemical shifts, Shielding and Deshielding mechanism-Factors influencing Chemical shift. Spin-Spin interactions-AX, $AX_2$ and AB types. Vicinal, Geminal and Long range coupling- Factors influencing coupling constants.

**UNIT – II** **5h**

Spin decoupling, Spin tickling, Deuterium exchange, Chemical shift reagents and Nuclear overhauser effect. Applications in Medical diagnostics, Reaction kinetics and Mechanically induced dynamic nuclear polarization. FT NMR and its Advantages.

**UNIT-III** **10h**

**UV & VISIBLE SPECTROSCOPY**

Electronic spectra of diatomic molecules. The Born-oppenheimer approximation. Vibrational coarse structure: Bond association and Bond sequence. Intensity of Vibrational-electronic spectra: The Franck-Condon principle. Rotational fine structure of electronic vibration transitions. Electronic structure of diatomic molecules.

Types of transitions, Chromophores, Conjugated dienes, trienes and polyenes, unsaturated carbonyl compounds-Woodward – Fieser rules.

**UNIT-IV** **5h**

Electronic spectra of polyatomic molecules. Chemical analysis by Electronic Spectroscopy – Beer-Lambert's Law. Deviation from Beer's law. Quantitative determination of metal ions ($Mn^{+2}$, $Fe^{+2}$, $NO_2^-$, $Pb^{+2}$). Simultaneous determination of Chromium and Manganese in a mixture.

**UNIT-V** **15h**

**Electron Spin Resonance Spectroscopy :**

Basic Principles, Theory of ESR, Comparison of NMR & ESR. Instrumentaion, Factors affecting the 'g' value, determination of 'g' value. Isotropic and Anisotropic constants. Splitting hyper fine splitting coupling constants. Line width, Zero field splitting and Kramer degeneracy. Crystal field splitting, Crystal field effects.

Applications:- Detection of free radicals; ESR spectra of (a) Methyl radical ($CH_3^{\cdot}$), (b) Benzene anion ($C_6H_6^-$) (c) Isoquinine (d) $[Cu(H_2O)_6]^{+2}$ (e) $[Fe(CN)_5NO]^{-3}$ (f)

**REFERENCE BOOKS:**

1. Electron Spin Resonance Elementary Theory and Practical Applications- John E. Wertz and James R. Bolton, Chapman and Hall, 1986.
2. Spectroscopic Identification of organic compounds – Silverstein, Basseler and Morril.
3. Organic Spectroscopy- William Kemp.
4. Fundamentals of Molecular Spectroscopy- C.N.Banwell and E.A. Mc cash 4th Edition, Tata Mc Graw Hill Publishing Co., Ltd. 1994.
5. Physical Methods in Inorganic Chemistry – R.S.Drago, Saunders Publications.
6. Application of MÖssbauer Spectroscopy – Green Mood.
7. NMR, NQR, EPR and MÖssbauer Spectroscopy in inorganic chemistry – R.V Parish, Ellis, Harwood.
8. Instrumental Methods of Chemical Analysis- H.Kaur, Pragathi Prakashan, 2003.
9. Instrumental Methods of Analysis, 7th Edition – Willard, Merrit, Dean, Settle, CBS Publications, 1986.
10. Molecular Structure and Spectroscopy – G. Aruldhas, Prentice Hall of India Pvt.Ltd, New Delhi, 2001.
11. MÖssbauer Spectroscopy – N.N. Green Wood and T.C. Gibb, Chapman, and Hall, Landon 1971.
12. Coordination Chemistry: Experimental Methods- K. Burger, London Butter Worths, 1973.
13. Analytical spectroscopy – Kamlesh Bansal, Campus books, 2008.
14. Structural Inorganic Chemistry MÖssbauer Spectroscopy – Bhide.
15. Principle of MÖssbauer Spectroscopy – T.C. Gibb, Chapman, and Hall, Landon 1976.

**Cluster Elective –III**
**ORGANIC**
**PAPER – VIII-C-2 : ADVANCED ORGANIC REACTIONS**
**45 hrs (3 h / w)**

**UNIT – I**
**ORGANIC PHOTOCHEMISTRY**
Organic photochemistry : Molecular orbitals, carbonyl chromophore–triplet states, Jablonski diagram, inter–system crossing. Energy transfer. Energies properties and reaction of singlet and triplet states of and transitions.
Photochemical reactions : (a) Photoreduction, mechanism, influence of temperature, solvent, nature of hydrogen donors, structure of substrates on the course of photo reduction,.

**UNIT – II**
**ORGNAIC PHOTOCHEMISTRY**
Norrisch cleavages, type I : Mechanism, acyclic cyclicdiones, influence of sensitizer, photo Fries rearrangement. Norrisch type II cleavage : Mechanism and stereochemistry, type II reactions of esters : 1: 2 diketones, photo decarboxylation., Di - π methane rearrangement, Photochemistry – of conjugated dienes, Decomposition of nitrites – Barton reaction.

**UNIT – III**
**PROTECTING GROUPS AND ORGANIC REACTIONS**
Principles of (1) Protection of alcohols – ether formation including silyl ethers – ester formation, (2) Protection of diols – acetal,ketal and carbonate formation, (3) Protection of carboxylic acids – ester formation, benzyl and t–butyl esters, (4) Protection of amines – acetylation, benzoylation, benzyloxy carbonyl, triphenyl methyl groups and fmoc, (5) Protection of carbonyl groups – acetal, ketal, 1,2–glycols and 1,2–dithioglycols formation.

**UNIT – IV**
**Synthetic reactions** : Mannich reaction – Mannich bases – Robinson annulations. The Shapiro reaction, Stork–enamine reaction. Use of dithioacetals – Umpolung, phase transfercatalysis – mechanisms and use of benzyl trialkyl ammonium halides. Witting reaction.

**UNIT –V : NEW SYNTHETIC REACTIONS**
Baylis–Hillman reaction, RCM olefm metathesis, Grubb catalyst, Mukayama aldol reaction, Mitsunobu reaction, McMurrey reaction, Julia–Lythgoe olefination, and Peterson's stereoselective olefination, Heck reaction, Suziki coupling, Stille coupling and Sonogishira coupling, Buchwald–Hartwig coupling. Ugi reaction, Click reaction.

**Recommended Books**

1. Molecular reactions and Photochemistry by Charles Dupey and O.L. Chapman.
2. Molecular Photochemistry by Turru.
3. Importance of antibonding orbitals by Jaffe and Orchin.
4. Text Book of Organic Chemistry by Cram,. Hammand and Henrickson.
5. Some modern methods of organic synthesis by W. Carruthers.
6. Guide Book to Organic Synthesis by R.K. Meckie, D.M. Smith and R.A. Atken.
7. Organic Synthesis by O.House.
8. Organic synthesis by Michael B. Smith.
9. Organic Chemistry Claydon and others 2005.
10. Name Reactions by Jie Jack Li
11. Reagents in Organic synthesis by B.P. Mundy and others.
12. Tandem Organic Reactions by Tse–Lok Ho.

**Cluster Elective –III**
**ORGANIC**
**PAPER – VIII-C-3 : PHARMACEUTICAL AND MEDICINAL CHEMISTRY**
**45 hrs (3 h / w)**

**UNIT-I** **8h**

**Pharmaceutical Chemistry Terminology**: Pharmacy, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics (ADME, Receptors - brief treartment) Metabolites and Anti metabolites.

**UNIT-II**

**Drugs:** **8h**

Nomenclature: Chemical name, Generic name and trade names with examples Classification: Classification based on structures and therapeutic activity with one example each, Administration of drugs

**UNIT-III**

**Synthesis and therapeutic activity of the compounds:** **12h**

a. Chemotheraputic Drugs:
l.Sulphadrugs(Sulphamethoxazole) 2.Antibiotics - β-Lactam Antibiotics, Macrolide Antibiotics, 3. Anti malarial Drugs(chloroquine)
b. Psycho therapeutic Drugs:
1.Anti pyretics(Paracetamol) 2.Hypnotics, 3.Tranquilizers(Diazepam) 4.Levodopa

**UNIT-IV**

**Pharmacodynamic Drugs:** **8h**

1. Antiasthma Drugs (Solbutamol) 3. Antianginals (Glycerol Trinitrate)
4. Diuretics(Frusemide)

**UNIT-V**

**HIV-AIDS:** **9h**

Immunity - CD-4cells, CD-8cells, Retro virus, Replication in human body, Investigation available, prevention of AIDS, Drugs available - examples with structures: PIS: Indivanir (crixivan), Nelfinavir(Viracept).

**List of Reference Books:**


1. Medicinal Chemistry by Dr. B.V.Ramana
2. Synthetic Drugs by O.D.Tyagi & M.Yadav
3. Medicinal Chemistry by Ashutoshkar
4. Medicinal Chemistry by P.Parimoo
5. Pharmacology& Pharmacotherapeutics R.S Satoshkar & S.D.Bhandenkar
6. Medicinal Chemistry by Kadametal P-I & P.II
7. European Pharmacopoeia

# STATISTICS

(For Mathematics Combinations)

**BA/BSC III YEAR : STATISTICS SYLLABUS**
**(With Mathematics Combination)**
**Semester-V**
**Paper - V Sampling Techniques and Design of Experiments**

## Unit-I

Sampling Theory: Principal steps in a sample survey, Censes versus sample survey, sampling and Non-sampling errors. Types of sampling - subjective, probability and mixed sampling methods.

## Unit-II

Simple Random Sampling:Meaning of Samples and methods to draw, estimation of population mean, variances in SRSWR& SRSWOR.

## Unit-III

Stratified random sampling: Proportional and optimum allocation of sample sizes in stratification. Variances in these methods. Systematic sampling : Systematic sampling when N = nk comparison of their relative efficiencies. Advantages and Disadvantages of above methods of sampling.

## Unit-IV

Analysis of Variance: One way with equal and unequal classifications and two way classifications.

## Unit - V

Design of Experiments: Principles of experimentation in Designs, analysis of completely randomised design (CRD), Randomised block design (RBD) and Latin square design (LSD) including one missing observation .

## Text Books:


1.Telugu AcademyBA/BSc III year paper - III Statistics - applied statistics - Telugu academy by prof.K.Srinivasa Rao, Dr D.Giri. Dr A.Anand, Dr V.Papaiah Sastry.

2. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC. PHI.


## Reference Books:


1.Fundamentals of applied statistics : VK Kapoor and SC Gupta.
2.Indian Official statistics - MR Saluja.
3.Anuvarthita Sankyaka Sastram - Telugu Academy.

## Practicals Semester – V

Conduct any 6 (Ms-excel is compulsory)

1. Estimation of population Mean, variance by SRSWOR.
2. Estimation of population Mean, variance by SRSWR.
3. Comparison of proportional, optimum allocations with SRSWOR.
4. Systematic Sampling .
5. ANOVA-CRD. (Equal and Unequal Observations)
6. ANOVA - RBD
7. ANOVA - LSD
8. ANOVA - RBD with one missing observation.
9. ANOVA - LSD with one missing observation.
10. Ms-excel practicals. (CRD, RBD)

**PRACTICAL QUESTION PAPER PATTERN**

| | | | |
|---|---|---|---|
| 1 | Sampling Techniques | SRSWOR or SRSWR | 1 Question |
| 2 | Sampling Techniques | Stratified Random Sampling or Systematic Sampling | 1 Question |
| 3 | Design of Experiments | ANOVA – CRD (Equal or Unequal Replications) | 1 Question |
| 4 | Design of Experiments | ANOVA – RBD or ANOVA – LSD | 1 Question |
| 5 | Design of Experiments | Missing Observation in RBD or Missing Observation in LSD | 1 Question |

Note:

**1.** All the Examiners are requested to give 5 Questions and ask the Students to answer any 3 Questions.

**2.** Each Questions carries 10 Marks 3X10= 30 Marks

**3.** Record Submission 10 Marks

**4.** Viva Voce 10 Marks

Important Note:

Submission of Bonafide Record by the Student is Compulsory.

**BA/BSC III YEAR : STATISTICS SYLLABUS**
**(With Mathematics Combination)**
**Semester-V**
**Paper - VI Quality and Game Theory**

## Unit-I

Importance of SQC in industry, statistical basis of shewart control charts, uses of control charts. Interpretation of control charts, control limits, Natural tolerance limits and specification limits.

## Unit – II

Variable Control Chart: Construction of $\overline{X}$ , R charts for variables, Attribute control charts- NP, P charts, C chart.

## Unit-III

Acceptance sampling plans: Scope, Producer's risk and consumer's risk . Concepts of AQL and LTPD.

## Unit-IV

Sampling Plans: Single and double sampling plans, OC and ASN functions, Double and single
Sampling plans for attributes using Binomial.

## Unit-V

Introduction – Terminology of Game Theory – Types of Games – Pure Strategies ; Games with Saddle point – The Maximin – Minimax Principle – Mixed Strategies ; Game without Saddle point – Solution of 2x2 Game, Solution of Game by Dominance Property.

## Text Books:


1.BA/BSc III year paper - IV Statistics - applied statistics - Telugu academy by Prof.K.Srinivasa Rao, Dr D.Giri. Dr A.Anand, Dr V.Papaiah Sastry.
2. Fundamentals of applied statistics : VK Kapoor and SC Gupta
3. S.K Sinha: Reliability and life testing. Wiley Eastern.


## Reference Books :


1. R.C.Gupta: Statistical Quality Control.

## Practicals - Semester – V
## Conduct any 6 (Ms-excel is compulsory)

1. Construction of( $\overline{X}$ ,R) charts.
2. Construction of P-chart-Fixed sample size.
3. Construction of P-chart-variable sample size
4. Construction of NP-Chart . – Fixed Sample size
5. Construction of C-Chart.
6. O.C.-Curve for Single Sampling Plan.
7. O.C.-Curve for Double Sampling Plan.
8. Solution of Game by Dominance Property.
9. MS-Excel methods for the Serial Numbers 1.
10. MS-Excel methods for the Serial Numbers 2 to 4 .

### PRACTICAL QUESTION PAPER PATTERN

| | | | |
|---|---|---|---|
| 1 | Control Charts | Mean Chart and Range Charts | 1 Question |
| 2 | Control Charts | P, NP Charts with Fixed Sample size or P Chart with Variable size | 1 Question |
| 3 | Control Charts | C Chart, Single Sampling Plan (O.C.- Curve) | 1 Question |
| 4 | Acceptance Sampling | O.C-Curve for Double Sampling Plan | 1 Question |
| 5 | Game Theory | Solution of Game by Dominance Property | 1 Question |

Note:

1. All the Examiners are requested to give 5 Questions and ask the Students to answer any 3 Questions.
2. Each Questions carries 10 Marks 3X10 = 30 Marks
3. Record Submission 10 Marks
4. Viva Voce 10 Marks

Important Note:

Submission of Bonafide Record by the Student is Compulsory.

# MICROBIOLOGY

**THIRD YEAR – SEMESTER –V**

**PAPER – V**

**MBT – 501 ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY**

**TOTAL HOURS :36** **CREDITS: 3**

**UNIT – I** **No. Of hours : 8**

Terrestrial Environment : Soil profile and soil microflora

Aquatic Environment: Microflora of fresh water and marine habitats

Atmosphere: Aeromicroflora and dispersal of microbes

Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity & low nutrient levels.

**UNIT – II** **No. Of hours : 8**

Role of microorganisms in nutrient cycling (Carbon, nitrogen, phosphorus).

Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a)standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation.

**UNIT – III** **No. Of hours : 6**

Outlines of Solid Waste management:Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill).

Liquid waste management: Composition and strength of sewage (D.O. BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.

**UNIT – IV** **No. Of hours : 7**

Plant GrowthPromoting Microorganisms – Mycorrhizae, Rhizobia, *Azospirillum, Azotobacter, Frankia*, phosphate-solubilizers and Cyanobacteria.

Outlines of biiological nitrogen fixation (symbiotic, non-symbiiotic).

Biofertilizers - *Rhizobium*

**UNIT – V** **No. Of hours : 7**

Concept of disease in plants, Symptoms of plant diseases caused by fungi, bacteria, and viruses. Plant diseases – groundnut rust, Citrus canker and tomato leaf curl.

Principles of plant disease control – Biological, Chemical, Immunological and Physical methods.

## MBP – 501 ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY

**TOTAL HOURS :36** **CREDITS: 2**

Analysis of soil – pH, Moisture content and water holding capacity.

Isolation of microbes (bacteria and fungi) from soil.

Study of air flora by petriplate exposure method.

Analysis of potable water: SPC, Presumptive, confirmed and completed test, determination of coilform count in water by MPN.

Determination of Biological Oxygen Demand (BOD) of water water samples.

Isolation of Rhizobium from root nodules.

Staining and observation of Vesicular Arbuscular Mycorrhizal (VAM) fungi

Observation of plant diseases of local importance – Citrus canker, Tikka disease of Groundnut, Bhendi yellow vein mosaic, Rusts, Smuts, Powdery mildews, Tomato leaf curl.

**SUGGESTED READING**


1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Barton LL & Northup DE (2011). Microbial Ecology. 1st edtion, Wiley Blackwell, USA
3. Campbell RE. (1983). Microbial Ecology. Blackwell Scientifc Publication, Oxford, England
4. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
5. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientifc Publication, U.K.
6. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition, Pearson/Benjamin Cummings
7. Maier RM, Pepper IL and Gerba CP. (2009). Envrionmental Microbiology. 2nd editon, Academic Press
8. Martin A. (1977). An Introduciton to Soil Microbiology. 2nd editon, Academic Press
9. Okafor, N (2011) Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York.
10. Singh A, Kuhad, RC &Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer – Verlad, Berlin Hedeilberg
11. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
12. Subba rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
13. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

**THIRD YEAR – SEMESTER –V**

**PAPER VI**

## MBT – 601 FOOD AND INDUSTRIAL MICROBIOLOGY

**TOTAL HOURS :36** **CREDITS: 3**

**UNIT – I** **No. Of hours : 8**

Intrinsic and extrinsic parameters that afferct microbial growth in food

Microbial spoilage of food – fruits, vegetables, milk, meat, egg, bread and canned foods

Food intoxication (botulism).

Food-borne diseases (salmonellosis) and their detection.

**UNIT – II** **No. of hours : 7**

Principles of food preservation – Physical and chemical methods.

Fermented Dairy foods – cheese and yogurt.

Microorganisms as food -- SCP, edible mushrooms (white button, oyster and paddy straw). Probiotics and thier benefits.

**UNIT – III** **No. of hours : 6**

Microorganisms of industrial importance – yeasts, moulds, bacteria, actinomycetes.

Isolation and Screening of industrially-important microorganisms.

Outlines of strain improvement.

**UNIT – IV** **No. of hours : 8**

Types of fermentation processes – solid state, liquid state, batch, fed-batch, continuous. Advantages & disadvantages

Design of fermenter

Ingredients of Fermentation media – Saccharine, Starch materials, hydrocarbons, Nitrogenous materials.

Downstream processing – filtration, centrifugation, cell disruption, solvent extraction.

**UNIT – V** **No. of hours : 7**

Microbial production of Industrial products – Citric acid, Ethanol, amylases, penicillin, glutamic acid and vitamin B12.

## MBP – 601 FOOD AND INDUSTRIAL MICROBIOLOGY

**TOTAL HOURS :36** **CREDITS: 2**

Isolation of bacteria and fungi from spoiled bread / fruits / vegetables

Preparation of Yogurt / Dahi

Determination of the microbiological quality of milk sample by MBRT

Isolation of antagonistic microorganisms by crowded plate technique

Design of Fermenter

Microbial fermentation for the production and estimation of ethanol from Grapes.

Microbial fermentation for the production and estimation of citric acid.

### SUGGESTED READING


1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age Internation (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Casida LE. (1991). Industrial Microbiology. 1st editon. Wiley Eastern Limited.
4. Crueger W and Crueger A. (2000), Biotechnology: A textbook of Industrial Microbiology. 2nd Edition. Panima Publishing Company, New Delhi
5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
6. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.
7. Patel AH. (1996). Industrial Microbiology. 1st Edition. MacMillian India Limited Publishing Company Ltd. New Delhi, India
8. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiolgy: An Introduction. 9th Edition. Pearson Education.
10. Willey JM, Sherwood LM and Woolverton CJ (2013), Prescott, Harley and Klen's Microbiology. 9th Edition. McGraw Hill education.

# ELECTRONICS

**SEMESTER : V**
**PAPER : V – MICROPROCESSORS (INTEL 8085)**
**(60 HOURS) (w.e.f.2017-2018)**

**UNIT I (12 Hours)**

**ARCHITECTURER OF 8085 MICROPROCESSOR**

Block diagram of Intel 8085 – register structure- multiplexing & demultiplexing of address/data bus-control signal generation and status signals-8085 pin out diagram &functions-Priority Concept – Instruction cycle-machine cycle-T state-Timing diagrams for Opcode fetch cycle memory Read,memory write,I/O Read,I/O Write.

**UNIT II (12 Hours)**

**INSTRUCTION SET 8085 MICROPROCESSOR**

Instruction set classification-addressing modes-Data transfer group-Arithmatic group-Logical group-Branch control group-I/O,Stock and machine control group.

**UNIT III (12 Hours)**

**PROGROMMING 8085**

Block data tranfer (8 bit data)-Addition and subtraction (8 bit &16 bit data)-mulplication-division-largest-smallest-ascending-descending (all 8 bit data)-Binary to BCD-BCD to Binary-Binary to ASCII-ASCII to Binary-BCD to ASCII-ASCII to BCD (all 8 bit data)-Stock & Subroutine Concept-Time delay usingsingle and double register and calculations-Debagging a program.

**UNIT IV (12 Hours)**

**INTERFACING MEMORY**

Functional explanaton of RAM,ROM,EPROM and EEPROM-2K X 8 ROM-RAM to 8085-Interfacing an I/O Port in Memory Mapped I/O and I/O Mapped I/O-Differences between I/O mapped and memory Mapped I/O.

**UNIT V (12 Hours)**

**8085 MICROPROCESSOR APPLICATIONS**

Programmable Peripheral Device (8255)-Block diagram-Pin function-Different Modes-Key Board and Disply Interface 8279 (Architecture)-Simple temperature Controller-Simple traffic light Controller-Stepper motor control interface.

**TEXT BOOKS**

1. RAMESH S.GAONKAR.,Microprocessor Architecture,Programming and Applications with the 8085-Penram International Publishing,Mumbai.
2. B RAM.,Fundamentals of microprocessors and microcomputers-Dhanpat Rai Publications,New Delhi.
3. N Senthilkumar,M Saravanan & S Jeevananthan.,Microprocessors &Microcontrollers -1st edition,Oxford press.

**REFERENCE BOOKS**

1. Mathur AP., Introduction to Microprocessors.,3rd edition.,Tata McGraw, New Delhi.
2. Leventhal L A.,Microprocessor Organisation and Architecture.,Prentice Hall India.
3. Microprocesser lab premier by k.a krishna murthy.

**ELECTRONICS LAB - 5**
**(MICROPROCESSORS LAB)**
**(All experiments should be done)**

**Programs Using Intel 8085**

1. Addition & subtraction(8&16-bits)
2. Multiplication & division(8-bit)
3. Largest&smallest number in given array.
4. Ascending & descending order.
5. Binary to ASCII & ASCII to Binary,BCD to ASCII & ASCII toBCD.
6. Block transfer of Data
7. Wave form generation using DAC Interface
8. Steppermotor interface

**LAB MANUAL**

1. Zbar,Malvino and Miller., Basic Electronics, A Text Lab Manual,Tata McGraw Hill.
2. Sugaraj Samual R., Horsley Solomen, B.E.S. Practicals.
3. Vijayendran V.,Fundamentals of microprocessor – 8085.-S Viswanathan publishers chennai.

**SEMESTER : V**
**PAPER : VI – ELECTRONIC COMMUNICATIONS**
**(60 HOURS) (w.e.f. 2017-2018)**

**UNIT I (12 Hours)**

**BASICS OF COMMUNICATIONS AND NOISE**

Block diagram of communication system.Types of Electronic communication systems. Simplex, Duplex, Analog/Digital Signals.Noise in communication:External noise-Atmospheric space noise , man made noise .Internal noise –Thermal,shot noise.Definations and relationship between Bit rate,Baud rate,Bandwidth and signal to noise ratio.

**UNIT II (12 Hours)**

**AMPLITUDE MODULATION**

Need for modulation,Amplitude modulation,modulation index,frequency spectrum,generation of AM(balanced modulator),Amplitude demodulation(dioede detector),other forms AM:Doubble side band suppressed carrier,DSCBC generation(balanced madulator).Single side bandsuppressed carrier,SSCBC generation( Filter method,phase cancellation method,third method),SSB detection,Introduction to ather forms of AM(Pilet carrier modulatation,Vestigial side band modulation)

**UNIT III (12 Hours)**

**ANGLE MODULATION**

Frequency and Phase modulation,modulation index and frequency spectrum, equivalence betweenFM and PM.Generation of FM (Direct and indirect methods),FM detector (Slope detector,balanced slope detector,PTL),Comparision between AM,FM and PM.

**UNIT IV (12 Hours)**

**TRANSMITTERS & RECEIVERS**

Transmitters:Communication channels for AM and FM broadcost,AM transmitter: Low level and High level modulation,FM Transmitter.

Receivers:Receiver parameters,sensitivity,selectivity and fidelity, superHeterodyne receiver,AM receivers,FM receivers.Frequency division multiplexing.

**UNIIT V (12 Hours)**

**DIGITAL COMMUNICATION**

Sampling theorem,Pulse amplitude modulation(PAM)Time Division Multiplexing(TDM) Pulse Width Modulation (PWM),Pulse Position Modulatiom(PPM),Pulse Code Modulation(PCM),Diffential Pulse Code Modulation ,Delta Modulation,Adaptive Delta Modulation.

**TEXT BOOKS**

1. H. Taub and D Schilling.,Principles of Communication Systems,Tata McGraw-Hill(1999)
2. W. Tomasi.,Electronic Communication Systems:Fundamental Through Advanced.Pearson Education (2004)
3. L.W. Couch H. Digital and Analog Communication Systems. Pearson Education(2005)
4. L.E Frenzel., Communication Electronics,Principle and Applications,Tata McGraw-Hill(2002)
5. H.P.Hsu.,Analog and Digital Communication.Tata McGraw-Hill(2006)
6. S.Haykin., Communication Systems. Wiley India (2006)
7. G. Kennedy and B Davis,Electronic communication systems. Tata McGraw-Hill(1999)
8. R.P Singh and S.D Sapre Communication systems:Analog and Digital.,Tata McGraw-Hill(2007)
9. T.G Thomas and S Chandra Sekhar., Communication theory,Tata McGraw-Hill(2006)

**ELECTRONICS LAB – 6(A)**
**ELECTRONIC COMMUNICATIONS LAB**
**(All experiments should be done)**

1. To study of Amplitude Modulation and Demodulation.
2. To study of Frequency Modulation and Demodulation.
3. Study of Pulse Amplitude Modulation.
4. Study of Pulse Width Modulation.
5. Study of Pulse Position Modulation.
6. Study of Pulse Code Modulation.
7. Simulation of AM Modulation and Demodulation using software.
8. Simulation of FM Modulation and Demodulation using software.

# COMPUTER SCIENCE

**III YEAR V SEMESTER**

**Paper-V: Data Base Management System**

**Course Objective**:

Design & develop database for large volumes & varieties of data with optimized data processing techniques.

**Course Outcomes**

On completing the subject, students will be able to:

1. Design and model of data in database.
2. Store, Retrieve data in database.

**UNIT I**

**Overview of Database Management System:** Introduction, file-based system, Drawbacks of file-Based System ,Data and information, Database, Database management System, Objectives of DBMS, Evaluation of Database management System, Classification of Database Management System, DBMS Approach, advantages of DBMS, Anis/spark Data Model, data models, Components and Interfaces of Database Management System. Database Architecture, Situations where DBMS is not Necessary, DBMS Vendors and Their Products.

**UNIT II**

**Entity-Relationship Model**: Introduction, the building blocks of an entity relationship diagram, classification of entity sets, attribute classification, relationship degree, relationship classification, reducing ER diagram to tables, enhanced entity-relationship model (EER model), generalization and specialization, **IS A** relationship and attribute inheritance, multiple inheritance, constraints on specialization and generalization, aggregation and composition, entity clusters, connection types, advantages of ER modeling.

**UNIT III**

**Relational Model:** Introduction, CODD Rules, relational data model, concept of key, relational integrity, relational algebra, relational algebra operations, advantages of relational algebra, limitations of relational algebra, relational calculus, tuple relational calculus,domain relational Calculus (DRC). QBE

**UNIT IV**

**Structured Query Language:** Introduction, History of SQL Standard, Commands in SQL, Data Types in SQL, Data Definition Language, Selection Operation, Projection Operation, Aggregate functions, Data Manipulation Language, Table Modification Commands, Table Truncation, Imposition of Constraints, Join Operation, Set Operation, View, Sub Query, Embedded SQL

**UNIT V**

**PL/SQL:** Introduction, Shortcoming in SQL, Structure of PL/SQL, PL/SQL Language Elements, Data Types, Operators Precedence, Control Structure, Steps to Create a PL/SQL, Program, Iterative Control, Cursors, Steps to create a Cursors, Procedure, Function, Packages, Exceptions Handling, Database Triggers, Types of Triggers.

**Reference Books**

1. "Database System Concepts" by Abraham Silberschatz, Henry Korth, and S.Sudarshan, McGrawhill, 2010, 9780073523323
2. "Database Management Systems" by Raghu Ramakrishnan, McGrawhill, 2002,
3. Fundamentals of Relational Database Management Systems by S.Sumathi, S.Esakkirajan, Springer Publications
4. "An Introduction to Database Systems" by Bipin C Desai
5. "Principles of Database Systems" by J. D. Ullman
6. "Fundamentals of Database Systems" by R. Elmasri and S. Navathe

**Student Activity:**
1. Create your college database for placement purpose.
2. Create faculty database of your college with their academic performance scores

**III YEAR V SEMESTER**
**DATABASE MANAGEMENT SYSTEMS LAB**

1. Draw ER diagrams for train services in a railway station
2. Draw ER diagram for hospital administration
3. Creation of college database and establish relationships between tables
4. Write a view to extract details from two or more tables
5. Write a stored procedure to process students results
6. Write a program to demonstrate a function
7. Write a program to demonstrate blocks, cursors & database triggers.
8. Write a program to demonstrate Joins
9. Write a program demonstrate
10. Write a program to demonstrate of Aggregate functions
11. Creation of Reports based on different queries
12. Usage of file locking table locking, facilities in applications.

**III YEAR V SEMESTER**
**Paper VI : Software Engineering**

**Course Objectives**

The Objective of the course is to assist the student in understanding the basic theory of software engineering, and to apply these basic theoretical principles to a group software development project.

**Course outcomes**

1. Ability to gather and specify requirements of the software projects.
2. Ability to analyze software requirements with existing tools
3. Able to differentiate different testing methodologies
4. Able to understand and apply the basic project management practices in real life projects
5. Ability to work in a team as well as independently on software projects

**UNIT I**

**INTRODUCTION:** Software Engineering Process paradigms - Project management - Process and Project Metrics – software estimation - Empirical estimation models - Planning - Risk analysis - Software project scheduling.

**UNIT II**

**REQUIREMENTS ANALYSIS :** Requirement Engineering Processes – Feasibility Study – Problem of Requirements – Software Requirement Analysis – Analysis Concepts and Principles – Analysis Process – Analysis Model

**UNIT III**

**SOFTWARE DESIGN:** Software design - Abstraction - Modularity - Software Architecture - Effective modular design - Cohesion and Coupling - Architectural design and Procedural design - Data flow oriented design.

**UNIT IV**

**USER INTERFACE DESIGN AND REAL TIME SYSTEMS :**User interface design - Human factors - Human computer interaction - Human - Computer Interface design - Interface design - Interface standards.

**UNIT V**

**SOFTWARE QUALITY AND TESTING :**Software Quality Assurance - Quality metrics - Software Reliability - Software testing - Path testing – Control Structures testing - Black Box testing - Integration, Validation and system testing - Reverse Engineering and Re-engineering.
CASE tools –projects management, tools - analysis and design tools – programming tools - integration and testing tool - Case studies.

**REFERENCE BOOKS:**

1. Roger Pressman S., "Software Engineering: A Practitioner's Approach", 7th Edition, McGraw Hill, 2010.
2. Software Engineering Principles and Practice by Deepak Jain Oxford University Press
3. Sommerville, "Software Engineering", Eighth Edition, Pearson Education, 2007
4. Pfleeger, "Software Engineering: Theory & Practice", 3rd Edition, Pearson Education, 2009
5. Carlo Ghazi, Mehdi Jazayari, Dino Mandrioli, "Fundamentals of Software Engineering", Pearson Education, 2003

**Student Activity:**

1. Visit any financial organization nearby and prepare requirement analysis report
2. Visit any industrial organization and prepare risk chart.

**III YEAR V SEMESTER**
**PROJECT & VIVA-VOCE**

The objective of the project is to motivate them to work in emerging/latest technologies, help the students to develop ability, to apply theoretical and practical tools/techniques to solve real life problems related to industry, academic institutions and research laboratories.

The project is of 2 hours/week for one (**Semester-V**) semester duration and a student is expected to do planning, analyzing, designing, coding, and implementing the project. The initiation of project should be with the project proposal. The synopsis approval will be given by the project guides.

The project proposal should include the following:

- Title
- Objectives
- Input and output
- Details of modules and process logic
- Limitations of the project
- Tools/platforms, Languages to be used
- Scope of future application

The **Project work** should be either **an individual one or a group of not more than five members** and submit a project report at the end of the semester. The students shall defend their dissertation in front of experts during viva-voce examinations.

**III YEAR VI SEMESTER**
**Paper-VII: Elective-A**
**Operating Systems**

**Course Objectives**

1. To understand the services provided by and the design of an operating system.
2. To understand the structure and organization of the file system.
3. To understand what a process is and how processes are synchronized and scheduled.
4. To understand different approaches to memory management.
5. Students should be able to use system calls for managing processes, memory and the file system.

**Course Outcomes**

1. Analyze the concepts of processes in operating system and illustration of the scheduling of processor for a given problem instance.
2. Identify the dead lock situation and provide appropriate solution so that protection and security of the operating system is also maintained.
3. Analyze memory management techniques, concepts of virtual memory and disk scheduling.
4. Understand the implementation of file systems and directories along with the interfacing of IO devices with the operating system.

**UNIT - I**

Operating System Introduction: Operating Systems Objectives and functions, Computer System Architecture, OS Structure, OS Operations, Evolution of Operating Systems - Simple Batch, Multi programmed, time shared, Parallel, Distributed Systems, Real-Time Systems, Operating System services.

**UNIT - II**

Process and CPU Scheduling - Process concepts - The Process, Process State, Process Control Block, Threads, Process Scheduling - Scheduling Queues, Schedulers, Context Switch, Preemptive Scheduling, Dispatcher, Scheduling Criteria, Scheduling algorithms, Case studies: Linux, Windows.
Process Coordination - Process Synchronization, The Critical section Problem, Synchronization Hardware, Semaphores, and Classic Problems of Synchronization, Monitors, Case Studies: Linux, Windows.

**UNIT - III**

Memory Management and Virtual Memory - Logical & physical Address Space, Swapping, Contiguous Allocation, Paging, Structure of Page Table. Segmentation, Segmentation with Paging, Virtual Memory, Demand Paging, Performance of Demanding Paging, Page Replacement Page Replacement Algorithms, Allocation of Frames.

**UNIT - IV**

File System Interface - The Concept of a File, Access methods, Directory Structure, File System Mounting, File Sharing, Protection, File System Structure

Mass Storage Structure - Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling.

**UNIT - V**

Deadlocks - System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery from Deadlock.

**REFERENCES BOOKS:**

1. Operating System Principles, Abraham Silberchatz, Peter B. Galvin, Greg Gagne 8th Edition, Wiley Student Edition.
2. Principles of Operating Systems by Naresh Chauhan, OXFORD University Press
3. Operating systems - Internals and Design Principles, W. Stallings, 6th Edition, Pearson.
4. Modern Operating Systems, Andrew S Tanenbaum 3rd Edition PHI.
5. Operating Systems A concept - based Approach, 2nd Edition, D. M. Dhamdhere, TMH.
6. Principles of Operating Systems, B. L. Stuart, Cengage learning, India Edition.
7. Operating Systems, A. S. Godbole, 2nd Edition, TMH

**Student Activity:**

1. Load any new operating system into your computer.
2. Partition the memory in your system
3. Create a semaphore for process synchronization

**III YEAR VI SEMESTER**
**Paper-VII: Elective-B**
**Computer Networks**

**Course Objectives**

1. To provide an introduction to the fundamental concepts on data communication and the design of computer networks.
2. To get familiarized with the basic protocols of computer networks.

**Course Outcomes**

After this course, the student will be able to

1. Identify the different components in a Communication System and their respective roles.
2. Describe the technical issues related to the local Area Networks
3. Identify the common technologies available in establishing LAN infrastructure.

**UNIT – I**

**Introduction:** Uses of Computer Networks, Network Hardware, Network Software, Reference Models, Example Networks.

**The Physical Layer:** The Theoretical Basis for Data Communication, Guided Transmission Media, Wireless transmission, the public switched telephone network

**UNIT – II**

**The Data Link Layer:** Data Link Layer Design Issues, Error Detection and Correction, Sliding Window Protocols.

**The Medium Access Control Sub-layer:** The channel allocation problem, **Multiple Access Protocols**, **Ethernet,** Data Link Layer Switching.

**UNIT – III**

**The Network Layer:** Network Layer Design Issues, Routing Algorithms, Congestion control algorithms, Quality of Service.

Internet Working, The Network Layer in the Internet

**UNIT – IV**

**The Transport Layer:** The Transport Service, Elements of Transport Protocols, Congestion Control Algorithms, The Internet Transport Protocols, The Internet Transport Protocols: TCP, Delay Tolerant Networks.

**UNIT – V**

**The Application Layer:** DNS – The Domain Name System, Electronic Mail, The World Wide Web, Real Time Audio & Video, Content Delivery & Peer-to-Peer.

**Reference Books:**

1. Andrew S. Tanenbaum, "Computer Networks", Fifth Edition, Pearson Education.
2. Bhushan Trivedi, Computer Networks , Oxford University Press
3. James F.Kurose, Keith W.Ross, "Computer Networking", Third Edition, Pearson Education
4. Behrouz A Forouzan, "Data Communications and Networking", Fourth Edition, TMH (2007).
5. Kurose & Ross, "***COMPUTER NETWORKS***" – A Top-down approach featuring the Internet", Pearson Education – Alberto Leon – Garciak.

**Student Activity:**

1. Study the functioning of network devices available in your organization.
2. Prepare a pictorial chart of LAN connections in your organization

**III YEAR VI SEMESTER**
**Paper-VII : Elective-C**
**Web Technologies**

**Course Objective**

- To provide knowledge on web architecture, web services, client side and server side scripting technologies to focus on the development of web-based information systems and web services.
- To provide skills to design interactive and dynamic web sites.

**Course Outcome**

1. To understand the web architecture and web services.
2. To practice latest web technologies and tools by conducting experiments.
3. To design interactive web pages using HTML and Style sheets.
4. To study the framework and building blocks of .NET Integrated Development Environment.
5. To provide solutions by identifying and formulating IT related problems.

**Unit I**

Introduction to XHTML, Cascading Style Sheets (CSS), JavaScript: Introduction to Scripting, Control Statements, Functions, Arrays, Objects

**Unit II**

Dynamic HTML: Object Model and Collections, Dynamic HTML: Event Model

**Unit III**

XML Representing Web Data, XSL Related Technologies and Case Study

**Unit IV**

Building Ajax-Enabled Web Applications, Web Servers (IIS and Apache)

Ruby and Ruby on Rails

**Unit V**

Java Server Faces Web Applications, Web Services

**References:**

1. Harvey M. Deitel and Paul J. Deitel, **"Internet & World Wide Web How to Program", 4/e,** Pearson Education.

2. Uttam Kumar Roy, Web Technologies from Oxford University Press

3. Jason Cranford Teague "**Visual Quick Start Guide CSS, DHTML & AJAX", 4e**, "Pearson Education.
4. Tom Nerino Doli smith **"JavaScript & AJAX for the web"** Pearson Education 2007.
5. Joshua Elchorn **"Understanding AJAX"** Prentice Hall 2006.
6. Hal Fulton **"The Ruby Way", 2e,** Pearson Education 2007.
7. David A. Black **"Ruby for rails"** Dreamtech Press 2006.
8. Bill Dudney, Johathan lehr, Bill Willies, Lery Mattingly **"Mastering Java Server Faces"** Wiely India 2006.

**Student Activities:**

1. **Prepare a web site for your college**
2. **Prepare your personal website**

**III YEAR VI SEMESTER**
**(Cluster 1) Paper-VIII: Elective–A-1**
**Foundations of Data Science**

**Course Objectives**

Modern scientific, engineering, and business applications are increasingly dependent on data, existing traditional data analysis technologies were not designed for the complexity of the modern world. Data Science has emerged as a new, exciting, and fast-paced discipline that explores novel statistical, algorithmic, and implementation challenges that emerge in processing, storing, and extracting knowledge from Big Data.

**Course Outcomes**

1. Able to apply fundamental algorithmic ideas to process data.
2. Learn to apply hypotheses and data into actionable predictions.
3. Document and transfer the results and effectively communicate the findings using visualization techniques.

**UNIT I**

**INTRODUCTION TO DATA SCIENCE :**Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL.

**UNIT II**

**MODELING METHODS :**Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

**UNIT III**

**INTRODUCTION TO R Language:** Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R - manipulating objects – data distribution.

**UNIT IV**

**MAP REDUCE**: Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop Map Reduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

**UNIT V**

**DELIVERING RESULTS :** Documentation and deployment – producing effective presentations– Introduction to graphical analysis – plot() function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph - using graphics parameters. Case studies.

**Reference Books**

1. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.
2. Jure Leskovec, Anand Rajaraman, Jeffrey D.Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014.
3. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012.
4. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013.
5. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd., 2014.
6. Nathan Yau, "Visualize This: The FlowingData Guide to Design, Visualization, and Statistics", Wiley, 2011.
7. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.

**Student Activity:**

1. Collect data from any real time system and create clusters using any clustering algorithm
2. Read the student exam data in R perform statistical analysis on data and print results.

**III YEAR VI SEMESTER**
**(Cluster 1) Paper-VIII : Elective–A-2**
**BIG DATA TECHNOLOGY**

**Course Objective**

The Objective of this course is to provide practical foundation level training that enables immediate and effective participation in big data projects. The course provides grounding in basic and advanced methods to big data technology and tools, including MapReduce and Hadoop and its ecosystem.

**Course Outcome**

1. Learn tips and tricks for Big Data use cases and solutions.
2. Learn to build and maintain reliable, scalable, distributed systems with Apache Hadoop.
3. Able to apply Hadoop ecosystem components.

**UNIT I**

**INTRODUCTION TO BIG DATA:** Introduction – distributed file system – Big Data and its importance, Four V's in bigdata, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

**UNIT II**

**INTRODUCTION HADOOP** : Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

**UNIT- III**

**HADOOP ARCHITECTURE**: Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Tasktrackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering – Monitoring & Maintenance.

**UNIT-IV**

**HADOOP ECOSYSTEM AND YARN :**Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features- NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

**UNIT-V**

**HIVE AND HIVEQL, HBASE**:-Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts- Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

**Reference Books**

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk deroos et al. , "Understanding Big data ", McGraw Hill, 2012.
3. Tom White, "HADOOP: The definitive Guide" , O Reilly 2012.
4. Vignesh Prajapati, "Big Data Analytics with R and Haoop", Packet Publishing 2013.
5. Tom Plunkett, Brian Macdonald et al, "Oracle Big Data Handbook", Oracle Press, 2014.
6. Jy Liebowitz, "Big Data and Business analytics",CRC press, 2013.

**Student Activity**:

1. Collect real time data and justify how it has become Big Data

2. Reduce the dimensionality of a big data using your own map reducer

**III YEAR VI SEMESTER**
**(Cluster 1 Paper-VIII : Elective–A-3)**
**COMPUTING FOR DATA ANALYTICS**

**Course Objectives**

The objective of this course is to teach fundamental concepts and tools needed to understand the emerging role of business analytics in Organizations.

**Course Outcomes**

1. Learn the Big Data in Technology Perspective.
2. Understanding of the statistical procedures most often used by practicing engineers
3. Understand Forecasting methods and apply for business applications.

**UNIT – I**

**DATA ANALYTICS LIFE CYCLE: Introduction** to Big data Business Analytics - State of the practice in analytics role of data scientists - Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.

**UNIT – II**

**STATISTICS Sampling Techniques** : Data classification, Tabulation, Frequency and Graphic representation - Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode, Median, Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient
variance, skewness, Moments & Kurtosis.

**UNIT – III**

**PROBABILITY AND HYPOTHESIS TESTING: Random** variable, distributions, two dimensional R.V, joint probability function, marginal density function. Random vectors - Some special probability distribution - Binomial, Poison, Geometric, uniform, exponential, normal, gamma and Erlang. Multivariate normal distribution - Sampling distribution – Estimation - point, confidence – Test of significance, 1& 2 tailed test, uses of t-distribution, F-distribution, x2distribution.

**UNIT – IV**

**PREDICTIVE ANALYTICS**: Predictive modeling and Analysis - Regression Analysis, Multicollinearity, Correlation analysis, Rank correlation coefficient, Multiple correlation, Least square, Curve fitting and good ness of fit.

**UNIT – V**

**TIME SERIES FORECASTING AND DESIGN OF EXPERIMENTS :** Forecasting Models for Time series : MA, SES, TS with trend, season - Design of Experiments, one way classification, two way classification, ANOVA, Latin square, Factorial Design.

**Reference Books**

1. Chris Eaton, Dirk Deroos, Tom Deutsch etal., "Understanding Big Data", McGrawHIll, 2012.
2. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", Wiley, 2014.
3. Eric Siegel, Thomas H. Davenport , "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", Wiley, 2013.
4. James R Evans, "Business Analytics – Methods, Models and Decisions", Pearson 2013.
5. R. N. Prasad, Seema Acharya, "Fundamentals of Business Analytics", Wiley, 2015.
6. S M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic Foundation, 2011.
7. David Hand, Heiki Mannila, Padhria Smyth, "Principles of Data Mining", PHI 2013.
8. Spyros Makridakis, Steven C Wheelwright, Rob J Hyndman, "Forecasting methods and applications", Wiley 2013( Reprint).

**Student Activity:**

1. Collect temperatures of previous months and prepare a logic to estimate the temperature of next one week
2. Collect real time data and apply statistical techniques to classify it.

**III YEAR VI SEMESTER**
**(Cluster 2) Paper-VIII : Elective–B-1**
**Distributed Systems**

**Course Objectives**

- To expose the fundamentals of distributed computer systems, assuming the availability of facilities for data transmission.
- To discuss multiple levels of distributed algorithms, distributed file systems, distributed databases, security and protection.

**Course Outcomes**

- Create models for distributed systems.
- Apply different techniques learned in the distributed system.

**UNIT I**

Introduction to Distributed Computing Systems, System Models, and Issues in Designing a Distributed Operating System, Examples of distributed systems.

**UNIT II**

Features of Message Passing System, Synchronization and Buffering, Introduction to RPC and its models, Transparency of RPC, Implementation Mechanism, Stub Generation and RPC Messages, Server Management, Call Semantics, Communication Protocols and Client Server Binding.

**UNIT III**

Introduction, Design and implementation of DSM system, Granularity and Consistency Model, Advantages of DSM, Clock Synchronization, Event Ordering, Mutual exclusion, Deadlock, Election Algorithms.

**UNIT IV**

Task Assignment Approach, Load Balancing Approach, Load Sharing Approach, Process Migration and Threads.

**UNIT V**

File Models, File Accessing Models, File Sharing Semantics, File Caching Schemes, File Replication, Atomic Transactions, Cryptography, Authentication, Access control and Digital Signatures.

**Reference Books**


1.Pradeep. K. Sinha: " Distributed Operating Systems: Concepts and Design", PHI, 2007.
2.George Coulouris, Jean Dollimore, Tim Kindberg: " Distributed Systems", Concept and Design, 3rd Edition, Pearson Education, 2005.


**Student Activity**

1. Implementation of Distributed Mutual Exclusion Algorithm.
2. Create a Distributed Simulation Environment.

**III YEAR VI SEMESTER**

**(Cluster 2 ) Paper-VIII : Elective–B-2**

## Cloud Computing

**Course Objectives:**

The student will learn about the cloud environment, building software systems and components that scale to millions of users in modern internet, cloud concepts capabilities across the various cloud service models including Iaas, Paas, Saas, and developing cloud based software applications on top of cloud platforms.

**Course Outcomes**

1. Compare the strengths and limitations of cloud computing
2. Identify the architecture, infrastructure and delivery models of cloud computing
3. Apply suitable virtualization concept.
4. Choose the appropriate cloud player , Programming Models and approach.
5. Address the core issues of cloud computing such as security, privacy and interoperability
6. Design Cloud Services and Set a private cloud

**Unit 1**

**Cloud Computing Overview** – Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self-service , Broad network access , Location independent resource pooling , Rapid elasticity , Measured service

**Unit II**

Cloud scenarios – Benefits: scalability , simplicity , vendors ,security. Limitations – Sensitive information - Application development – Security concerns - privacy concern with a third party - security level of third party - security benefits Regularity issues: Government policies

**Unit III**

**Cloud architecture**: Cloud delivery model – SPI framework , SPI evolution , SPI vs. traditional IT Model

**Software as a Service** (SaaS): SaaS service providers – Google App Engine, Salesforce.com and google platfrom – Benefits – Operational benefits - Economic benefits – Evaluating SaaS

**Platform as a Service** ( PaaS ): PaaS service providers – Right Scale – Salesforce.com – Rackspace – Force.com – Services and Benefits

**Unit IV**

**Infrastructure as a Service** ( IaaS): IaaS service providers – Amazon EC2 , GoGrid – Microsoft soft implementation and support – Amazon EC service level agreement – Recent developments – Benefits
**Cloud deployment model** : Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing

**Unit V**

**Virtualization**: Virtualization and cloud computing - Need of virtualization – cost , administration , fast deployment , reduce infrastructure cost - limitations
**Types of hardware virtualization**: Full virtualization - partial virtualization - para virtualization
**Desktop virtualization**: Software virtualization – Memory virtualization - Storage virtualization – Data virtualization – Network virtualization
**Microsoft Implementation**: Microsoft Hyper V – Vmware features and infrastructure – Virtual Box - Thin client

**Reference Books**

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter TATA McGraw- Hill , New Delhi - 2010
2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008
3. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
4. Cloud Computing, A Hands on approach, Arshadeep Bahga, Vijay Madisetti, University Press
5. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christenvecctiola, S Tammarai selvi, TMH

**Student Activity:**

5. Prepare the list of companies providing cloud services category wise.
6. Create a private cloud using local server

**III YEAR VI SEMESTER**

**(Cluster 2) Paper-VIII : Elective–B-3**

## Grid Computing

**Course Objectives:**

The student will learn about the Grid environment, building software systems and components that scale to millions of users in modern internet, Grid concepts capabilities across the various Grid services.

**Course Outcomes**

1. Compare the strengths and limitations of Grid computing
2. Identify the architecture, infrastructure and delivery models of Grid computing
3. Apply suitable virtualization concept.
4. Address the core issues of Grid computing such as security, privacy and interoperability

**UNIT I**

**CONCEPTS AND ARCHITECTURE** :Introduction-Parallel and Distributed Computing-Cluster Computing-Grid Computing- Anatomy and Physiology of Grid- Web and Grid Services-Grid Standards - OGSA-WSRF - Trends, Challenges and applications.

**UNIT II**

**GRID MONITORING** :Grid Monitoring Architecture (GMA) - An Overview of Grid Monitoring Systems- R-GMA –Grid ICE – MDS- Service Level Agreements (SLAs) -Other Monitoring Systems- Ganglia, Grid Mon, Hawkeye and Network Weather Service.

**UNIT III**

**GRID SECURITY AND RESOURCE MANAGEMENT**: Grid Security-A Brief Security Primer-PKI-X509 Certificates-Grid Security-Grid Scheduling and Resource Management, Grid way and Grid bus Broker-principles of Local Schedulers- Overview of Condor, SGE, PBS, LSF -Grid Scheduling with QoS.

**UNIT IV**

**DATA MANAGEMENT AND GRID PORTALS** :Data Management-Categories and Origins of Structured Data-Data Management Challenges-Architectural Approaches-Collective Data Management Services-Federation Services-Grid Portals-Generations of Grid Portals.

**UNIT V**

**GRID MIDDLEWARE:** List of globally available Middleware's - Case Studies- Recent version of Globus Toolkit and gLite - Architecture, Components and Features. Features of Next generation grid.

**Reference Books**

1. Ian Foster, Carl Kesselman, The Grid 2: Blueprint for a New Computing Infrastructure, Elsevier Series, 2004.
2. Vladimir Silva, Grid Computing for Developers, Charles River Media, January 2006.
3. Parvin Asadzadeh, Rajkumar Buyya, Chun Ling Kei,Deepa Nayar, and Srikumar Venugopal, Global Grids and Software Toolkits: A Study of Four Grid Middleware Technologies, High Performance Computing : Paradigm and Infrastructure, Laurence Yang and Minyi Guo (editor s), Wiley Press, New Jersey, USA, June 2005.
4. Jarek Nabrzyski, Jennifer M. Schopf, Jan Weglarz , Grid Resource Management: State of the Art and Future Trends , (International Series in Operations Research & Management Science), Springer; First edition, 2003

**Student Activity:**

1. Implement and analyze any one Grid Resource Sharing algorithm.
2. Listout various security issues with Grid

**III YEAR VI SEMESTER**
**PROJECT & VIVA-VOCE**

The objective of the project is to motivate them to work in emerging/latest technologies, help the students to develop ability, to apply theoretical and practical tools/techniques to solve real life problems related to industry, academic institutions and research laboratories.

The project is of 2 hours/week for one (**Semester-VI**) semester duration and a student is expected to do planning, analyzing, designing, coding, and implementing the project. The initiation of project should be with the project proposal. The synopsis approval will be given by the project guides.

The project proposal should include the following:

- Title
- Objectives
- Input and output
- Details of modules and process logic
- Limitations of the project
- Tools/platforms, Languages to be used
- Scope of future application

The **Project work** should be either **an individual one or a group of not more than five members** and submit a project report at the end of the semester. The students shall defend their dissertation in front of experts during viva-voce examinations.

# COMPUTER APPLICATIONS

## SEMESTER-V
## PAPER-V (CORE) : Database Management Systems

**Unit-I: Overview of Database Management System:** Introduction, Data and Information, Database, Database Management System, Objectives of DBMS, Evolution of Database Management Systems, Classification of Database Management System.

**Unit-II:** File-Based System, Drawbacks of File-Based System , DBMS Approach, Advantages of DBMS, Data Models , Components of Database System, Database Architecture, DBMS Vendors and their Products.

**Unit-III: Entity–Relationship Model:** Introduction, The Building Blocks of an Entity–Relationship, Classification of Entity Sets , Attribute Classification, Relationship Degree, Relationship Classification, Generalization and Specialization, aggregation and composition, CODD'S Rules, Relational Data Model , Concept of ,Relational Integrity.

**Unit-IV: Structured Query Language:** Introduction, History of SQL Standard, Commands in SQL, Data types in SQL, Data Definition Language (DDL), Selection Operation Projection Operation, Aggregate Functions, Data Manipulation Language, Table Modification, Table Truncation, Imposition of Constraints, Set Operations.

**Unit -V: PL/SQL:** Introduction, Structure of PL/SQL, PL/SQL Language Elements ,Data Types, Control Structure,, Steps to Create a PL/SQL Program, Iterative Control ,Cursors , Steps to Create a Cursor , Procedure, Function ,Packages ,Exceptions Handling, Database Triggers, Types of Triggers.

**Reference Books:**


1. Paneerselvam: Database Management Systems, PHI.
2. David Kruglinski, Osborne, Data Management System McGraw Hill Publication
3. Shgirley Neal and Kenneth LC Trunik Database Management Systems in Business – PHI.
4. Godeon C. EVEREST, Database Management – McGraw Hill Book Company.
5. MARTIN, Database Management – Prentice Hall of India, New Delhi.
6. Bipin C. Desai, "An Introduction to Database Systems", Galgotia Publications.
7. Korth, Database Management systems.
8. Navathe, Database Management systems.
9. S.Sumathi, S.Esakkirajan, Fundamentals of Relational Database Management Systems

**SEMESTER-V**
**PAPER-VI (CORE) : Web Technology**

**Unit-I: Introduction**: HTML, XML, and WWW, Topologies, Bus, Star, Ring, Hybrid, Tree, LAN, WAN, MAN. **HTML**: Basic HTML, Document body, Text, Hyper links, Adding more formatting, Lists, Tables using colors and images. **More HTML**: Multimedia objects, Frames, Forms towards interactive, HTML document heading.

**Unit-II: Cascading Style Sheets**: Introduction, using Styles, simple examples, your own styles, properties and values in styles, style sheet, formatting blocks of information, layers.

**Unit-III: Introduction to JavaScript**: What is DHTML, JavaScript, basics, variables, string manipulations, mathematical functions, statements, operators, arrays, functions.

**Unit-IV: Objects in JavaScript**: Data and objects in JavaScript, regular expressions, exception handling, built-in objects, events.

**Unit-V: DHTML with JavaScript**: Data validation, opening a new window, messages and confirmations, the status bar, different frames, rollover buttons, moving images, multiple pages in single download, text only menu system.

**Reference Books**


1. Uttam Kumar Roy, Web Technologies, Oxford University Press.
2. Black Book HTML 5.0
3. Complete reference HTML 5.0
4. Web Technology, PHI Publications.

**SEMESTER-V**
**PROJECT & VIVA-VOCE**

The objective of the project is to motivate them to work in emerging/latest technologies, help the students to develop ability, to apply theoretical and practical tools/techniques to solve real life problems related to industry, academic institutions and research laboratories.

The project is of 2 hours/week for one (**Semester-V**) semester duration and a student is expected to do planning, analyzing, designing, coding, and implementing the project. The initiation of project should be with the project proposal. The synopsis approval will be given by the project guides.

The project proposal should include the following:

- Title
- Objectives
- Input and output
- Details of modules and process logic
- Limitations of the project
- Tools/platforms, Languages to be used
- Scope of future application

The **Project work** should be either **an individual one or a group of not more than five members** and submit a project report at the end of the semester. The students shall defend their dissertation in front of experts during viva-voce examinations.

## SEMESTER-VI

### PAPER-VII : ELECTIVE-I (A) : PHP and My SQL

**Unit-I: Building blocks of PHP:** Variables, Data Types, Operators and Expressions, Constants. **Flow Control Functions in PHP:** Switching Flow, Loops, Code Blocks and Browser Output. **Working with Functions:** Defining Functions, Calling functions, Returning the values from User-Defined Functions, Variable Scope, Saving State between Function calls with the Static statement, more about arguments.

**Unit-II: Working with Arrays:** Arrays, Creating Arrays, Some Array-Related Functions. **Working with Objects:** Creating Objects, Object Instance. **Working with Strings, Dates and Time:** Formatting Strings with PHP, Investigating Strings with PHP, Manipulating Strings with PHP, Using Date and Time Functions in PHP.

**Unit-III: Working with Forms:** Creating Forms, Accessing Form - Input with User defined Arrays, Combining HTML and PHP code on a single Page, Using Hidden Fields to save state, Redirecting the user, Sending Mail on Form Submission, Working with File Uploads**. Working with Cookies and User Sessions:** Introducing Cookies, Setting a Cookie with PHP, Session Function Overview, Starting a Session, Working with session variables, passing session IDs in the Query String, Destroying Sessions and Unsetting Variables, Using Sessions in an Environment with Registered Users.

**Unit-IV: Working with Files and Directories:** Including Files with include(), Validating Files, Creating and Deleting Files, Opening a File for Writing, Reading or Appending, Reading from Files, Writing or Appending to a File, Working with Directories, Open Pipes to and from Process Using popen(), Running Commands with exec(), Running Commands with system() or passthru(). **Working with Images:** Understanding the Image-Creation Process, Necessary Modifications to PHP, Drawing a New Image, Getting Fancy with Pie Charts, Modifying Existing Images, Image Creation from User Input.

**Unit-V: Interacting with MySQL using PHP:** MySQL Versus MySQL Functions, Connecting to MySQL with PHP, Working with MySQL Data. **Creating an Online Address Book:** Planning and Creating Database Tables, Creating Menu, Creating Record Addition Mechanism, Viewing Records, Creating the Record Deletion Mechanism, Adding Sub-entities to a Record.

**Reference Book:**


1. Julie C. Meloni, PHP MySQL and Apache, SAMS Teach Yourself, Pearson Education (2007).
2. Xue Bai Michael Ekedahl, The Web Warrior Guide to Web Programming, Thomson (2006).

**SEMESTER-VI**

**PAPER-VII : ELECTIVE-I (B) : Computer Networks**

**UNIT – I**

**Introduction:** Uses of Computer Networks, Network Hardware, Network Software, Reference Models, Example Networks.

**The Physical Layer:** The Theoretical Basis for Data Communication, Guided Transmission Media, Wireless transmission, the public switched telephone network

**UNIT – II**

**The Data Link Layer:** Data Link Layer Design Issues, Error Detection and Correction, Sliding Window Protocols.

**The Medium Access Control Sub-layer:** The channel allocation problem, Multiple Access Protocols, Ethernet, Data Link Layer Switching.

**UNIT – III**

**The Network Layer:** Network Layer Design Issues, Routing Algorithms, Congestion control algorithms, Quality of Service.

Internet Working, The Network Layer in the Internet

**UNIT – IV:**

**The Transport Layer:** The Transport Service, Elements of Transport Protocols, Congestion Control Algorithms, The Internet Transport Protocols, The Internet Transport Protocols: TCP, Delay Tolerant Networks.

**UNIT – V:**

**The Application Layer:** DNS – The Domain Name System, Electronic Mail, The World Wide Web, Real Time Audio & Video, Content Delivery & Peer-to-Peer.

**Reference Books:**


1. Andrew S. Tanenbaum, "Computer Networks", Fifth Edition, Pearson Education.
2. Bhushan Trivedi, Computer Networks , Oxford University Press
3. James F.Kurose, Keith W.Ross, "Computer Networking", Third Edition, Pearson Education
4. Behrouz A Forouzan, "Data Communications and Networking", Fourth Edition, TMH (2007).
5. Kurose & Ross, "***COMPUTER NETWORKS***" – A Top-down approach featuring the Internet", Pearson Education – Alberto Leon – Garciak.

**SEMESTER-VI**

**PAPER-VIII : ELECTIVE-II (A1) : Data Mining and Ware Housing**

**Course Objectives**

The Objective of this course is to understand data mining principles and techniques: Introduce DM as a cutting edge business intelligence method and acquaint the students with the DM techniques for building competitive advantage through proactive analysis, predictive modeling, and identifying new trends and behaviors. Develop and apply critical thinking, problem-solving, and decision-making skills

**Course Outcomes**

1. Examine the types of the data to be mined and present a general classification of tasks and primitives to integrate a data mining system.
2. Apply preprocessing statistical methods for any given raw data
3. Discover interesting patterns from large amounts of data to analyze and extract patterns to solve problems , make predictions of outcomes
4. Comprehend the roles that data mining plays in various fields and manipulate different data mining techniques
5. Select and apply proper data mining algorithms to build analytical applications.
6. Evaluate and implement a wide range of emerging and newly-adopted methodologies and technologies to facilitate the knowledge discovery.

**Unit I**

**Introduction to Data Mining** : Fundamentals of data mining, data mining functionalities, data and attribute types, statistical description of data. Data Preprocessing, Data cleaning, data integration, data reduction, data transformation and data discretization.

**Unit II**

**Data Warehousing**: Basic concepts, data ware house modeling data cube and OLAP, data warehouse design and implementation.

**Unit III**

**Mining Frequent Patterns and Associations**: Basic methods, frequent Item set mining methods any two algorithms, pattern evaluation methods.

**Unit IV**

**Classification**: Basic concepts, decision tree induction, Bayes classification, any two advanced methods, model evaluation.

**Unit V**

**Cluster Analysis**: Basic concepts, clustering structures, major clustering approaches, partitioning methods, hierarchical methods, density based methods, the expectation maximization method, cluster based outlier detection Essential Reading.

**References:**

1. Data Mining by Vikram Pudi, P.Radha Krishna, Oxford Universith Press
2. Data Warehousing by Reema Thareja , Oxford University Press
3. J. Han , M. Kamber and J. Pei , Data Mining: Concepts and Techniques , 3rd.edMorgan Kaufmann, 2011
4. Introduction to data mining –G.K.Gupta, PHI
5. Data mining, Data warehouse & Olap-Berson, Tata McGraw Hill

**Student Activity:**

1.Predict the course taken by a student based on his activities and way of learning
2. Learn visual patterns of any real time data

## SEMESTER-VI

### PAPER-VIII : ELECTIVE-II (A2) : Distributed Systems

**UNIT I**

Introduction to Distributed Computing Systems, System Models, and Issues in Designing a Distributed Operating System, Examples of distributed systems.

**UNIT II**

Features of Message Passing System, Synchronization and Buffering, Introduction to RPC and its models, Transparency of RPC, Implementation Mechanism, Stub Generation and RPC Messages, Server Management, Call Semantics, Communication Protocols and Client Server Binding.

**UNIT III**

Introduction, Design and implementation of DSM system, Granularity and Consistency Model, Advantages of DSM, Clock Synchronization, Event Ordering, Mutual exclusion, Deadlock, Election Algorithms.

**UNIT IV**

Task Assignment Approach, Load Balancing Approach, Load Sharing Approach, Process Migration and Threads.

**UNIT V**

File Models, File Accessing Models, File Sharing Semantics, File Caching Schemes, File Replication, Atomic Transactions, Cryptography, Authentication, Access control and Digital Signatures.

**Reference Books**


1.Pradeep. K. Sinha: “Distributed Operating Systems: Concepts and Design”, PHI, 2007.

2 .George Coulouris, Jean Dollimore, Tim Kindberg: “Distributed Systems”, Concept and Design, 3rd Edition, Pearson Education, 2005.

**SEMESTER-VI**

**PAPER-VIII : ELECTIVE-II (A3) : Grid Computing**

**UNIT I**

**CONCEPTS AND ARCHITECTURE** :Introduction-Parallel and Distributed Computing-Cluster Computing-Grid Computing- Anatomy and Physiology of Grid-Web and Grid Services-Grid Standards - OGSA-WSRF - Trends, Challenges and applications.

**UNIT II**

**GRID MONITORING** :Grid Monitoring Architecture (GMA) - An Overview of Grid Monitoring Systems- R-GMA –Grid ICE – MDS- Service Level Agreements (SLAs) - Other Monitoring Systems- Ganglia, Grid Mon, Hawkeye and Network Weather Service.

**UNIT III**

**GRID SECURITY AND RESOURCE MANAGEMENT**: Grid Security-A Brief Security Primer-PKI-X509 Certificates-Grid Security-Grid Scheduling and Resource Management, Grid way and Grid bus Broker-principles of Local Schedulers-Overview of Condor, SGE, PBS, LSF -Grid Scheduling with QoS.

**UNIT IV**

**DATA MANAGEMENT AND GRID PORTALS** :Data Management-Categories and Origins of Structured Data-Data Management Challenges-Architectural Approaches-Collective Data Management Services-Federation Services-Grid Portals-Generations of Grid Portals.

**UNIT V**

**GRID MIDDLEWARE:** List of globally available Middleware's - Case Studies-Recent version of Globus Toolkit and gLite - Architecture, Components and Features. Features of Next generation grid.

**Reference Books**


1. Ian Foster, Carl Kesselman, The Grid 2: Blueprint for a New Computing Infrastructure, Elsevier Series, 2004.
2. Vladimir Silva, Grid Computing for Developers, Charles River Media, January 2006.
3. Parvin Asadzadeh, Rajkumar Buyya, Chun Ling Kei,Deepa Nayar, and Srikumar Venugopal, Global Grids and Software Toolkits: A Study of Four Grid Middleware Technologies, High Performance Computing : Paradigm and Infrastructure, Laurence Yang and Minyi Guo (editor s), Wiley Press, New Jersey, USA, June 2005.
4. Jarek Nabrzyski, Jennifer M. Schopf, Jan Weglarz , Grid Resource Management: State of the Art and Future Trends , (International Series in Operations Research & Management Science), Springer; First edition, 2003

**SEMESTER-VI**

**PAPER-VIII : ELECTIVE-II (B1) : Cloud Computing**

**Unit 1**

Cloud Computing Overview – Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, Measured service

**Unit II**

Cloud scenarios – Benefits: scalability, simplicity, vendors, security. Limitations – Sensitive information - Application development – Security concerns - privacy concern with a third party - security level of third party - security benefits Regularity issues: Government policies

**Unit III**

Cloud architecture: Cloud delivery model – SPI framework , SPI evolution, SPI vs. traditional IT Model

Software as a Service (SaaS): SaaS service providers – Google App Engine, Salesforce.com and google platfrom – Benefits – Operational benefits - Economic benefits – Evaluating SaaS

Platform as a Service ( PaaS ): PaaS service providers – Right Scale – Salesforce.com – Rackspace – Force.com – Services and Benefits

**Unit IV**

Infrastructure as a Service ( IaaS ): IaaS service providers – Amazon EC2, GoGrid – Microsoft soft implementation and support – Amazon EC service level agreement – Recent developments – Benefits Cloud deployment model : Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing

**Unit V**

Virtualization: Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations - Types of hardware virtualization: Full virtualization - partial virtualization - para virtualization - Desktop virtualization: Software virtualization – Memory virtualization - Storage virtualization – Data virtualization – Network virtualization Microsoft Implementation: Microsoft Hyper V – Vmware features and infrastructure – Virtual Box - Thin client

**Reference Books**


1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte, Robert Elsenpeter TATA McGraw- Hill , New Delhi – 2010
2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008
3. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier
4. Cloud Computing, A Hands on approach, Arshadeep Bahga, Vijay Madisetti, University Press
5. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christenvecctiola, S Tammarai selvi, TMH

## SEMESTER-VI

### PAPER-VIII : ELECTIVE-II (B2) : e-Commerce

**Unit-I: Introduction to E-Commerce**: Scope, Definition, e-Commerce and the Trade Cycle, Electronic Markets, Electronic Data Interchange, Internet Commerce. Business Strategy in an Electronic Age: Supply Chains, Porter's Value Chain Model, Inter Organizational Value Chains, Competitive Strategy, First Mover Advantage - Sustainable Competitive Advantage, Competitive Advantage using E-Commerce - Business Strategy.

**Unit-II: Business-to-Business Electronic Commerce**: Characteristics of B2B EC, Models of B2B EC, Procurement Management by using the Buyer's Internal Market place, Just in Time Delivery, Other B2B Models, Auctions and Services from traditional to Internet Based EDI, Integration with Back-end Information System, Role of Software Agents for B2B EC, Electronic marketing in B2B, Solutions of B2B EC, Managerial Issues, Electronic Data Interchange (EDI), EDI: Nuts and Bolts, EDI and Business.

**Unit-III: Internet and Extranet** : Automotive Network Exchange, Largest Extranet, Architecture of the Internet, Intranet and Extranet, Intranet software, Applications of Intranets, Intranet Application Case Studies, Considerations in Intranet Deployment, Extranets, Structures of Extranets, Extranet products and services, Applications of Extranets, Business Models of Extranet Applications, Managerial Issues. Electronic Payment Systems: Issues and Challenges.

**Unit-IV: Public Policy**: From Legal Issues to Privacy : Legal Incidents, Ethical and Other Public Policy Issues, Protecting Privacy, Protecting Intellectual Property, Free speech, Internet Indecency and Censorship, Taxation and Encryption Policies, Other Legal Issues: Contracts, Gambling and More, Consumer and Seller Protection in EC.

**Unit-V: Infrastructure For EC** : Network of Networks, Internet Protocols, Web-Based client/Server, Internet Security, Selling on the Web, Chatting on the Web, Multimedia delivery, Analyzing Web Visits, Managerial Issues, Equipment required for establishing EC Sites – Problems in Operation – Future of EC.

**Reference Books**


1. David Whiteley, "E-Commerce", Tata McGraw Hill, 2000.
2. E Business by Parag Kulakarni and Sunitha Jahirabadkar from Oxford University Press.
3. E Business by Jonathan Reynolds from Oxford University Press.
4. Eframi Turban, Jae Lee, David King, K. Michael Chung, "Electronic Commerce", Pearson Education, 2000.
5. R. Kalakota and A. B. Whinston, Frontiers of Electronic Commerce, Addison Wesley.
6. David Kosiur, Understanding Electronic Commerce, Microsoft Press.
7. Soka, From EDI to Electronic Commerce, McGraw Hill.

**SEMESTER-VI**

**PAPER-VIII : ELECTIVE-II (B3) : Unix**

**Course Objectives**

1. To understand Unix Operating System
2. To explore the Basic Shell Commands

**Course Outcomes**

After this course, the student will be able to

1. Implement and innovate commands using the basic tool kit.
2. Develop shell programs in vi/vim editor

**Unit I**

Overview of UNIX Operating System, basic features of Unix operating System, File Structure, CPU Scheduling, Memory Management, File System Implementation of Operating System Functions in UNIX.

**Unit II**

Starting Of Unix and Text Manipulation and user-to-user communication User Names and Groups, Logging In, Format of Unix Commands, Changing your password, Unix Documentation,

**Unit III**

Files and Directories:, File permission, Basic Operation on Files, Changing Permission Modes, Standard files , Processes Inspecting Files, Operating On Files, Printing Files, Rearranging Files, Sorting Files, Splitting Files, Translating Characters, On line communication, Off line communication.

**Unit IV**

vi Editors-General characteristics, Adding text and Navigation, changing text, searching for text, copying and Moving text, Features of Ex, Line Editors Ex and Ed, Stream editor SED, changing several file s in SED, AWK.

**Unit V**

Shell Programming: Programming in the Bourne and C-Shell, Wild Cards, Simple Shell program, variables, Programming Construct, Interactive Shell scripts, Advanced Features, Unix Compiler, Maintaining program System Administration Define system Administration, Booting the system, Maintaining User Accounts, File System, and special files, Backup and Restoration.

**References Books:**


1. Unix and shell Programming by B.M Harwani, OXFORD University Press
2. Unix Concept and application- Sumitabhadas
3. Unix Shell Programming-Yashwant Kanetkar
4. Unix Programming Environment- RobPike
5. Unix in a Nutshell- Donill Gily


**Student Activity:**

1. Load unix/linux in your system in a separate drive
2. Create graphics in unix environment

**SEMESTER-VI**
**PROJECT & VIVA-VOCE**

The objective of the project is to motivate them to work in emerging/latest technologies, help the students to develop ability, to apply theoretical and practical tools/techniques to solve real life problems related to industry, academic institutions and research laboratories.

The project is of 2 hours/week for one (**Semester-VI**) semester duration and a student is expected to do planning, analyzing, designing, coding, and implementing the project. The initiation of project should be with the project proposal. The synopsis approval will be given by the project guides.

The project proposal should include the following:

- Title
- Objectives
- Input and output
- Details of modules and process logic
- Limitations of the project
- Tools/platforms, Languages to be used
- Scope of future application

The **Project work** should be either **an individual one or a group of not more than five members** and submit a project report at the end of the semester. The students shall defend their dissertation in front of experts during viva-voce examinations.