SEMESTER - V
T.Y.B.Sc. (PHYSICS)
SEM.-V (CBCS-2018)
P – 51: MATHEMATICAL MEHODS FOR PHYSICS

Total Credits: 04   **Total Lectures: 60**

Course Learning Outcomes:

By the end of this course student will be able to have following learning outcomes,

- Ability to explain different coordinate system to describe the motion of particle
- Understanding of different types of equations and special function utilized mathematically to explain the physical phenomenon
- Student will get detailed information and understanding about thespecial theory of relativity and a lot many important concepts associated with it.

Course Content:

1. **Curvilinear coordinates:**   **(18)**
   Introduction to Cartesian (x, y, z), spherical polar (r, ⎪⎪, ⎪⎪) and cylindrical (⎪⎪, ⎪⎪, z) coordinate systems and transformation equations, General curvilinear coordinates, coordinate surfaces, coordinate lines, length element, surface element and volume element in curvilinear coordinate system, Metric coefficientsOrthogonal curvilinear coordinate system; expressions for gradient, divergence, Laplacian and curl, special cases of the above for Cartesian, spherical polar and cylindrical coordinate systems

2. **Equations and special functions:**   **(14)**
   Introduction to partial differential equations, frequently occurring partial differential equations, (degree, order, linear/nonlinear, homogeneous/non-homogeneous), Method of separation of variables, singular points of differential equations, point of infinity, Fuch's theorem (statement with proof) Frobeniu's method of series solution. Series solution of Legendre, Hermite and Bessel differential equations

3. **Special functions:**   **(12)**
   Generating functions for Legendre P (x), Hermite $H_n(x)$ Polynomials and Bessel functions of first kind J_n (x) and their properties

4. **Special theory of relativity:**   **(16)**
   Introduction, Newtonian relativity Galilean transformation equation, Michelson-Morley experiment, Postulates of special relativity,Lorentz transformations, Kinematic effects of Lorentz transformation, Length contraction, Proper time, Transformation of velocities, Variation of mass with velocity, Mass-energy relation.Four vectors.

Reference Books

(1) Mathematical physics - Joshi, Wagh, Mandke and Agashe, G. Y. Prakashan, Pune.

(2) Mathematics for physics - Bhat, Panat, Ogale, Rane (SuvicharPrakashan)

(3) Mathematical methods for physicists, Arfken and Weber, Acadmic press Newyork.

(4) Vector analysis - Spiegel (Schaum series)

(5) Mathematical methods in the physical sciences – Marry L. Boas, John Willy and sons publication

(6) Applied mathematics for engineers and physicists - L. A. Pipes (McGraw Hill)

(7) Introduction to special relativity, Robert Resnick, willyeastrn Ltd.

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T.Y.B.Sc. (PHYSICS)

SEM.-V (CBCS-2018)

P-52: QUANTUM MECHANICS

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Total Credits: 04   **Total Lectures: 60**

Course Learning Outcomes:

By the end of this course student will be able to have following learning outcomes,

- Understanding of historical basics of quantum mechanics
- Student will be able to understand the Schrodinger's wave equation and its application
- Explanation of hydrogen atom and significance of quantum numbers
- Student will have understanding of how operators in quantum mechanics works

Course Content:

1. Background of Quantum Mechanics: **(16)**
   Historical Background, a) Review of Black body radiation, b) Review of photoelectric effects, Matter waves, De Broglie hypothesis. Davisson and Germer experiment, Wave particle duality, Wave function of a particle having definite momentum, Concept of wave packet, phase velocity, group velocity and relation between them, Dual nature of matter, phase velocity, Heisenberg'suncertainty principle, different forms of uncertainty principle (statement only), Heisenberg's gamma ray microscope, electron diffraction experiment.

2. Schrodinger's wave equation: **(14)**
   Physical interpretation of wave function, formulation of time dependent and time independent Schrodinger's wave equation (one, two and three dimensional). Boundary conditions,   energy eigen values and eigen functions, expectation values, Ehrenfest's theorem withproof Equation of continuity (probability density, probability current density).

3. Applications of Schrodinger's equation: **(10)**
   Step potential of finite depth, potential barrier, particle in one dimensional rigid box (infinite depth), one dimensional harmonic oscillator, three dimensional harmonic oscillators.

4. Operators: **(12)**
   Hermitian operator, Position, Momentum operator, angular momentum operator, and total energy operator (Hamiltonian), Commutator brackets- Simultaneous Eigen function, Commutator algebra, Commutator brackets using position, momentum and angular momentumoperator, Raising and lowering angular momentum operator, Concept of parity, parity operator and its Eigen values.

5. Hydrogen atom: **(08)**
   Schrodinger's wave equation for hydrogen atom, separation of radial and angular parts, solutions of radial part to obtain energy eigenvalues, Significance of quantum numbers n, l, ml, ms.

   Reference books
1. Introduction to quantum mechanics - by P. T. Mathew.
2. Quantum mechanics - by J. Powel and B. Craseman.
3. Introduction to quantum mechanics - by R. H. Dicke and J. P. Wittke.
4. Introduction to quantum mechanics - by Ogale, Panat, Bhide etc.
5. Perspective of modern physics - by Beiser.
6. Quantum Mechanics. - By Ghatak and Lokanathan Published by Mc. Millan.

T.Y.B.Sc. (PHYSICS)

SEM.-V (CBCS-2018)

P-53: SOLID STATE PHYSICS

Total Credits: 04   **Total Lectures: 60**

Course Learning Outcomes:

By the end of this course student will be able to have following learning outcomes,

- Understanding of basic concepts required in solid state Physics
- Information about the crystallite state of matter and concept of lattices and their properties
- Student will be able to understand about the X-ray diffraction
- Ability to analyze different magnetic properties of materials

Course Content:

1. **The crystalline state:**   **(18)**
   Translational vectors and lattices, symmetry operations, two and three dimensional lattice types, Miller indices, interplaner distances, simple crystal SC, BCC and FCC structural, packing fraction, concept of reciprocal lattice and its properties. Problems

2. **Diffraction of x-rays by crystals:**   **(16)**
   Introduction, Crystal as a grating for x-rays, Bragg's law of diffraction in reciprocal lattice, Bragg's diffraction conditions in direct and reciprocal lattice, Ewald,s construction, Experimental method of X-ray diffraction:- cubic crystals by powder method. Problems

3. **Magnetism:**   (12)
   Diamagnetism,Langevin theory of diamagnetism, application of diamagnetic material,superconductivity, superconductor, critical magnetic field and Meissner effect,paramagnetism,Langevin theory of paramagnetism, ferromagnetism, ferromagnetic doorman,hystersis, Curie temperature, ferrites and its applications.

4. **Free Electron and Band Theory of Metals**   **(14)**
   Free Electron model, Energy levels and Density of orbital in 1D and 3D, Bloch theorem (statement only), Nearly free electron model, Fermi energy, Fermi level, Hall Effect, Origin of energy gap, Energy bands in Solids, Effective mass of electron (with derivation), Distinction between metal, semiconductor and insulator, Problems

   Reference books

1. Solid State Physics-S.O.Pillai, 3rd Edition, New Age International (P) Ltd, Publisher, (1999)
2. Solid State Physics – Kakani and Hemrajani, S. Chand Publication
3. Solid State Physics BySaxena, Gupta and Saxena, PragatiPrakation.
4. Introduction to Solid State Physics- Charles Kittel, John Wiley and Sons, 7th Edition.
5. Solid State Physics-A.J.Dekker, Macmillan India Ltd, (1998)
6. Solid State Physics- R.K. Puri, V.K. Babbar, S. Chand Publication
7. Problems in Solid State Physics-S.O. Pillai, New Age International (P) Ltd.
8. Solid State Physics-Palanyswamy.
9. Solid State Physics- David, Snoke, Pearson Publication

T.Y.B.Sc. (PHYSICS)

SEM.-V (CBCS-2018)

P-54: ADVANCED ELECTRONICS

Total Credits: 04   **Total Lectures: 60**

Course Learning Outcomes:

By the end of this course student will be able to have following learning outcomes,

- Student will be able to develop the understanding of application of fundamental laws of physics in different areas such astelecommunications and power electronics for automation in industries
- Acquire essential laboratory skills in designing experiments, assembling standard tools power electronics and analyzing acquired data
- Identify the critical areas in application levels and derive typical alternative solutions, select suitable electronic devices as per the requirement
- A thorough understanding of integrated circuits (ICs) and their applications
- Develop understanding of Basic circuit in electronics and their practical applications

Course Content:

1. **Electronic devices:**   **(10)**
   Introduction, classification, principle, working and IV characteristics ofFET, MOSFET (D-MOSFET and E-MOSFET).Problems on FET, SCR and UJT principle, working and applications of each

2. **Power supplies:**   **(8)**
   Principle of electronically regulated power supply, Series and shunt regulated power supply, electronically regulated power supply using IC 723 (both low voltage and high voltage)

3. **Amplifiers:**   **(8)**
   Idea of A.C. and D.C. load lines, graphical analysis of transformer coupled amplifier and impedance coupled amplifier.

4 A. **Power amplifiers:**   **(8)**
   Class A, Class B, Class C and Class AB amplifiers, calculation of efficiency in case of class A amplifier with resistive load and transformer coupled amplifier

   B. **Push-pull amplifiers:**   **(6)**
   Class A and Class B push pull amplifiers, idea of cross over distortion, and calculation of efficiency in class B push-pull amplifiers.

   C. **Differential amplifier:**   **(4)**
   Circuit, operations, common mode, differential mode, CMRR, need for constant current source (No mathematical derivations)

   D. **Operational amplifiers:**   **(6)**
   IC 741, inverting and non-inverting configurations, concept of virtual ground ,parameters, offset, operational amplifier as adder, subtractor, comparator, integrator and differentiator. Problems based on above theory.

5. **I C Versions:**   **(4)**
   Block diagram of IC 555 and its applications as astablemultivibrator

6. **Oscillators:** (6)

Theory of oscillator, RC and LC oscillators - Phase shift, Weinbridge,Colpitt and Hartly oscillator. Problems based on theory.

Reference books:

1. Solid state electronics devices- by B. G. Streetman
2. Integrated electronics - by Millmun-Halkais.
3. Basic electronics - by Grob
4. Digital electronics: principles and applications- by Malvino-Leach.
5. Electronic fundamentals and applications - John D. Ryder.
6. Electronic Devices and Circuits - Allen Mottershed

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T.Y.B.Sc. (PHYSICS)
SEM.-V (CBCS-2018)
P-55: CLASSICAL MECHANICS

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Total Credits: 04   **Total Lectures: 60**

Course Learning Outcomes:

By the end of this course student will be able to have following learning outcomes,

- Students will understand the discipline specific knowledge in classicalmechanics such as application of Newton's laws Lagrange's equations, Hamiltonian equations of motion etc.
- Students will be able to understand the concepts of classical mechanics and demonstrate a proficiency in the fundamental concepts in this area of science
- This course will enhance the ability of critical thinking to formulateand solve quantitative problems in applied physics

Course Content:

1. **Newton's laws and constant fields:** **(18)**
   Conservation laws and mechanics of particles, equation of motion of a particle, applications of Newton's laws to the motion of charged particles under constant electric, magnetic fields and electromagnetic field, Mechanics of system of particles, concept of center of mass, Conservation of anglar momentum of the particle, energy of the system., Problems

2. **Motion in a central force field**: **(12)**
   concept of the central force, Equivalent one body problem, motion of a particle in a central force field, general features of motion like constancy of angular momentum, motion in an inverse square law of force, qualitative discussion of the orbits, equation of orbit, Kepler's laws of planetary motion with proof, problems

3. **Lagrangian and Hamiltonian formulation:** **(16)**
   General Idea about Lagrangian and Hamiltonian formulation, Constraints, generalized coordinates, D'Alembert's principle, Lagrange's equation from D'Alembert's principle, symmetric and conservation laws, cyclic coordinates, Hamiltonian and Hamilton's equation of motion, simple applications of Hamilton's and Lagrange's equations of motions such as simple pendulum, compound pendulum, projectile motion. Linear harmonic oscillator, Atwood's machine

4. **Moving coordinate system:** **(14)**
   Coordinate systems with relative translation motions, Galilean relativity and invariance of Newton's laws under Galilean transformations, rotating coordinate system, derivation of $(d/dt)_f$ $= (d/dt)_r + w \, X$ - is expected, Corioli's force, effect of motion on the Earth, freely falling body in a rotating frame, effect of Corioli's force, problems

Reference books

1. Introduction to Classical Mechanics, R. G. Takawale, P. S. Puranik, Tata McGraw Hill publishing Company Ltd.
2. Classical Mechanics, N. C. Rana, P. S. Joag, Tata McGraw Hill Publishing company Ltd.
3. Principles of mechanics, J. L. Synge, B. A. Griffith, TataMcGraw Hill Publishing company Ltd.
4. Classical Mechanics, Herbert Goldstein, Narosa Publishing House
5. Classical Mechanics by J.C. Upadhyaya, Himalaya publishing Houses.
6. Problem solution of classical mechanics by P.V.Panat

P-56: PRACTICAL COURSE – V

Total Credits: 02

Course Learning Outcomes:

By the end of this course student will be able to have following learning outcomes,

1. Measurement of surface tension by Quink's and Fergusson method
2. Study of phenomenon of Hall effect and its demonstration
3. Measurement of different physical quantities such as Young's Modulus, viscosity of liquid, moment of inertia, thermal conductivity etc.
4. Ability to understand the characteristics of Thermostat

A   GENERAL PHYSICS:

1.   Surface tension by Quink's method
2.   Surface tension by Fergusson method
3.   Y by Newton's rings
4.   Determination of coefficient of viscosity of a liquid by rotating cylinder method.
5.   To study coupled oscillations and hence to determine the coefficient of coupling
6.   Moment of Inertia by Bifilar suspension
7.   Young's modulus by Newton's rings Young's modulus by Koenig method
8.   Hall Effect
9.   Kater's pendulum
10. Joyll's steam calorimeter.
11. Verification of Stefan's law of radiation.
12. Thermal conductivity of a metal by Forbe's method
13. Thermal continuity of rubber by rubber tubing method.
14. Thermal conductivity of glass.
15. Determination of pressure coefficient of air by constant volume thermometer
16. To study the characteristics of thermostat.
17. Platinum resistance thermometer

Note: At least 8 experiments should be performed from the course

SEM.-V (CBCS-2018)

P-57: PRACTICAL COURSE –VI

Total Credits: 02

Course Learning Outcomes:

1. Understanding of self and mutual inductance
2. Study of Inverse square law
3. Understanding of measuring techniques of quantities such as band gap energy (Eg), Zeeman shift (d), inductance etc.
4. Ability to understand the working of Transformer
5. Understanding of characteristics of FET, SCR, operational amplifier, electromagnetic pendulum etc.
6. Understanding of basics in C-programming.

Course Content:

1. To find unknown inductance by Maxwell's Induction Bridge or Anderson bridge
2. To determine the core losses in transformer by C.R.O.
3. Hysteresis by ballistic galvanometer (Determination of B and H).
4. To study self and mutual inductance.
5. Electromagnetic pendulum.
6. Core losses in transformers
7. To determine energy gap (Eg) of a semiconductor.
8. Building of E. R. P. S. by using transistor
9. Designing, Building and testing of E. R. P. S. by using IC 723
10. Astablemultivibrator using IC 555
11. Characteristics of FET
12. Characteristics of SCR
13. Applications of Opamp as adder and differentiator
14. To determine a plateau voltage of G. M. tube
15. To determine e/m by Thomson's method.
16. To study the emission spectra of H_2 atom and determination of Rydberg's constant.
17. To determine Zeeman shift (d) by using constant deviation spectrometer.
18. Inverse square law (γ-rays)
19. Write a program to find Factorial of a given number
20. Write a program for conversion of Temperature from ^{O}C to ^{O}F
21. Write a program to find roots of differential equation.

Note: At least 8 experiments should be performed from the course

T.Y.B.Sc. (PHYSICS)
SEM.-V (CBCS-2018)
P-58: PRACTICAL COURSE – VII
(PROJECT WORK)

Total Credits: 02

T.Y.B.Sc. (PHYSICS)

SEM.-V (CBCS-2018)

Elective I (Student should select any one of the following subject)

P-59 A: Elective I (A) Elements of Materials Science

Total Credits: 04   **Total Lectures: 60**

Course Learning Outcomes:

- Students will review physics and chemistry in the context of materials science
- Ability to describe the different types of bonding in solids.
- Ability to describe and demonstrate diffraction, including interpretation of basic x-ray data.
- Student will understand metals, ceramics, polymers, and electronic materials in the context of molecular level.
- Student will also get familiar with the processing, structure, and physical properties of smart materials and their applications in the different fields.

Course Content:

1. Defects in Solids   **(12)**

Introduction of materials science, Material Properties – Mechanical, Electrical and thermal, Impurities in solids, Solid solutions in metals, Rules of solid solubility, Imperfection in crystals, Defects in solids point, line, surface and volume, Atomic diffusions definition, mechanism, Fick's laws.

2. Single Phase Metals   **(10)**

Single phase compound, Deformation, Elastic Deformation and Plastic Deformation, Mechanism of plastic Deformation by slip, Critical resolved shear stress (CRSS), Plastic deformation in poly crystalline materials

3. Molecular Phases   **(10)**

Introduction, Polymers, Polymerization, Molecular weight of polymers, linear polymers addition and condensation, Cross linked polymer vulcanization of rubber

4. Ceramic Materials   **(10)**

Ceramic Phases, Classification of ceramic materials, Ceramic crystals (AX), Mechanical behavior of ceramics, Electromagnetic behavior of ceramics – a) Electric propertiesdielectrics, semiconductors, piezoelectric b) Magnetic Properties MagneticCeramics, hard and soft ferrites

5. Phase Diagrams   **(10)**

Basic terms System, Surrounding, Component, Coordinates, Phase, Equilibrium, Phase Diagram definition, importance and objective, Lever rule, Gibb's phase rule, Phase diagram of a) Sugar water b) NaCl water, Types of phase diagrams with construction a) Type ILenstypeCuNiphase diagram, b) Type II Only introduction c) Type IIIEutectic typePbSnphase diagram, Isothermal cuts

6. Introduction to smart materials   **(08)**

Definition of smart materials, types and structure of smart materials, Properties of smart Materials, Applications of smart materials

Reference books

1. Elements of materials science and EngineeringI.H.Vanvlach (4ᵗʰ Edition)
2. Materials science and Engineering - V. Raghvan

List of experiments

1. To determine the dipole moment of a given liquid
2. To determine magnetic susceptibility of FeCl3
3. To determine the specific heat of graphite
4. Determination of the yield point and the breaking point of an elastic material

SEM.- V (CBCS-2018)
Elective I (Student should select any of the following subject)
P-59 B: Elective I (B): Medical Electronics

Total Credits: 04   **Total Lectures: 60**

Course Learning Outcomes:

By the end of this course student will be able to have following learning outcomes,

- Ability to explain different biosensors and their principal of working
- Understanding of how medical equipments works and their analysis
- Use of amplifiers in medical field
- Study of spectrometry, photometer required in medical diagnosis
- Understanding of pressure and volume measurement of body fluid

Course Content:

1. **Introduction:**   (14)
   Terminology of medical instrumentation, Physiological system of body, Sources of bioelectric signals, Origin of bioelectric signals, Analysis of ECG pattern, Nernst equation, Various types of bioelectric signals, Basic medical instrumentation system, Introduction to man instrument system, Problems Reference: 1

2. **Bio potential Electrodes and sensors:**   (14)
   Electrode-electrolyte interfacePolarizable and non-polarizable electrodes, Electrodes for ECG,EEG, EMG, Resistive sensor, Capacitive sensor , Inductive sensor , Piezoelectric sensor , Radiation sensor, Temperature sensor Problems Reference: 2

3. **Amplifiers and Signal Processing:**   (12)
   Introduction, Basic amplifier requirements, The Differential amplifier, Common mode rejection, Instrumentation amplifier, Isolation amplified, Patient safety, Cardiac monitor Problems Reference:- 2

4. **Clinical Laboratory Instrumentation:**   (10)
   Spectrophotometry, Spectrophotometer type instruments, Calorimetry and calorimeter, Clinical flame photometer Problems Reference: 1

5. **Measurements of Pressure and Volume Flow of Blood:**   (10)
   Direct measurements of blood pressure, Indirect measurements of BP., Heart sounds, Phonocardiography, Ultrasonic blood flow meter, Laser Doppler blood flow meter Problems Reference1

Reference Books:

1. Handbook of Biomedical Instrumentation, R.S. Khandpur
2. Medical Instrumentation application design, John G Webster, Houghon Mifflin Co.
3. Introduction to Biomedical Electronics, Joseph DfuBovy, McGraw Hill.
4. Clinical Biophysics, P. Narayanan
5. Introduction to Biomedical equipment technology, 4th edition, by Joseph J. Carr and John M. Brown

Practicals:

1. Measurement of BP using Mercury sphygmomanometer and digital BP meter
2. Recording of ECG and its analysis
3. Absorbance using calorimeter/ Absorption spectra using Spectrophotometer
4. Pulse oxymetry
5. Use of biosensor.

T.Y.B.Sc. (PHYSICS)

SEM.- V (CBCS-2018)

P-59 C: Elective I (C): Digital Electronics I

Total Credits: 04   Total Lectures: 60

Course Learning Outcomes:

By the end of this course student will be able to have following learning outcomes,

- Ability to analyze different types of digital electronic circuits using various mapping and logic tools
- Design different types with and without memory element digital electronic circuits for particular operation, performance, user friendly devices etc.
- Apply the fundamental knowledge of analog and digital electronics to get different types of analog to digitized signals.
- Access and understanding of nomenclature of different memory devices and circuits

Course Content:

1. Karnaugh maps **(10)**

Significance of Karnaughs map, Concept of fundamental product, SOP and POS method, Simplification of 2, 3 & 4 variables.

2. Application of gates **(10)**

Half and full adders, Four bit adder, four bit adder Subtractors, Parity checkers, Inter conversions of logic gates

3. Flip-flops **(12)**

Revision of flip-flops, JK flip-flop, Race around condition D and T flip-flop., Edge   triggering and level triggering in flip-flops., Examples of commonly used flip-flops and their applications.

4. Logic families **(08)**

Classification, DTL families, MOS Families, Comparison of logic families

5. Counters: **(10)**

Synchronous counters, Asynchronous counters, Modular counters,)Study of IC 7490 and IC 74192 / 193.

6. Clock Generating circuits **(10)**

Study of IC 555, Working of IC 555 as a clock generator, Working of IC 741 as a clock generator (no derivations expected for the above, only formula and problems)

Reference Books
1) Digital Electronics by R.P.Jain
2) Basic Electronics by B.L.Theraja
3) Electronic Principles by Malvino

   List of Experiments:
i) Study of Half and Full adder

ii) Study of R-S flip- flop

ii) Study of J-K flip- & lop.

iv) Study of IC 7490 as MOD2, MOD5 & MODIO.

v) Implementation of Boolean equations.

T.Y.B.Sc. (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - V
C - 51   :   PHYSICAL CHEMISTRY-I

Credits: 04   **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Understand the fundamentals of quantum chemistry.

2. Know the use of surface chemistry in chemical reactions.

3. Solve the numerical based on Nernst equations .

4. Develop new concepts of absorption spectroscopy.

Course content

1. **Surface Chemistry**   **(14 Lectures)**
   Adsorption isotherm.
   (i)   Langmuir adsorption isotherm with derivation and its limitations.
         Types of physical adsorption isotherms.
         BET equation (derivation not expected).
         Determination of surface area of adsorbent using.
   (i)   B.E.T. equation.
   (ii) Harkin and Jura method.
         [Ref, 2: Pages 928-938, Ref 3: Pages 171-180]

2. **Electromotive force.**   **(18 lectures)**

   Introduction, (Convention: Reduction potentials to be used)Thermodynamics of electrode potentials, Nernst equation for electrode andcell potentials in terms of activities, Types of electrodes: Description in terms of construction, representation, half cell reaction and emf equation for i) Metal – metal ion electrode, ii) Amalgam electrode, iii) Metal – insoluble salt electrode, iv) Gas – electrode, Oxidation –Reduction electrode, Reversible and Irreversible cells, i) Chemical cells without transference, ii) Concentration cells with and without transference, iii) Liquid – Liquid junction potential : Origin, elimination and determination, Equilibrium constant from cell emf, Determination of the thermodynamic parameters such as ΔG, ΔH and ΔS, Applications of emf measurements: i) Determination of pH of solution using Hydrogen electrode. ii) Solubility and solubility product of sparingly soluble salts (based on concentration cell).
   Numerical problems.
   [Ref, 1: Pages 471-486, 492-519]

3. **Introduction to Absorption Spectrophotometry**   **(14 Lectures)**
   Principles of colorimetry, nature of radiation, interaction of radiation and matter, Laws of absorptivity, factors governing absorptivity, deviatiations and limitations of absorption laws. Additivity of absorbances, simultaneous determinations, photometric titrations.
   [Ref, 4: Pages 2.107-2.147]

4. Elementary Quantum Mechanics. **(14 lectures)**

Introduction, Black body radiation, Planck's radiation law, Photoelectric effect, Compton effect, De Broglie hypothesis, The Heisenberg's uncertainty principle, Schrodinger wave equation and its importance (no derivation), Physical interpretation of the wave function.

[Ref. 11. Quantum Chemistry second edition by Manas Chandra-Relevant Pages
Ref. 12.Physical Chemistry a molecular approach by Donald A.McQuarrie, John D. Simon-Relevant pages]

Reference Books:
1. Principles of Physical Chemistry by S.H.Marron and C.FPrutton. 4thedition.Oxford and IBH Publishing Co. Pvt Ltd.
2. Essentials of Physical Chemistry by B. S. Bahl, G. D. Tuli and ArunBhal Edition 2000 S Chand and Company Ltd.
3. Physical Chemistry by R.L. Madan and G. D. Tuli, 5th edition 2009, S. Chand & Co Ltd.
4. Instrumental methods of Chemical Analysis by Chatwal and Anand, Enlarge edition 2011, Himalaya Publications.
5. Elements of Physical Chemistry by S.Glasstone and D.Lewis. 2nd edition.McMillan Education.
6. Physical Chemistry by N. Kundu and S.K. Jain, S. Chand and Co. Ltd. 1987.
7. University General Chemistry, C.N.R. Rao, MacMillan.
8. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
9. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
10. Physical Chemistry Through problems, S.KDogra and S. Dogra, Walley Eastern Ltd.
11. Quantum Chemistry Second Edition by Manas Chandra
12. Physical Chemistry a Molecular Approach by Donald A. Mcquarrie, John D. Simon

Credits: 04   **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Understand IUPAC nomenclature of coordination compounds .

2.Study Werner's coordination theory .

3.Distinguish between geometrical and optical isomerism.

 4.Know the concept of Sedgwick model.

5. Analyze critically Pauling's valence bond theory.

6. Explain prevention of corrosion and passivity.

Course Content:

1. **Coordination Chemistry**   **(10 Lectures)**
    a. Introduction to coordination chemistry
    b. Double salts and Coordination compounds
    c. Basic terms involved in coordination chemistry- Coordinate bond, central metal atom or ion, complex compound, complex ion etc , charge on complex ion, calculation of oxidation number of metal, coordination number, Ligands: Classification of ligands, definitions, Chelates and chelating agents.
    d. IUPAC nomenclature of coordination compounds
    e. Applications of metal complexes in different fields
  Ref. 2: pages 194-195, 230-232
  Ref.12: pages 620-685

2. **Werner's Theory of Co-ordinations compounds**   **(10 Lectures)**
    Postulates of Werner's coordination theory, Werner's formulation of Coordination compounds, Physical and chemical test to support his formulation of ionizable and non-ionizable complexes, Stereoisomerism in complexes with C.N.4 and C.N. 6 to identify the correct geometrical arrangement of the complexes.
    Ref.2: pages 234-238

3. **Isomerism in Coordination Complexes (Coordination No 8 and 6)**   **(08 Lectures)**
    a. Structural isomemerism (Ionisation, hydrate, linkage, Ligand, Co-ordination Position. Polymerisation isomers)
    b. Geometrical isomerism and optical isomerism.

    Ref-14: pages 205-230

4. Sidgwick model:

Introduction to Sidgwick's model, Scheme of arrow indication for M-L bond suggested by Sidgwick, Concept of Effective Atomic Number rule (EAN), Calculations of EAN value for complexes and stability of complexes, Advantages and Drawbacks of Sidgwick's theory.

Ref 9: pages 411-415, Ref.14: pages 229-2315.

5. Pauling's Valence Bond Theory: **(08 Lectures)**
 a. Introduction
 b. Assumptions
 c. Concept of hybridization
 d. Bonding in Terahedral, Square Planer and Octahedral complexes with examples.
 e. Inner and outer orbital complexes.
 f. Electro neutrality Principle.
 g. Multiple bonding
 h. Limitations

  Ref 3: pages 77-78, Ref.14.pages-231-241

6. Crystal Field Theory: (CFT):   **(12 Lectures)**
 a. Introduction
 b. Assumptions
 c. Degeneracy of 'd' orbitals
 d. Application of CFT to octahedral, tetrahedral & Square planer complexes
 e. CFSE, Calculation of CFSE in Weak field and Strong field complexes.
 f. Evidences of CFSE
 g. Factors Affecting 10 Dq
 h. CFT and magnetic properties
 i. Spectrochemical series
 j. Nephelauxetic effect
 k. Jahn Teller Distortion, Merits and Limitation of CFT.
 Ref 9: pages 421-434

7 (A) Corrosion: **(12 Lectures)**
 Definition, Electrochemical theory of corrosion, Factors affecting the corrosion, Position of elements in the electrochemical series, Purity of metal, Effect of moisture, Effect of oxygen,Physical state of metal, Methods for protection of the metals like, alloy formations, coating of the metals such as electroplating, hot dipping, metal spraying, cladding, Cathodic protection and use of inhibitors.
(B) Passivity :
Definitions, theories of passivity, electrochemical passivity and its applications.
Ref-13: pages 211-234.

Reference Books:

1. Introduction to Electrochemistry by Glasstone - 2ndedition.
2. Concise Inorganic Chemistry by J.D. Lee - 5thedition.
3. Inorganic Chemistry, - D.F. Shiver & P.W. Atkins- C.H.Longford ELBS - 2ndedition.
4. Basic Inorganic Chemistry, - F.A. Cotton and G. Wilkinson, Wiley Eastern Ltd 1992.
5. Concept and Model of Inorganic Chemistry by Douglas – Mc Daniels - 3rdedition.
6. Chemistry by Raymond Chang - 5thedition
7. New Guide to Modern Valence Theory by G.I. Brown - 3rdedition
8. Co-ordination Compounds by Baselo and Pearson.
9. Theoretical Inorganic Chemistry by Day and Selbin.
10. Inorganic Chemistry by A. G. Sharpe - 3rd Edition.
11. Coordination Chemistry by A. K. De.
12. General and Inorganic Chemistry, Part-II byR. Sarkar, New central book agency
13. Applied inorganic Chemistry, T.W. swaddle pp211-234 corrosion
14. Modern inorganic chemistry, P.R. Shukla, Ed 1st, 2002,Himalaya publishing House.

T.Y.B.Sc. (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - V
C - 53   :   ORGANIC CHEMISTRY-I

Credits: 04   **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Learn Kinetics, mechanism and stereo chemistry of SN^1 & SN^2 reactions.

2. Understand E_1 & E_2 elimination reaction.

3. Know mechanism of nitration, sulphonation, halogenation, Friedel Craft alkylation & Friedel Craft acylation

4. Write electrophilic addition reactions to Carbon – Carbon double bond. .

5. Explain stereochemistry of cyclic compounds.

Course Content:

1. **Nucleophilic substitution at Saturated carbon.**   **(12 Lectures)**

    (a) Nucleophilic aliphatic substitution.
    (b) Nucleophiles and leaving groups.
    (c) Rate of reactions.
    (d) Kinetics of first order and second order reactions.
    (e) Duality of mechanism.
    (f) SN^1 reaction : - Kinetics, mechanism and stereo chemistry.
    (g) SN^2 reaction: - Kinetics, mechanism and stereo chemistry.
    (h) Comparison between SN^1 & SN^2 *reactions*.
    Ref .1: Sections: - 5.7 to 5.21, 5.23
    Pages   -   172 to 203 and 208 to 210

2. **Elimination Reactions**   **(10 Lectures)**

    (a) 1, 2 elimination reactions.
    (b) Kinetics (duality of mechanism)
    (c) E_2 mechanism with evidence.
    (d) Orientation and Reactivity.
    (e) E_1 mechanism with evidence
    (f) Orientation in E_1 reaction.
    (g) Elimination Vs substitution.
        Ref.1 – Sections: - 8.13 to 8.25
        Pages   -   290 to 310

3. **Aromatic Electrophilic substitution.**   **(14 Lectures)**
    (a) Introduction.
    (b) Effect of substituent group (orientation)
    (c) Determination of orientation and relative reactivity.
    (d) Classification of substituent groups.
    (e) Orientation in disubstituted benzene.
    (f) Mechanism of nitration, sulphonation, halogenation, Friedel Craft alkylation, Friedel Craft acylation.
    Ref. 1- Sections: 15.1 to 15.19, 16.8, 16.9 & 18.5 Pages: -517 to 544, 666 to 667
    Ref.4 Sections: - 6.10.2 : Pages: - 169 to 173

4. **Electrophilic addition to Carbon – Carbon double bond.**   **(12 Lectures)**

    a) Introduction.
    b) Reactions at Carbon – Carbon double bonds: -
       (i)   Addition of halogens.
       (ii)   Addition of halogen acids.
       (iii)   Addition of water.
       (iv)   Addition of KM_nO_4.
       (v)   Addition of O_sO_4.
       (vi)   Addition of H_2SO_4.
       (vii)   Addition of per acid.
       (viii) Ozonolysis.
       Ref. 1   Section: - 9.1 – 9.2, 9.5 to 9.14, 9.17to 9.21, 9.25, 9.26
       Pages: - 317 to 323, 327 to 343, 346 to 355, 357 to 360.

5. **Stereochemistry of cyclic Compounds.**   **(12 Lectures)**
    Introduction, Disubstituted cyclohexane – 1,1 disubstituted cyclohexane, 1,2 disubstituted cyclohexane, 1,3 disubstituted cyclohexane and 1,4 disubstituted cyclohexane. Geometrical and optical isomers & their relative stabilities.

Reference books:
1) Organic Chemistry by Morrison and Boyd - 6th Ed. 1996.
2) Organic Chemistry by John McMurry – 5th Ed. Assian books 1999.
3) Organic Chemistry by Graham Solomans and Craig Fryhle - 7th Ed. 2002.
4) A guide book to reaction mechanism by peter sykes - 6th Ed.
5) Organic chemistry by I.L.Finar vol.II – 6th Ed. 1975.
6) Absorption spectroscopy of organic molecules by V.M.Parikh (1974).
7) Designing organic synthesis by stuart warron (1983).
8) Organic Chemistry by pine 5th ed. 1987.

T.Y.B.Sc (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - V
C - 54   :   ANALYTICAL CHEMISTRY-I

Credits: 04   **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Analyse the ppt. of SO_4^{2-} and CT gravimetrically.

2. Understand the principles of TGA and DTA.

3. Know theory of Nephelometry and Turbidimetry.

4. Know the qualitative and quantitative estimation of elements by AAS.

Course Content:

1. Gravimetric Analysis: **(14 Lectures)**
Introduction, Common ion effect and solubility product principles, solubility of precipitates, effect of acids, temperature and solvents upon solubility of precipitates. Super saturation and precipitate formation. co-precipitation and post-precipitation, precipitation from homogeneous solution, optimum conditions for precipitation, filtration of precipitates, washing of precipitates, Drying and Ignition of precipitates, Numerical problems.
Ref. 1.Pg. 22-28, 30-33, 95, 107-114, 169-171, 403-404, 407-415
Ref. 3.Pg. 527-532

2. Thermal methods of analysis: **(12 Lectures)**
Principle of thermal analysis, classification of thermal techniques, Principle, instrumentation and applications of TGA and DTA, factors affecting the thermal analysis, numerical problem.
Ref. 1.Pg. 515-527,531-537
Ref. 6 Pg. 732-737

3. Nephelometry and Turbidimetry: **(12 Lectures)**
Introduction, Principles and instrumentation of Nephelometric and Turbidimetric analysis,
Difference between Nephelometric and Turbidimetricmeasurements,   Choice between Nephelometry and Turbidimetry, Factors affecting Nephelometric and Turbidimetric measurements, Quantitative Applications, Numerical Problems
Ref.1. Pg.781-785
Ref.3. Pg.380-390

4. Polarimetry: **(12 Lectures)**
Introduction, polarization of radiation, essential terms, Nicol prism, Optical activity, Types of optically active substances, Instrumentation-Polarimeter-construction, working of polarimeter and applications of Polarimetry. numerical problems.
Ref.6. 691-734

5. Atomic Absorption Spectroscopy: (10 Lectures)

Introduction and theory of atomic absorption spectroscopy, Instrumentation of single beam atomic absorption Spectrophotometer, Measurement of absorbance of atomic species by AAS, Spectral and Chemical Interferences, Qualitative and Quantitative Applications of AAS.
Ref. 3.Pg. 321-342

Reference Books:

Ref. 1   Textbook of Quantitative Chemical Analysis- 3rd Edition, A. I. Vogel

Ref. 2   Principles of Physical Chemistry 4th edition – Prutton and Marron

Ref. 3   Instrumental Methods of Chemical Analysis- Chatwal and Anand

Ref. 4   Basic Concept of Analytical Chemistry-2ndedition S.M. Khopkar

Ref. 5   Vogel's textbook of Quantitative Inorganic Analysis-4th edition Besset Denney, Jaffrey, Mendham

Ref. 6   Instrumental Methods of Chemical Analysis- 6thedition Willard, Merritt, Dean and Settle

Ref. 7   Analytical Chemistry by Skoog

Ref. 8   Introduction to Instrumental Analysis- R.D. Braun

C - 55   :   INDUSTRIAL CHEMISTRY-I

Credits: 04   **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Learn modern approach to chemical industry.

2. Know manufacture of basic chemicals.

3 . Understand various processes involved in manufacture of sugar from sugar cane.

4. Write aspects in food and starch industry.

5. Study manufacturing of cement & glass industry.

6. Explain manufacturing of some small-scale industry products.

Course Content:

1. **Modern Approach to Chemical Industry**   **(12 Lectures)**
   Introduction, basic requirements of chemical industries, chemical production, raw
   materials, unit process and unit operations, Quality control, quality assurance, process
   control, research and development, pollution control, human resource, safety measures,
   classification of chemical reactions, batch and continuous process, Conversion, selectivity
   and yield, copy right act, patent act, trademarks.
   Ref. No. 1

2. **Manufacture of Basic Chemicals**   **(10Lectures)**
   a) Ammonia: Physicochemical principles involved, Manufacture of ammonia by modified
   Haber- Bosch process, its uses.
   b) Sulphuric acid: Physicochemical principles involved, Manufacture of sulphuric acid
   by contact process, its uses.
   c) Nitric acid: Physicochemical principles involved, Manufacture of nitric acid by
   Ostwald's process, its uses.
   Ref.No.1: P.No. 571 to 588, 618 to 664

3. **Sugar Industry.**   **(12 Lectures)**
   Introduction, manufacture of cane sugar, Details of various steps, Extraction of juice,
   purification of juice, Defecation, Sulphitation & Carbonation, concentration,
   Crystallization, separation of crystals, Dying, Refining, Recovery of sugar from molasses,
   Bagasse, Manufacture of sucrose from Beet root, Testing of sugar, sugar Industry in India.
   Ref. 1 – page 664, 674

4. **Food and Starch Industry**   **(12Lectures)**

Food Industry:

(a) Definition and scope, nutritive aspects of food constituents, , food deterioration factors and their control; (b) Preservation and processing: Heat and cold preservation and processing, cold storage, food dehydration and concentration, various foods, their processing and preservation methods, fruits, beverages, cereals, grains, legumes and oil seeds; (c) Food additives: Enhancers, sugar substitutes, sweeteners, food colors,
Ref.6

Starch industries:

Chemistry of starch, manufacturing of industrial starch and its applications, characteristics of some food starches, non-starch polysaccharides-cellulose-occurrence.
Ref. 5

5. **Cement and Glass industry**   **(08Lecture)**

Cement industry:

Introduction, Importance, composition of portland cement, raw materials, proportioning of raw materials, setting and Hardening of cement, reinforced concrete.
Ref.1: P.No. 313-333 Ref. 2: P.No173-176, Ref. 4: P.No.188-192

Glass industry

Introduction, importance, physical and chemical properties of glass, chemical reaction, annealing of glass Special glasses: colored, safety, hard, borosilicate, optical, photosensitive, conducting, glass laminates.
Ref.1: *P. No.*160-171;Ref. 2: *P. No.* 247-265; Ref.3: *P. No.* 197-212

6. **Some small scale Industries**   **(06 Lectures)**

7. Safety matches, Agarbattis, Naphthalene balls, wax candles, shoe polish, Gum paste, plaster of Paris, chalk crayons, fountain pen ink.
Ref. 1 - page. sect. IV 1 – 8

Reference Book:

1) Industrial Chemistry – B.K.Sharma.
2) Shreeve's chemical process industries 5th Edition, G.T. Oustin, McGraw Hill
3) Riegel`s hand book of Industrial chemistry, 9th Edition, Jems A. Kent
4) Industrial chemistry –R.K. Das, 2nd Edition, 1976.
5) Chemistry and industry of starch, New York, N.Y., Academic Press, incby Kerr, Ralph Waldo Emerson
6) The Complete Manual Of Small-Scale Food Processing, by Peter Fellows, Practical Action Pub
7) Industrial Chemistry. Arora & Singh

T.Y.B.Sc (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - V
C-59A ENVIRONMENTAL CHEMISTRY-I

Credits: 04   **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Explain composition, evolution , chemical and photochemical reactions in the atmosphere

 2. Study air pollutants & its effects on the atmosphere.

3 . Learn aspects involved in the Hydrosphere.

4. Know water pollutants, Sampling, Preservation, Monitoring techniques , methodology and total hardness .

5. Understand origin of life

Course Content:
1. Evolution and Structure of Atmosphere **(12 Lectures)**
Composition of the atmosphere; Atmospheric structure; Evolution of the atmosphere;
Earth's radiation balance; Particles, ions and radicals in the atmosphere; Chemical
and photochemical reactions in the atmosphere; Green house effect; Ozone hole; The
earth's mechanism and global climate; El Nino Phenomenon
Reference 1 : Pages 13-51.

2. Air Pollution and Air Pollution disasters **(12 Lectures)**
Air pollutants (carbon monoxide, Nitrogen oxides, Hydrocarbons and Photochemical
smog, sulphur dioxide, Acid rain, Particulates, Radioactivity), Effects of atmospheric
pollution, TCDD accident, Bhopal disaster, Chernobyl disaster); Air quality
standards; Sampling; Monitoring (CO, SOx, NOx, H2S, SPM, HC).
Reference 1: Pages 107-167.

3. Hydrosphere **(12 Lectures)**
Water resources; The hydrologic cycle; Physical chemistry of sea water; composition;
Sea water equilibrium, pH, pE, Complexation in natural water and waste water;
Nitrogen transformation by bacteria.
Reference 1: Pages 52-65.
4. Water Pollution and monitoring **(12 Lectures)**
Aquatic environment; water pollutants (Organic pollutants- pesticides, detergents,
marine pollution); Inorganic pollutants; Acid mine drainage; Sediments; Thermal
pollution; Eutrophication; Trace elements in water; Chemical speciation and
environmental chemistry of Cu, Pb, Hg and As; water quality parameters and
standards; Sampling; Preservation; Monitoring techniques and methodology of D.O.,
NH3, NO3, and NO2, F, CN, PO4, Cl, Total hardness, As, Cd, Cu, Pb, Hg, COD,
BOD, TOC, E.Coli (Principle and necessary equations and procedures are expected).
Reference 1: Pages 172-279

5. Origin of Life   (12 Lectures)

The atmosphere and hydrosphere of primitive earth; synthesis of building block molecules; formation of biopolymers; the second stage of atmospheric evolution; The third stage of atmospheric evolution.

Reference 2: Pages 40-61.

Reference Books:

1. Environmental Chemistry, A. K. De, Fourth Edition, New age International (P) Ltd., Publishers, New Delhi, 2000.
2. Environmental Chemistry, John W. Moore and Elizabeth A. Moore, Academic Press, New York, 1976.
3. Environmental Chemistry, S. E. Manahan, Willard Grant Press, Boston, Third Edition, 1983.
4. Chemistry and Man's Environmental, E. D. Fuller, Houghton Mifin Co., Boston, Third edition, 1974.
5. Environmental Pollution, A. M. Dix, John Wiley, New York, 1980

T.Y.B.Sc. (CHEMISTRY) (CBCS- 2018)

SEMESTER - V

C – 59B   :   NUCLEAR CHEMISTRY-I

Credits: 04   **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Study Difference between simple compounds and polymers.

2. Understand Terms-Monomer, Polymer, Polymerisation.

 3. Explain Mechanisms of polymerization &Polymerisation techniques.

4. Learn Physical parameters of polymers & Ingredients added to polymers.

Course Content:

1. The atomic nucleus, properties of nucleons and nuclei   (10 Lectures)

The atom, elementary particles, subnucleons, quarks, classification of nuclides, nuclear stability-even odd nature , N/Z ratio, binding energy.

Nucleus, its size and shape, mechanical effects due to orbiting and spinng of nucleons, Magnetic quantum numbers, principal and radial quantum number.

Ref.1: pages 1 to 4,7 to 15 , 22 to30.

2. Nuclear Models   (16 Lectures)

The Shell model, the periodicity in nuclear properties, salient features of Shell Model, merits of shell model, the liquid drop model, semiempirical binding energy equation, limitations of liquid drop model.
Ref.1 pages 76 to 107

Ref.2 pages 464 to 469

3. Radioactivity   (17 Lectures)

Types of radioactive decay, general characteristics of decays, decay kinetics, Alpha decay: Alpha active nuclides, the alpha energy spectrum,Geiger-Nuttals law The theory of alpha decay.

Beta decay: Types of beta decay, absorption and range through matter Fermi theory Of beta decay (mathematical details are not expected)

Gamma decay: Nuclear isomerism and isomeric transitions, internal conversion, Auger effect.

Ref.1 pages 117 to 124,140 to 144, 148 to 151, 174 to 179

4. Nuclear Reactions   (17 Lectures)

Bethes notation, types of nuclear reactions, conservation of nuclear reaction Reaction cross-section, the compound nucleus theory, photonuclear reactions, Thermonuclear reactions.

Ref.1 pages 185 to 206, 222 to 226

References:

1. Essentials of Nuclear Chemistry:Prof.H.J.Arnikar, 4TH Edition,Wiley Estern
2. Source book of Atomic energy :Samuel Glasstone ,3rd edition,East -West press

T.Y.B.Sc. (CHEMISTRY) (CBCS- 2018)
SEMESTER - V
C – 59C   :   POLYMER CHEMISTRY-I
Credits: 04   Lectures : 60

Course Learning Outcomes:
After completion of this course students should be able to:

1. Know The atom, elementary particles,subnucleons and the quarks, Classification of nuclides,

isotopes, isobars, isotones and isomers. Nuclear stability on the basis of even-odd nature of Z and

N, N/Z ratio.

 2.Understand The Shell model & the liquid drop model.

 3. Explain types of radioactive decay, decay kinetics and their general characteristics.

4. Learn Bethes notation & Different types of Nuclear reactions.

Course Content:
   1. **Introduction to Polymer Chemistry**   **(06 Lectures)**
      Brief   History, Polymer definition, Preparation, Classification, Chemical bonding &
      Molecular forces in Polymers.
                    Ref 1 : Pages 1-14, Ref 2 : Pages 1-16

                    Ref 3 : Pages 1-12, Ref 7 : Pages 1-6

   2. **Mechanism and Nomenclature of Polymers**   **(06 Lectures)**
      a) Polymerisation Mechanism
      b) Nomenclature of Polymers
          i) Based on sources
          ii) Based on structure (Non IUPAC)
          iii) IUPAC structure-based nomenclature system
          iv) Trade names
             Ref 7 : Pages 6-17
   3. **Chemistry of Polymerisation**   **(12 Lectures)**
      i) Introduction
      ii)Chain Polymerisation : Free radical Polymerisation, Ionic
      polymerisation,Ionic polymerisation, Co-ordination polymerisation- Ziegler-
      Natta catalyst
      iii) Step Polymerisation : Polycondensation, Polyaddition- polymerisation,Ring
      opening polymerisation.
          Ref. 1 : Pages 15-64
          Ref. 2 : Pages 25-32, 49-56, 82-86, 88-89, 91-94
          Ref. 3 : Relevant Pages, Ref. 5 : Pages 14-17, 273-289, 342-349

4. Polymerisation Techniques   **(12 Lectures)**

Bulk polymerisation, Solution polymerisation, Suspension polymerisation, Emulsion polymerisation, Melt polymerisation, Solution polymerisation, Interfacial condensation, Electrochemical polymerisation, Salient features of different polymerisation techniques.

  Ref. 1 : Pages 71-79, 82-84,Ref. 2 : Pages 126-132

  Ref. 5 : Pages 196-198,Ref. 7 : Pages 335-341, 173-175

5. Polymer Additives   **(09 Lectures)**

Filters & Reinforcement, Plasticisers, Antioxidants & Thermal Stabilizers, Ultraviolet stabilizers, Fire retardants, Colourants & other additives.

  Ref. 3 : Pages 170-176

  Ref. 4 : Pages 250-282

6. Molecular Weights of Polymers   **(07 Lectures)**

  c) Average Molecular weight, Number Average & Weight Average Molecular weight, Molecular weight & degree of polymerisation, Practical significance of polymer molecular weights.
  d) Molecular weight determination – End Group Analysis, Viscocity
  e) Problems based on Number Average & Weight Average Molecular weight Ref. 1 : Pages 86-89, 92, 96-98, 402-409

7. Polymer Reactions   **(08 Lectures)**

Introduction, Hydrolysis, Hydrogenation, Addition and Substitution reactions, Cross -linking reactions, Cure reactions.
Ref. 1 : Pages 291-297, 306-308, 311-321
Ref. 3 : Relevant Pages

  REFRERENCE BOOKS
  1. Polymer Science by V.R.Gowarikar, N.V.Vishvanathan, Jaydev Shreedhar New Age International Ltd. Publisher 1996.
  2. Textbook of Polymer Science by Fred Billmeyer, 3rd Edn. A Wiely-Interscience Publication John Wiely & Sons New York 1984.
  3. Introductory Polymer Chemisrty by .S.Misra New Age International Ltd. Publisher 1996.
  4. Introduction to Polymer Chemistry by Raymond Saymour International Student Edn. 1971.
  5. Polymer Chemistry by Malcom P. Stevens Oxford University Press 1990.
  6. Inorganic Polymers by G.R.Chatwal Himalaya Publishing House 1st E dn.1996
  7. Principles of Polymerisation by George Odian 3rd Edn. John Wiely & Sons New York.

T.Y.B.Sc. (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - V
C-56: PRACTICAL COURSE - V
(PHYSICAL CHEMISTRY)

Credits: 02
Course Learning Outcomes:

After completion of this course students should be able to:

1. Determine the order of the reaction.

2. Study the CST of phenol-water system.

3. Find out the transport nos. of cations and anions.

4. Calculate the λmax and concentration of $KMnO_4$.

5. Measure the molar & specific refractivities of given liquids.

Course Content:

GROUP-I

NON - INSTRUMENTAL EXPERIMENTS
A   Chemical Kinetics
1.   To study the effect of concentration of the reactants on the rate of hydrolysis of an ester.
2.   To determine the first order velocity constant of decomposition of H_2O_2 by volume determination of oxygen.
3.   To determine the energy of activation for the reaction between $K_2S_2O_8$ and Kl for unequal initial concentration.
4.   To study the effect of addition of electrolyte (KCl) on the reaction between $K_2S_2O_3$ and KI.(Equal Concentration)
5.   Determine the order of reaction of a given reaction.
    (Any three experiments)
B   Phenol-Water
1.   To study the mutual solubility of phenol and water at various temperatures and hence determine the critical solution temperature.
C   Transport Number
1.   To determine the transport number of cation by moving boundary method.

GROUP-II

INSTRUMENTAL EXPERIMENTS
A   Potentiometry
1.   Titration of strong acid with strong alkali.
2.   Determine the formal redox potential of ferrous/ferric system by potentiometry.
    (Any one experiment)

B   Colorimetry.
1.   Determine the λ_{max} and concentration of the given solution of $KMnO_4$ in 2N H_2SO_4.

C Conductometry
1. To determine the dissociation constant of a weak acid conductometrically.
2. To determine the strength of the given acid conductometrically using standard alkali solution.
3. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conductometrically.
4. Titration of a mixture of weak and strong acid with strong alkali.
(Any two experiments)

D P^{H}Metry.
1. Determination of degree of hydrolysis of aniline hydrochloride.

E Refractometry.
1. Determination of molar refraction of the given liquids A,B,C and D.
2. To verify law of refraction of mixtures(e.g., glycerol and water) using Abbe's refractometer.
(Any one experiment)

G Polarimetry.
1. To determine the specific rotation of a given optically active compound.

Reference Books:
1. Experiments in Chemistry Dr.D.V.Jahagirdar, Himalaya Publishing House.
2. Systematic Experimental Physical Chemistry by S.W.Rajbhoj and Dr.T.K.Chondhekar, Anjali Publication Aurangabad.
3. Experimental Physical Chemistry, Daniel.Alberts.7th Edition.
4. Findlay's Practical Physical ChemistryB.P.Levitt.9th Edition.
5. Experiments in PhysicalChemistry, R.C.Dasand .Behra. Tata McGrawHill.
6. Advanced Practical Physical Chemistry, J.B.Yadav, Goel Publishing House.
7. Advanced Experimental Chemistry, Vol1-Physical,J.N.GurtuandR.Kapoor,S.Chand&Co.
8. Selected Experiments in Physical Chemistry N.G.Mukherjee. J.N.Ghose& Sons.
9. Experiments in Physical Chemistry, J.C.Ghosh, BhartiBahavan.

T.Y.B.Sc. (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - V

C-57: PRACTICAL COURSE - VI
(INORGANIC CHEMISTRY)

Credits: 02
Course Learning Outcomes:

After completion of this course students should be able to:

1.Perform binary mixture of inorganic compound.

2.Prepare various inorganic complexes .

3. Study binary mixtures with borates and phosphates.

Course Content:

A) Inorganic Qualitative Analysis(Six mixtures)
   a) Water soluble mixture – any one
   b) Water insoluble mixture-any one
   c) Mixtures containing Borate-any two
   d) Mixtures containing Phosphate-any two

B) Inorganic preparations (Any Three)
   1. Preparation of Potassium trioxalatoaluminate(III) trihydrate
   2. Preparation of Reinecke's salt.
   3. Preparation of Tris(Thiourea)Copper (I) Chloride [Cu (Thiourea)$_3$]Cl.
   4. Preparation of Manganese (III) acetylacetone [Mn(acac)$_3$].
   5. Preparation of Potassium Trioxalatoferrate (III), K$_3$[Fe(C$_2$O$_4$)$_3$].

Reference Books:
1.Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.
2. Quantitative Chemical Analysis S. Sahay (S. Chand & Co.).
3. Quantitative Analysis R.A. Day, Underwood (Prentice Hall).
4. General Chemistry Experiment – Anil J Elias (University press).
5. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
6. Vogel's Textbook of Quantitative Chemical Analysis.
7. "Experimental Methods in Inorganic Chemistry." Tanaka, J. and Suib, S.L., Prentice Hall

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C-58: PRACTICAL COURSE - VII
(ORGANIC CHEMISTRY)

Credits: 02
Course Learning Outcomes:

After completion of this course students should be able to:

1.Perform Organic Estimations.

 2.Prepare Organic derivatives.

3. Carry out single stage preparations.

Course Content:

1. **Organic Estimations** (Any three)
    (i)   Estimation of Iodine value.
    (ii) Estimation of Glucose.
    (iii) Estimation of Ethyl benzoate.
    (iv) Determination of Molecular weight of Mono and Dibasic acids by Volumetric Methods
    (v)   Determination of acid value of the given oil.

2. **Preparation of derivatives** (Any Two)
    (i)   2, 4 DNP derivatives of – CHO / C = O group.
    (ii) Semicarbazone derivatives of – CHO / C = O group.
    (iii) Oxime derivatives of – CHO / C = O group.

3. **Single stage preparations** (Any Three)
    (i)   Hydroquinone to Quinone.
    (ii) Acetanilide to p-Nitroacetanilide.
    (iii) p – Nitroaniline to p - Iodonitrobenzene.
    (iv) Sulphanilic acid to Methyl orange.
    (v)   m – Dinitrobenzene to m – Nitroaniline.

Note:
(i)   Starting Compound should not be given more than 1 gm.
(ii) The purity of preparation and derivative products should be checked by TLC.
(iii) The crystalline sample should be submitted and M.P.must be reported to the examiner

Reference Books:
1) Practical Qualitative Analysis by A.I. Vogel.
2) Advanced Practical Organic Chemistry by O.P.Agarwal.
3) Laboratory Manual in Organic Chemistry by R.K.Bansal, Wiley Eastern.
4) Experimental Organic Chemistry I & II by P.R.Singh, D.S.Gupta and K.S.Bajpal (Tata McGraw Hill)

(C.B.C.S. 2018 Course) SEMESTER-V
B – 51: BIOLOGY OF CRYPTOGAMES (ALGAE & FUNGI)

Core Course – Theory; Credits- 04   **Total lectures- 60 L**

Course Learning Outcomes :

On completion of this course, students are able to:

- Know the salient features of Cryptogams plants.
- Become aware of the status of cryptogams as a group in plant kingdom.
- Understand the life cycles of selected genera.
- Learn about the economic and ecological importance of Cryptogams plants.

Course Content:

A) ALGAE

1) Occurrence and distribution.   **03 L**
2) Criteria for classification of Algae   **07 L**
    (i) Cell organization, flagellation, pigmentation, reserve food
    (ii) Smith's system of classification

3) Thallus organization and evolutionary tendencies and life histories of selected forms.
(markedby bold type)   0**6 L**
    (i) Chlorophyta…............. e.g. *Chlamydomonas, Volvox, Chlorella,*
Hydrodictyon, Ulothrix, Stigeoclonium, Coleochaete, Ulva ,Acetabularia, Spirogyra,
Oedogonium.
    (ii) Charophyta…………….. e.q. ***Chara.***   **02 L**
    (iii) Phaeophyta……………. e.q. *Sargassum*.   0**2 L**
    (iv) Rhodophyta…………….e.q. ***Batrachospermum.***   **02 L**
    (v) Cyanophyta……………….e.q. *Oscillatoria, Nostoc*.   0**2 L**

4) Ultrastructure of algal cells Prokaryotic
    (Cyanophyceae) & Eukaryotic (*Chlamydomonas*)   **02 L**
5) Role of algae in human welfare   **06 L**
    (i)Biofertilizers, single cell proteins (s c p).

(ii)Phycocolides – agar-agar, carragenin, alginic acid.

(iii)Medicine and food.

(iv)Algal blooms.

(v)Aquaculture.

B) FUNGI

6) Occurrence and distribution.   **3 L**

7) Ultrastructure of fungal cell – cell wall composition, seputum,flagella, cytoplasm, other cell organelles

and spores.   **3 L**

8) Nutrition and reproduction.   **2 L**

9) Modern concept and classification of fungi.   **2 L**

10) Characters of main groups of fungi & life histories of some forms.(marked by bold type)
8 L

(i) Chrytidiomycotina – ***Synchitrium***, *Allocymes*.

(ii) Zygomycota – ***Rhizopus***, *Entemopthora*.

(iii) Ascomycotina – *Saccharomyces, Aspergillus**, Clavicep**, Zylaria,Erysiphae*.

(iv) Basidiomycota – *Agaricus, Puccinia, **Ustilago**.*

(v) Oomycota – ***Saprolegnia***, *Albugo, Plasmophora*.

(vi) Plasmodiophoromycota – ***Plasmodiophora**.*

(vii) Deteromycetes – general consideration.

11) Types of fungal spore & mode of liberation.   **3 L**

12) Role of fungi in human welfare -fungal metabolites, fermentation, pharmaceutical products, VAM fungi, biofertilizers, biodegradation, mushrooms & antibiotics.   **7 L**

Reference Books:

1. Bold & Wynne - Introduction to algae 4th Edition 1996.
2. B.R.Vashishta – Botany for degree students – algae.
3. C.I. Alexopoulus, C.W. Mims, M.Blackwell– An introduction to mycology. 4th Edition1996
4. J.G.Vaidya – Biology of fungi.
5. Dube, H.C. 1990. An Introduction to Fungi.Vikas Publishing House Pvt. Ltd. Delhi.
6. Gilbert, M.S. 1985. Cryptogamic Botany, Vol. I & II (2nd Edition). Tata McGraw HillPublishing Co. Ltd., New Delhi.
7. Kumar, H.D. 1988. Introductory Phycology.Affiliated East-West Press Ltd., York.

T.Y.B.SC. (BOTANY)
(C.B.C.S. 2018 Course) SEMESTER-V
B – 52: BIOLOGY OF SEED PLANTS (ANGIOSPERMS)

Core Course – Theory;   **Credits- 04**   **Total lectures- 60 L**

Course Learning Outcomes :

On completion of this course, students are able to:

- Understand the status of angiosperms in plant kingdom.
- Realize the origin of Angiosperms with respect to time, place, origin and probable ancestors.
- Know the Pre-Darwinian and Post- Darwinian systems of Classification.
- Understand various angiosperm families emphasizing their morphology, distinctive features and biology.
- Know the role of cytology and Phytochemistry in Taxonomy.

1) Introduction   **05 L**

Salient features of angiosperms and probable causes of their evolutionary success. Differences between angiosperms and gymnosperms.

2) Anatomy   **10 L**

(a) Organography and anatomy of root, stem and leaf

(b) Leaf – venation; - distribution and functions of veins, concept of vein islet, vein termination number, stomatal number, stomatal index and types of stomata. Nodal anatomy and wood anatomy, General Concept of floral anatomy.

3) Flower structure   **08L**

(a) Concept of flower as a modified shoot – evidences.

(b) Genetic control of floral organs and functions of flower.

(c) Evolution of flower.

4) Structure of anther   **09 L**

(a) Ovule – structure and types.

(b) Megasporogenesis.

(c) Development and structure of female gametophyte (embryo Sac) in *Polygonum and Allium.*

6) Classification   **03 L**

        Details account of Hutchinsion's and Taktajan's system of of classification with merits&demerits.

7) Bentham & Hooker's system of classification   **14 L**

        Study of following plants according to Bentham & Hooker's system of classificationwith reference to systematic position, morphological characters, distinguishing features, floralformulae,floral diagram, pollination & economic importance of (any ten families).

    (i) Magnoliaceae
    (ii) Papaveraceae
    (iii) Myrtaceae
    (iv) Combretaceae
    (v) Cucurbitaceae
    (vi) Sapotaceae
    (vii) Apocynaceae
    (viii) Asclepidaceae
    (ix) Verbenaceae
    (x) Bignoniaceae
    (xi) Labiatae
    (xii) Convolvulaceae
    (xiii) Euphorbiaceae
    (xiv) Cannaceae

Reference Books:
1) Cronquist, A. 1968. The evolution and classification of flowering plants. Thomas Nelson(Printers) Ltd., London & Edinburgh.
2) Delevoryas Th. 1965. Plant Diversification.modern biology series, Halt, Rinehart &Winston, New York.
3) Foster, A.S. and Gifford, A.E.M., Jr. 1967. Comparative Morphology of Vascular Plants.Vakils.Peffer& Simons Pvt. Ltd.
4) Spome, K.R. 1977. The Morphology of Angiosperms. B.I. Publication, Bombay.
5) Bhowani. S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, 4th revised and enlarged edition. Vikas publishing house, Deihi.
6) Johri B.M.1984, Embryology of Angiosperms. Springer-Verlag, Berlin.
7) V.N.Naik, 1985. Taxonomy of Angiosperms.
8) P.Shukla and S.Mishra, 1979. An Introduction to taxonomy of Angiosperms.

T.Y.B.Sc. (BOTANY) (C.B.C.S. 2018 Course) SEMESTER-V
B – 53: PLANT PATHOLOGY AND PLANT PROTECTION
Core Course – Theory; Credits- 04   Total lectures- 60 L

Course Learning Outcomes :

On completion of this course, students are able to:

- Understand and study concepts of plant protection, host, pathogen, disease and classification of plant diseases based on symptoms and causal agents like fungi, bacteria, mycoplasma and viruses.
- Study various methods of studying plant diseases.
- Impart knowledge about role of environmental factors in determining the extent of inoculums, penetration, infection, development.
- Understand pathogen attack, defense mechanisms and plant disease epidemiology.
- Gain knowledge about principles of plant protection, management of plant diseases and general account of application of information technology in plant pathology**.**

1) Introduction   10 L

i) Concepts of plant protection, host, pathogen and disease.

ii) Importance of plant diseases and their control.

iii) Few important mile stones in the development & plant pathology.

iv) Classification of plant diseases based on symptoms and causal agents like fungi,bacteria, mycoplasma and viruses.

v) Symptoms and types of fungal bacterial, mycoplasma diseases.

vi) Symptoms transmission & control of plant – virus diseases.

2) Methods of studying plant diseases   07 L

   i.   Field diagnosis of plant diseases. Laboratory diagnosis of plant diseases. Cock's postulates.

   ii. Principles of infection, development and spread of plant diseases. Concept of plant disease clinic..

3) Role of environmental factors in determining the extent of inoculums, penetration, infection, development

And epiphytotics – like temperature, relative humidity, rainfalland wind.   **05 L**

4) Pathogen attack and defense mechanisms   05 L

I) Morphological structural / physical.

ii) Physiological.

iii) Biochemical and molecular

5) Plant disease epidemiology   13 L

i) Definition, disease triangle and general account of sporadic, endemic, severe andepiphytotics.

ii)Pathogenesis, disease cycle and control measures of the following diseases --

a. Downy mildew of grapes.

    b. Black stem rust of wheat.

    c. Tikka disease of groundnut. (leaf spot)

    d. Black arm of cotton.

    e. Little leaf of Brinjal.

    f. Yellow mosaic of papaya.

6) Principles of plant protection and management of plant Diseases   10 L

i) Exclusion:

    a) Tuber indexing.

    b) Seed certification

    c) Quarantine laws.

ii) Eradication:

    a) Roguing and cutting

    b) Crop - rotation

    c) Modern cultural practices

    d) Sanitary measures

iii) Protection:

    a) Chemical

    b) Biological and biopesticids

    c) Antibiotics

    d) IMP systems

    e) Development of transgenics

7) Molecular plant pathology   05 L

    i) Molecular diagnosis – concept.

    ii) Identification of genes and specific molecules in disease development.

    iii) Molecular manipulation of disease resistance.

8) General account of application of information technology in Plant Pathology   05 L

    i) Simulation of epidemics.

    ii) Remote sensing and image analysis for ecosystem level effects.

    iii) Prediction of disease control decisions.

Reference Books :
1. R.S.Singh - Introduction to principles of Plant Pathology.
2. M.N.Kamat - Introductory Plant Pathology
3. M.K.Rangaswami - Diseases of crop plants in India.
4. Meherhotra – Plant diseases
5. D.A.Robert and C.W.Bootheroyd – Fundamentals of Plant Pathology.
6. R.S.Mathur – Plant diseases.
7. M.K.Dasgupta – Principles of Plant Pathology.
8. Dr.Wani&Dr.Pingle – A text book of plant protection and plant pathology.
 9. M.K.Mundkur : Plant diseases

B – 54: GENETICS AND BIOSTATISTICS

Core Course – Theory; Credits- 04   **Total lectures- 60 L**

Course Learning outcomes :

      On completion of this course, students are able to:

- know the basic principles of biostatistics and computer applications in biology.
- understand the fundamental concepts of biostatistics.
- learn about the computer and imbibe computer skills for biological data management and graphical presentation.
- enlightened about the need for computer applications, programs and techniques for biology.
- gain knowledge about "Cell Science
- understand Cell wall Plasma membrane, Cell organelles and cell division
- learn the scope and importance of genitics & biostatistics
- understand the biochemical nature of nucleic acids, their role in living systems, experimental evidences to prove DNA as a genetic material.

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1. Mendel's experiments and principles of inheritance   **09 L**

      (a) Mendel's Laws of heredity.

      (b) Monohybrid ratio and dihybrid ratio.

      (c) Back cross and test cross.

      (d) Gene interactions and modified dihybrid ratios – Complementary,supplementary, duplicate and epistatic factors.

2. Multiple allelism   **08 L**

      a) Concept and characters of multiple alleles.

      b) Multiple alleles in *Drosophila* (eye colour).

      c) Multiple alleles in Man (blood groups).

      d)Multiple alleles in plants (self incompatibility)

3. Quantitative genetics   **06 L**

      a) Quantitative traits and quantitative genetics.

      b) The multiple factor hypothesis.

      c) Descriptive statistics.

4. Linkage and recombination   **08 L**

      a) Theories of linkage & detection of linkage.

      b) Linkage in Maize.

c) Coupling and repulsion phases

d) Two and three point test crosses with their significance in chromosome mapping.

e) Interference and co-efficient of coincidence

5. Cytoplasmic inheritance   **08 L**

a) Concept and definition.

b) Cytoplasmic inheritance and plastid transmission in plants. *(Mirabilis jalapa).*

c) Male sterility in plants.

d)Cytoplasmic inheritance in Yeast (Mitochondria).

6. Alterations in genetic makeup:- change at genetic level   **08 L**

a) Spontaneous and induced mutations.

b) Mutagens – types and mode of action.

c) Transitions, transversions and frame-shift mutations.

d)Detection of mutations.

7. Alterations in genetic makeup: - change in chromosome structure   **06 L**

a) Origin, types and effects of duplications.

b) Deletions, inversions and translocations.

c) Meiosis in structural heterozygotes.

8. Biostatistics   **07 L**

a) Central value and desperation.

b) Mode, median, mean, range, mean deviation and standard deviation.

c) Coefficient of variation and standard error.

Reference Books:

1. Atherly, A.G., Girton, J.R. and McDonald. 1999. The Science of Genetics. SaundersCollege Publishing Co., Fort Worth, USA.

2. Gardener, J., Simmons, H.J. and Snustad. D.P. 1991.Principles of Genetics (8th Edition).John Wiley & Sons, New York.

3. Sinnott Dunn – Principles of geneties.

4.. Arora and Sandhu – Genetics.

5. Hartl, D.L. and Jones, E.W. 1998. Genetics: Principles and Analysis (4th Edition). Jones& Bartlett Publishers, Massachusetts, USA.

6. Gupta, P.K. 1994. Genetics.Rastogi Publications. Shivaji Road, Meerut

7. Gupta, P.K. 1995. Cytogenetics.Rastogi Publications, Meerut.

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T.Y.B.Sc. (BOTANY)
(C.B.C.S. 2018 Course)
SEMESTER-V
B – 55: MOLECULAR BIOLOGY & BIOCHEMISTRY

Core Course – Theory; Credits- 04   **Total lectures- 60 L**

Learning Outcomes :

On completion of this course, students are able to:

• Understand structural organization and variation in chromosome as well as karyotype analysis.

• Learn about the extra-chromosomal inheritance in plant system.

• Know the molecular biology in relation to genetic material, its inheritance, modification, replication and repair.

• Understand transcription, translation post translation modification of protein.

• Know gene regulation in prokaryotes and eukaryotes and to understand cocept of Biochemistry..

Course Content:

Molecular Biology

1) Nucleic Acid structure   **09 L**

Synthesis of nucleotides.DNA as a genetic material.Forms of DNA (A,B& Z).DNA replication.RNA structure, forms and role.

2) Recombinant DNA technology   **12 L**

Restriction endonucleases.Cloning vectors & choice of vectors.Gene cloning principle & technique.

Construction of Genomic and cDNAlibraries.Southern and Northern blotting technique.DNA fingerprinting.DNA sequencing (Maxam, Gillbert& Sangers method) Polymerase chain reaction (PCR).

3) Genetic engineering of plants.   **10 L**

Concept of genetic engineering.Transfer of genes in plants.Agrobacterium the natural genetic engineer.

Transgenic plants (BT cotton & Golden rice).Chloroplast transformation and its significance.

Biochemistry

4) Amino acids   **06 L**

      Definition, structure and functions, properties, synthesis of amino acids.

5) Proteins   **08 L**

      Definition, classification according to structure, functions of proteins,Protein synthesis,
importance of proteins.

6) Carbohydrates   **07 L**

      Introduction, classification, functions of monosaccharaides,
oligosaccharides,Polysaccharides including starch, cellulose & pectins.

7) Lipids – definition, classification, properties, functions   **03 L**

8) Enzymes   **05 L**

      Definition, Classification, properties, mechanism of enzyme action, Lock-key hypothesis,
active sites, coenzymes, factors affecting enzyme activity, pH, temp, inhibitors,
substratcs& activators.

Reference books:

1. Alber B. Bray, D.Leweis, J.Rald, M.Robert, Watson J.D…1999 – MoL biology ofcell

2. M.L.Gupta, M.L.Jangir – The cell and biotechnology

3. L.M.Narayanan, A.M.Selva Raj, A.Mani Padmalatha Singh – Molecular and
Genetics.engineering

4. Anna C.Pai – Foundation of genetics

5. B.K.Jain – A Text book of Genetics

6. Karvita B. Ahluwalia – Genetics

7. Lea P.J. and Leegood R.C. – 1999-plant Biochemistry and Molecular biology

8. Old R.W and Primrose S.B. – 1999 – Principles of Gene Manipulation.

9. T.N.More, K.N.Dhumal et.al-2003, A Text book of Botany – Plant Biotechnology

T.Y. B.Sc. (BOTANY)
C.B.C.S. 2018 Course)
B – 56: PRACTICAL COURSE V
(Based on B- 51: Biology of Cryptogams & B-52: Biology of Seed Plants)

Core Course – Practical's; Credits- 02   (Any 10 practical's to be covered)

Learning Outcomes :
On completion of this course, students are able to:
• The range of thallus structure in algae.
• Understand the salient features of Algae and Fungi..
• .Study of morphological and biological peculiarities of plants
• Study of the families with respect to morphological characters using botanical

terms,floral formula, floral diagram.

• Identification of genus and species with the help of flora of the plant materials.
• Preparation of artificial, bracketed/indented dichotomous keys based on vegetative and

reproductive characters.

Course Content:
1. Study of thallus organisation in algae e.g. *Chlorella, Volvox, Ulothrix,*

Hydrodictyon,Cladophora, Fritschiella Vaucheria, Polysiphonia and *Ulva.* 1P

2. Study of Life histories of *Chara and Batrachospermum*   1P
3. Study of life histories of *Rhizopus* &*Synchitrium*.   1P
4. Study of life history of *Agaricus*.   1P
5. Study of life cycle of Rust of wheat. (*Puccinia*)   1P
6. 6 to 10 Study of the following plants families with helps of locally available

specimens.Myrtaceae, Cucurbitaceae, Sapotaceae, Apocynaceae, Solanaceae,

Acanthaceae,Labiatae, Ephorbioceae, Liliaceae & Cannaceae. **8P**

11. Preparation of dichotomous key and identification of genus & species by using

floras   1P

12. Field visit: students should be taken for field visits to study flora to collect
plant specimens & to prepare herbaria.

13. Study of – Stomatal number.Stomatal index and Vein - islet number with suitable
examples.   1P

14. To study the types of ovule, megasporogenesis, structure of the *Polygonum* type
and *Allium* type embryo sac with help of permanent slides.   **1 P**

T.Y. B.Sc. (BOTANY)
(C.B.C.S. 2018 Course)
B-57 - PRACTICAL COURSE – VI

(Based on B-53: Plant Pathology and Plant Protection & B-54: Genetics and Biostatistics)
Core Course – Practical's; Credits- 02   (Any 10 practical's to be covered)
Learning Outcomes :

On completion of this course, students are able to:

- study of plant pathogens representing different diseases in angiosperms
- Study differnt types of enzymes and its significance-Pectolytic enzymes
- Principle working and uses of laminar air flow hood, autoclave, hot air oven, electrophoresis and centrifuge.
- understand MS media preparation. & cocept of genetics
- understand preperation of chromosomes maps & to determine mean ,mode & median

1. Study of important plant pathogens (symptoms and host parasite relationship).   **1 P**
2. Effect of pathogens on physiology of a host.   **1 P**

3. Study of following plant diseases.   **3 P**
        Black stem rust of wheat.
        Downy mildew of grape.
        Powdery mildew of Cucurbita / Tectona.
        Tikka disease of ground-nut.
        Yellow Mosaic of papaya.

4. Isolation of pectolytic enzymes from diseased plants.   **1 P**
5. Isolation of cellulase from diseased plants.   **1 P**

6. Demonstration of biopesticides (essential oils, neem, turmeric and garlic) against some pathogens.   **1 P**
7. Determination of chromosome count from dividing pollen mother cells, root tips and pollen grains.   **1 P**
8. Determination of intraspecific variation in chromosome number from locally available taxa **1 P**
9. Preparation of chromosome maps from 3-point test cross data.   **1 P**
10. To determine the mode, median and mean of the specimens.   **1 P**

(C.B.C.S. 2018 Course)
B-58- PRACTICAL COURSE – VII
(Based on B- 55 Molecular biology and Biochemistry B-59 (A) Aerobiology / B-59 (B)
Medico botany / B-59 (C) Conservation of Medicinal Plants)
Core Course – Practical's; Credits- 02   (Any 10 practical's to be covered)

Learning Outcomes :

      On completion of this course, students are able to:
- Students should understand, molicular biology indetail
- To know biochemical view of evry experiment & to understand concept of aerobiology
- Student should understood aerospora,allergic pollen grains.
- Preparation of cotton blue, permanent algal slidesctophenol and culture medium – PDA.
- Study fungi with respect to vegetative,reproductive structures and classification with reasons.

Practicle course content;
1. Chemical tests to demonstrate the presence of starch, sugar, fat and protein in plant materia**1 P**
2. To identify the amino acids in a mixture by resolving through paper Chromatography or T**1 P**
3. Colorimetric estimation of RNA using orcinol.   **1 P**
4. Colorimetric estimation of DNA using diphenyl amine.   **1 P**
5. Study of amino acid, proteins, lipids & carbohydrates   **2 P**

Practicals based on B-59 (A) Aerobiology
6. Study of construction and working of Volumetric Tilak air sampler & Andersen air sample **1P**
7. Preparation of culture media and culturing of airborne fungal forms by petriplate exposure method   **1 P**
8. Preparation of mountant – glycerine jelly, scanning and identification of fungal spores. **1 P**
9. Air monitoring for pollen grains and identification of pollen grains.   **2 P**

Practicals based on B-59 (B) Medicobotany
1. Study of any six drug plants from theory syllabus (Macroscopic and Microscopic)   **2P**

2. Study of ethno botany of any two locally available Plants   **1P**
3. Study and preparation of ayurvedic formulations - Asav, Arishtia, Churna   **1P**
4. Visit to pharmaceutical industry where plant formulations are prepared   **1P**
5. Extraction and Qualitative analysis of Alkaloid, Glycoside and Tannin   **1P**

acticals based on B-59 (C) Consrvation of Medicinal Plants:
1. Study of identification of genus and species of plants by preparing key with the help of Cook'sflora.   **1P**

2. To study morphological characters of rare, endangered and threatened plants with suitable examples. **1P**

3. Study of cultivation practices of *Aloe / SafedMusali.* **1P**

4. Study of cultivation practices of important medicinal plants by in situ conservation. **1P**

5. Visit to local medicinal plant garden. **D**

SEMESTER– V

(Elective Courses): Choose any one course of the following

B – 59 (A): AEROBIOLOGY

Core Course – Theory; Credits- 04   **Total lectures- 60 L**

Course Learning Outcomes:

On completion of this course, students are able to:
- Know the nature and its co-relation with human society.& to understand cocept of aerobiology
- Realize the impact of human activities on environment.
- Understand global issues concerned with aerospora & allergic pollen grains
- Know the sustainable development and care of environment.

1. Introduction   **08 L**

i) Definition and importance of Aerobiology. ii) Brief history and progress of Aerobiology

in India. iii) Scientific contributions of Prof. P. H. Gregory, Prof. K. C. Meheta, Prof. T.Sreeramulu and Prof. S. T. Tilak. iv) Multidisciplinary approach

2. Methods of sampling   **06 L**

i) Principles. ii) Qualitative and quantitative sampling. iii) Intramural and extramural sampling. iv) Utility of intramural and extramural sampling.

3. Types of air samplers and working of following air samplers   **05 L**

i) Volumetric Tilak air sampler. ii) Rotorod air sampler. iii) Andersen air sampler

4. Airborne Biological materials   **09 L**

i) General survey and classification. ii) Concept of aerobiopollutants. iii) Study of the following biological materials. Algae (b) Fungi (c) Bacteria (d) Pollen (e) Mites

5. Analysis of Aerospora   **07 L**

i) Identification methods. ii) Vertical and horizontal distribution.
iii) `Statistical analysis of aeromicrobiota. iv) Logical interpretation of data.

6. Meteorological parameters and aerospora   **06 L**

i) Temperature, humidity and rainfall. ii) Diurnal periodicity.
iii) Day and Night (nocturnal) aerospora.

7. Impact of Aerobiopollutants on living systems   **07 L**

i) On human – Allergy and Skin diseases. ii) On animal – Skin diseases.
iii) On plants – Plant diseases.

8. Plant disease forecasting and aerobiology   **05 L**

i) Principles. ii) Methods. iii) Model in brief.

9. Concept of bio-deterioration and biodegradation with reference toairborne microbes.   **02 L**

10. House Dust mites   **05 L**

i) General account and types. ii) Relevance of House Dust mites in house dust.
iii) Culturing of any one organism. iv) Human health hazards.

Reference Books :

S.T.Tilak – Aerobiology

S.T.Tilak – Environmental Ecology and Aerobiology.

S.T.Tilak – Airborne pollen & Fungal Spores.

S.T.Tilak – Aerobiology (Revised edition 2000)

P.H.Gregory – Microbiology of Atmosphere.

S.N.Agashe – Recent Advances in Aerobiology.

T.Y. B.Sc. (BOTANY)
(C.B.C.S. 2018 Course)
SEMESTER - V
B – 59 (B): MEDICO BOTANY

Core Course – Theory; Credits- 04   **Total lectures- 60 L**

Course Learning Outcomes :

On completion of this course, students are able to:

- Know about history and relevance of herbal drugs in Indian system of medicine
- Learn the macroscopic and microscopic characters, chemical constituents, adulterants,
- Understand the techniques for drug evaluation (Chemical, Physical and Biological),
- Phytochemical investigations, standardization and quality control of herbal drugs
- Know the technique of medicinal gardening - Cultivation practices, marketing and utilization of selected medicinal plants
- Get knowledge on pharmacological importance of medicinal plants and its bioactive compounds.
- Set up process of harvesting, drying and storage of medicinal herbs

1) Study of Crude drugs with reference to macroscopic and microscopic characters, active principles, therapeutic action and medicinal use of –   **14 L**

*a)*Root and rhizome durgs – *Rauwolfia surpentina, Glycirhiza glabra, Zingiber officinalis.*

b) Stem drugs :-*Tinospora cordifolia, Ephedra*SP.

c) Bark drugs – *Holarrhenaanti dysenterica, Cinnamom zeylanicum.*

d) Leaf drugs – *Cassia angustifolia, Datura metel.*

2) Study of Crud drugs with reference to macroscopic and microscopic characters, active principles, therapeutic action and medicinal use of –   **09 L**

a) Flower drugs – *Eugenia caryophyllum, Rosa indica .*

b) Seed drugs – *Plantage ovata, Myristica fragrans.*

c) Fruit drugs – *Terminalia belarica (Behada), Aegle marmelos.*

3) Medicinal use of common house hold crude drugs -   **12 L**

a) Adhatoda vasica b) *Acorous callamus* c) *Gardenia gumifera* d) *Helicteris isora*

e) *Curcuma longa* f) *Terminaliabelarica* g) *Terminaliachebula* h) *Emblicaofficinalis*

i) *Ocimum sanctum* **j)** *Allium sativum*

4) Study of important Medicinal plants used as spices and condiments –   **12 L**

a) Curcuma longa b) *Zingiber officinale* c) *Cinnamomum verum* d) *Cinnamomum tamala*

e) *Coriandrum sativum* f) *Murraya   koenigii* g) *Eugenia caryophyllata* h) *Carum copiticum*

i) *Elettaria cardamomum* j) *Myristica fragrans*

5) Ayurvedic concept of preparation of crude drugs   **08 L**
a) Churne b) Asava c) Arishta d) Gutti e) Kadha

6) Lower plants in medicine   **05 L**
Sources and uses of *Chlorellin* and *Penicillin* and *Ergotine.*
Medicinal uses of bryophytes and pteridophytes.

References
1) Pharmacognosy: Trease and Evans
2) Pharmacognosy :Gokhale, Kokate and Purohit
3) Pharmacognosy: Wallis
4) Medicinal plants: Jain S.K.
5) Practical pharmacognosy: Khandelwal and Pawar et al.
6) Indian Medicinal plants: Kirtikar and Basu

B – 59 (C): Conservation of Medicinal Plants
Core Course – Theory; Credits- 04   **Total lectures- 60 L**
 Course Learning Outcomes :

  On completion of this course, students are able to:

- understand medicinal plants are considered as a rich resources of ingredients which can be used in drug development either pharmacopoeial, non- pharmacopoeial or synthetic drugs.
- understand some plants and their derivatives are considered as important source for active ingredients which are used in aspirin and toothpaste.

1. BASIC STUDIES   14 L
• **Traditional knowledge and the use of plants in health care**
    1. Introduction to traditional knowledge.
    2. Importance and significance of this knowledge to local people.
    3. Communities involved in traditional knowledge about medicinal plants, application of traditional knowledge with examples.
• **Identification and classification of medicinal plants**
    4. Concept of identification and classification, system used presently for identification, Botanical approach for identification and classification of the plants
    5. The classification for medicinal plant used by Ayurveda – basic principles and system
    6. Field identification technique for the medicinal plants
· **Outline of medicinal plants distribution and their abundance**
    7. List of plants required in large quantity from various parts of India
    8. Distribution of the important medicinal plants in Maharashtra and India.
    9. Threatened / Endemic / medicinal plants of India

2. UTILIZATION   16 L
• **Whenever possible to cultivate the medicinal plants as a source of supply**
    1. Cultivation of the medicinal plants, principles and concept, methods of cultivation.
    2. Scenario of highly cultivating medicinal plants; demand and supply ration
    3. Existing sources of medicinal plants for cultivation.
    4. Status of medicinal plants available in wild, in Pune and surrounding regions.Major areas of Maharashtra from where medicinal plants are collected from wild
• **Improved techniques for harvesting, storage and production**
    5. Pre processing and post processing techniques for harvesting and recent techniques for the storage of the medicinal plant parts.

6. State level and National level policies for harvesting, storage and production of medicinal plants Introduction to ADMA – Ayurvedic Drug Manufacture Association, role in collection of medicinal plants from various parts of India

7. Status of medicinal plant product companies in Maharashtra, India and at International level

8. Opportunities to the students for initiating a business in medicinal plants

3. CONSERVATION   14 L
• **Conserve population of medicinal plant sciences in natural habitat**

1. What is conservation? In-situ & ex-situ conservation, concept & introduction

2. Important parameters for the conservation, viz. Community involvement, dependence ofcommunities on the natural resources, availability of resource

3. Identification of existing threats to the natural resources / medicinal plants

• **Conserve population of medicinal plant species ex-situ**

4. Ex-situ conservation technique and its significance, Need of ex-Situ Conservation and itsapplication

5. Successful stories of Ex-Situ conservation of medicinal plants – 4 case studies

National and International policies on conservation and current scenario of conservation

Tools available for the conservation of medicinal plants at local level – e.g. MPCA

6. Government policies under NMPB and SMPB

7. Government funding at village level for cultivation practices of medicinal plants; role ofDistrict

KrishiVigyan Kendra for giving training for conservation

8. Forest Department – on Protected and non-protected areas

9. Method of collection of medicinal plants and their conservation

4. COMMUNICATION AND CO-OPERATION   16 L
• **Built public support for conservation of medicinal plants**

1. Market requirement for the medicinal plants and availability on ground, Co-operativecultivation of medicinal plant – A model

2. Which are the major companies in drug productions

3. Role of National Medicinal Plant Board (NMPB) and State medicinal Plant Board inmarketing of the raw products

4. What is buy-back mechanism; its significance and implementation in other states

5. National Medicinal Plant Board and Maharashtra Medicinal Plant Board, Department of Biotechnology

• Involvement of Non-Governmental Organization (NGO) in cultivation, conservation and marketing of medicinal plants

    1. List of NGOs at local and at national level

    2. Discussion of case studies of any 4 organizations

References

1) Pharmacognosy: Trease and Evans

2) Pharmacognosy:Gokhale, Kokate and Purohit

3) Pharmacognosy: Wallis

4) Medicinal plants: Jain S.K.

5) Practical pharmacognosy: Khandelwal and Pawar et al.

6) Indian Medicinal plants: Kirtikar and Basu

SEMESTER-V
MB 51 Medical Microbiology

Total credits 04   **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to -

- **Explore the types of infectious diseases**

- **Know the etiology, symptoms and mode of transmission of human diseases and veterinary diseases**

- **Study the human diseases including AIDS**

- **Identify the Medical and Cosmetic uses of certain toxins.**

- **Know the health insurance policies & limitations of Customer courts**

Course Content

I]   **Introduction to important Medical Terminologies.**   **02**

II]   **Outline studies of the following human diseases w.r.t. Etiology, symptoms and mode of transmission.**   **15**

     i ikungunya

     ii Dengue

    iii. Japanese Encephalitis

    iv. Herpes

     v. Common-cold

    vi. Viral Diarrhoea

    vii. Rabies

   viii. Typhoid

    ix. Cholera

     x. Gonorrhoea

    xi. Plague

    xii. Amoebiasis

     xii. Leptospirosis

III]   **Outline studies of the following veterinary diseases**   **08**
   w.r.t. etiology, symptoms, mode of transmission & treatment.

    i.   Mastitis

    ii.   Ranikhet

    iii.   Marek's Disease

    iv.   Brucellosis

IV]   **Detailed study of following Human   Diseases.**   **25**

1.   **AIDS**

2]   **Poliomyelitis:**
   a) Structure of HIV
   b) ICTV Classification of HIV
   c) Difference between HIV 1 and HIV 2
   d) Mode of transmission
   e) Significance of CCR5 AND CXR4 receptors in the Pathogenesis of AIDS
   f) Apoptosis of CD_4 cells following HIV infection.
   g) ELISA, Western Blott, for Diagnosis of HIV infection.
   h) Morphology
   i) Antigenic Propertie
   j) Pathogenesis
   k) Prophylaxis
      - Injectable Polio Vaccine (IPV)
      - Live Polio Vaccine (Oral Polio Vaccine)

 3]   **Bacillary Dysentery:**
            a) Morphology
            b) Cultural characteristics

            c) ochemical properties
            d) Toxic activities of *Shigelladysenteriae* Type 1 in
            terms of Neurotoxicity, Enterotoxicity,Cytotoxicity
            e) Classification
            f) Pathogenicity
            g) Epidemiology

4] *Helicobacter pylori* **a resourceful gastric pathogen:**

i) Morphology of *H. pylori*
         ii) Unusual features of flagella of H. pylori
         iii) Mechanism of colonization in the stomach mucosa
         iv) Eliciting an inflammatory response by *H. pylori*
         v) LPS- Immune Mimicry of *H. pylori*

5] *Clostridium difficile* **and Pseudomembranous colitis:**

i) Concept of Pseudomembranous colitis
         ii) Characteristics of *C. difficile*
         iii) Virulence factors of *C. difficile*
iv) Unexplained resistance of Babies to toxins of *C. difficile*

V] Medical Microbiology and Community: **10**
      1. Botulism:

i) Concept of Botulism
      ii) Botulinum toxin
      iii) Medical and cosmetic uses of Botulinum toxin

2. Microbiology and Health Insurance:
- Permanent exclusions in Medical Policies
a) Microbial Infections
b) Hereditary Conditions
- Comparative claim settlement ratios of prime health insurance companies in India
- Limitations of consumer courts in the context of violation of terms and conditions of health policy documents in India

References:-

1. Anthony T.,Diplock(1995),Fat soluble vitamins, First edition, Heinemann: London(Topic V)

2. Chakraborty P. 2009, Textbook of Medical Parasitology, Central Publications, Kolkata, India. (Topic I..pt.12, Topic IV..pt.4)

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5. N.I.V. handbook, 1993 PUNE NIV PUNE. (Topic II)

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8. Sharma J.B., 2014, Medical Microbiology, A Clinical Perspective, Paras Medical Publishers, Hyderabad, India. (Topic I and IV)

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10. Abigail A. Salyers and Dixie D Whitt 2018, Part 2, Bacterial Pathogenesis A Molecular Approach, ASM Press, Washington (Topic IV- Point 4 and 5,Topic V- Point- I)

B. Sc. Part III (T.Y.B.Sc.) MICROBIOLOGY
To Be Implemented From Academic Year 2020 – 2021
SEMESTER-V
MB 52 Clinical Pathology

Total credits 04   **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to -

- **Identify the role of blood cells & their significance**

- **Have a conceptual knowledge about lipids & clinical pathology**

- **Know the clinical relevance of hepatic system**

- **Develop the skills to perform the various renal& liver function tests**

- **Understand the community health services**

Course Content

I. Haematology :-   **20**

i.	Cytology and significance of Eosinophil,
ii.	Cytology and significance of Basophil,
iii.	Cytology and significance of Neutrophil,
iv.	Cytology and significance of Macrophages
v.	Cytology and significance of NK Cells.
vi.	Plasma electrolytes and their importance in human health,
vii.	Significance of hemoglobin,
viii.	Anticoagulants used in laboratories,
ix.	Anticoagulants used as therapeutic agents,
x.	Nomenclature of Procoagulants,
xi.	Formation of Platelet plug,
xii.	Intrinsic Pathway for Blood Coagulation,
xiii.	Extrinsic pathway for Blood Coagulation.

II. Lipids & Clinical Pathology:-   **10**

i.	HDL & LDL cholesterol & their diagnostic significance,
ii.	Docosahexaenoic acid & it's clinical significance,
iii.	Lipid hypothesis of schizophrenia. .

III.   Clinical Relevance of Hepatic system:-   **10**

    i.   Bilirubin metabolism,

    ii.   Conjugate &Unconjugate bilirubin,

    iii. Overproductive jaundice,

    iv. Obstructive jaundice,

    v.   Hepatocellular jaundice,

    vi. Congenital jaundice,

IV.   Organ Function Tests: **10**

A. Renal Function Tests:

    i.   Creatine Clearence Test

    ii.   Urea Clearence Test

    iii. Phenol Sulfonaphthalein (PSP) Test

B. Liver function tests

    i.   SGOT,

    ii.   SGPT,

    iii. Total Serum Bilirubin,

    iv. Van Den Bergh Test,

    v.   Bromosulphalein Excretion Test

V.   Community Health services & Measures:-   **10**

    i.   Blood – grouping

       a) ABO   b) Rh,

   ii. Methods of blood grouping,

  iii. 'Blood Banking',

  iv. Rh-incompatibility (HDN).

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2. David male, Jonathan Brostoff, David B Roth, lvan Roitt, 2006 Immunology 7th edition (Topic I)
3. E. Roy Skinner (Ed.) 2002, brain lipids and Disorders in Biological Psychiatry, ELSEVIER. (Topics II)
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7. World Health Organization Blood Transfusion Services 2015,(Authorized reprint by B.I. Churchill Livingstone. (Topic V)

B. Sc. Part III (T.Y.B.Sc.) MICROBIOLOGY
To Be Implemented From Academic Year 2020 – 2021
SEMESTER-V
MB 53Virology

Total credits 04   **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to -

- **Focus on the study of viruses that includes the origin, structure & nucleic acids**

- **Know the methods of isolation ,cultivation & enumeration of viruses**

- **Identify the life cycles of bacteriophages& genetic recombination in phages**

- **Master the techniques in the reproduction of specific animal & plant viruses**

Course Content
I Introduction   05
i.	Discovery and definition of a Virus
ii.	Importance of Viral nucleic acids
iii.	Properties of Viruses
iv.	Origin of Viruses
v.	Classification of viruses

II Structure of Viruses   12
A. Subunits of viruses
B. Structure of various viruses (one example each)
i.	Filamentousviruses
ii.	Isometricviruses
iii.	Icosahedralviruses
iv.	Picornaviruse
v.	Bacteriophages
vi.	Adenoviruses
vii.	Envelopedviruses

C. Viral Nucleic acids
i.	DNA Viruses – Single and Double stranded
ii.	RNA viruses- Single and Double stranded

D. SubviralInfectious agents
i.	Satellite viruses
ii.	Viroids
iii.	Prions

III.   Isolation, cultivation and enumeration of viruses   15
   A. **Isolation and cultivation of viruses**
    i. Animal virus - tissue culture, chick embryo and live animals.
    ii. Plant virus – plant tissue culture and protoplast formation
    iii. Bacteriophages – plaque method.

   B **Enumeration of viruses**
    i. Latex droplet method (Direct Microscopic count)
    ii. Haemagglutination assay
    iii. Plaque and pock method.
    iv. LD 50 or ID5O assays (50% end point method.)

IV] T even phages and T odd phages. comparison 02

V] Gene regulation in bacteriophages   16

  A. Life cycles of Bacteriophages: T Even phages (T_2 T_4 $T_{6)and}$ λ
     i. One step growth curve
     ii. Single burst experiment
     iii. Doermann's experiment
     iv. Features Of The T_4 Life cycle
    a. Taking over the cell
    b. Replication of T_4 DNA
    c. Production of T4 phage particles

  B. Genetic Mapping of Phage T_4
    i. The genetic map of T_4 is circular
    ii. Possible explanations for the T_4 circular map
  C. Life cycles of Phage λ
  i. λ DNA and its gene organization
  ii The Lytic cycle of λ
 a. DNA replication and phage production
 b. DNA replication and maturation: coupled processes

c. Particle assembly

iii. Lysogenic establishment of λ

iv. Immediate Early, Delayed Early and the Late genes

v. Essential and Nonessentional genes

vi. Establishment and Maintenance of Lysogeny

vii. C_I, C_{II}, C_{III} and Cro proteins-Role as inducers and repressors

viii. A delicate balance: lysogeny versus lysis

D. Phage Mutants

F. Genetic Recombination in Phages

     i.   Effect of the parental ratio on recombination frequencies

     ii.   Reciprocity in genetic recombination

     iii. Recombination by breakage and rejoining of DNA molecule

VII   Specialized Transduction   05

    i.   Other Lysogenic phages

    ii.   Lysogenic phages and bacterial pathogenesis

VIII Reproduction of Plant and Animal viruses   05

A. Animal Viruses

    i.   Adenovirus

    ii.   Influenza virus

B Plant virus

TMV (Tobbacco Mosaic Virus)

References

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B. Sc. Part III (T.Y.B.Sc.) MICROBIOLOGY
To Be Implemented From Academic Year 2020 – 2021
SEMESTER-V
MB 54 Genetics of Prokaryotes

Total credits 04   **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to

- **Understand the different modes of Recombination in Bacteria**

- **Get knowledge of operon & regulation of gene expression in bacteria**

- **Identify the transposable elements & their significance**

- **Know the properties of Fertility factor & their importance in bacterial recombination**

Course Content

I Recombination in bacteria
   A. Bacterial Transformation   **10**
     i. Discovery of Transformation
    ii. Steps in Transformation
         a. Competence development
         b. Uptake of DNA during Natural Transformation.
         c. Integration
   iii. Transformation in Gram positive and Gram negative bacteria
   iv. Molecular mechanism of Transformation.
    v. Uses of Transformation
   vi. Transformation In nature
  vii. Artificial Transformation (Transfection)

   B. Bacterial Conjugation   **10**
    i. F^+ cells. Properties of F^+ cells. Cross between F^+ and F^- cells
    ii. Transfer of Plasmid DNA
         a. Stages in transfer process
         b. Effective contact and pilli
         c. Mobilization and transfer
         d. Fertility inhibition
         e. *tra* genes of F
         f. Host restriction in transfer

iii. Formation of Hfr cells. Hfr Transfer: Cross between Hfr and F^-, F^- Phenocopies (Lethal zygosis)

iv. Chromosome transfer mediated by F' Plasmid (F-duction)
   a. Conjugation in *Streptococcus faecalis* system
   b. Conjugation in *E.coli*. system

   C. Bacterial Transduction   **10**

i. Generalized Transduction

ii. Specialized Transduction
   a. Formation of specialized transducing particles from a λlysogen
   b. Specialized transduction of a nonlysogen
   c. Specialized transduction of a lysogen
   d. High frequency transducing lysates

iii. Specialized Transducing Phage as a cloning vehicle

iv. Transduction and phage conversion

II Regulation of Gene Expression in Bacteria.
   i **Concept of Operon**   **02**
   ii. Lactose Operon   **08**
   a. Structure of Lactose operon
   b. Regulation of *lac* system : Repression, Allolactose, role of cAMP
   c. Lac mutants
   d. Isolation of muants in *lac* operon
   e. Differential Translation of the genes in *lac* m RNA
   f. Positive and negative regulation of the *lac* operon

   iii. Arabinose Operon   **04**
   a. Structure of Arabinose n operon
   b. Regulation of *Ara* system: Repression
   c. Regulation of *Ara* system at different concentration of arabinose
   d. Positive regulation of the*Ara* operon
   e. Double regulation by repressor

   iv. Typtophan Operon   **06**
   a. Regulation of a biosynthetic pathway
   b. Structure of Tryptophan operon
   c. Regulation of*Trp*system at different conc of trypyophan
   d. Autoregulation
   e. Repression Vs Attenuation
   f. Antitermination

III Transposable Elements   10

     i.   Insertion sequences
     ii.   Structure of Transposable elements
     iii.   Transposon terminology
     iv.   Types of bacterial transposones
     v.   Transposition
     vi.   Simple transposition
     vii. Duplication of a target sequence at an insertion site
     viii. Replicative transposition
     ix.   Mechanism of replicative transposition (J. Shapiro's Model)
     x.   Excision of transposons
     xi.   Genetic phenomena mediated by transposons in bacteria
     xii.   Transposons and evolution

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6. Russel. P.J. (2006) Genetics: A molecular Approach. 2nd Edition. Pearson Benjamin Cummings.

7. Russet P.J. (1998) Genetics fifth. Edition. Addison Wesley Longman. Inc.

8. Snyder L and W. Champness (2003) Molecular Genetics of Bacteria Second Edition. ASM Press. Washing ton D.C.

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B. Sc. Part III (T.Y.B.Sc.) MICROBIOLOGY
To Be Implemented From Academic Year 2020 – 2021
SEMESTER-V
MB 55 Enzyme Kinetics and Regulation

Total credits 04   **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to -

- **Have conceptual knowledge of properties, Structure & function of Enzymes, Types of Enzymes**

- **Have knowledge about Enzyme Kinetics & their Regulation**

- **Specify the application of enzymes in large scale Industrial process**

- **Understand the applications of Biochip, Enzyme Electrodes & Biosensors**

- **Learn the enzyme immobilization & Industrial application**

Course Content

I.   **Enzymes as biocatalysts: review**   **03**

II.   **Types of enzymes**   **07**
       i.   **Monomeric enzymes**- Characteristics, function of monomeric enzymes - Serine proteases.
       ii. **Oligomeric enzymes**. Characteristics and functions of oligomeric enzymes -Tryptophansynthatase, Lactose synthase
       iii. **Multimeric enzymes** Characteristics and functions of multimeric enzyme, Pyruvate dehydrogenase

III.   **Regulatory enzymes and mechanism of regulation.**   **16**
       A.   **Allosteric enzymes**
         i.   Structure
         ii. Co-operativity
         iii. MWC mode (concerted model)l, KNF model(sequential model)
         iv. Kinetic behavior of allosteric enzymes, K- enzymes and M-enzymes
         v.   ATPase.

B. **Covalently modulated regulatory enzymes**
   i.   Glycogen phosphorylase enzymes
   ii.   Glutamine synthetase

C. **Covalent activation of zymogens.**

D. **Fee back inhibition-** Concerted, Cumulative, Sequential regulation

E. **Isoenzymes**
   i.   Concept and functioning
   ii.   Identification of isozymeforms
   iii. Lactate dehydrogenase

IV.   **Coenzymes.**   **10**

   i.   Riboflavin coenzymes.
   ii.   Thiamine coenzymes
   iii. Pantothenic acid and Coenzyme A.
   iv.   Pyridoxine coenzymes

V.   **Kineticsofsingle substrate enzyme catalyzed reaction**.   **10**
   i. The concept and use of initial velocity
   ii. The Michaelis – Menten equation for initial velocity, Michaelis Menten plot and
       its significance
   iii. Brigg's and Haldane modification of Michaelis – Menten equation.
   iv. Transformations of the Michaelis Menten equation for plotting kinetic data.
       The Lineweaver & Burk plot, Edie-Hofstee Plot, Hanes Plot.

VI.   **Enzyme inhibitions**   **06**
   i. Reversibile inhibition
         a) Competitive inhibition
         b) Uncompetitive inhibition
         c) Noncompetitive inhibition
   ii. Irreversible inhibition

VII **Applications of enzymes in Biotechnology**   **08**
   i.   Production of enzymes on large scale
   ii.   Enzymes in DNA technology
   iii. Systems Biology and Microarrays
   iv.   Preparation properties applications of immobilized enzyme
   v.   Biosensors and biochips, Enzyme electrode

References:-

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B. Sc. Part III (T.Y.B.Sc.) MICROBIOLOGY
To Be Implemented From Academic Year 2020 – 2021
SEMESTER-V
MB 56   Practical Course – V

Total credits 02   **Total number of Experiments: 15**

Course Learning Outcomes:

On completion of Course Students are able to -

- **Identify common infectious agents & diseases that they cause**
- **Evaluate methods used to identify infectious agents in the Clinical Microbiology Laboratory**
- **Articulate Diagnostic, Clinical reasoning skills in all major disciplines**
- **Recognize & Diagnose common infectious diseases from the clinical presentation & associated Microbiology**

Course Content

1. Isolation and Identification of pathogenic *Staphylococci*.   3
    a. Coagulase Test.
    b. DNA ase Test.

2. Isolation and Identification of Gram negative Intestinal pathogens-   4
E.coli, Salmonella.

3. Isolation and Identification of Urinary Tract pathogens-   4
Proteus, Pseudomonas.

4. Slide Agglutination Test: Serological typing.   3
    a. Blood grouping ABO and Rh.
    b. Tube Agglutination Test: The WidalTest
    c. Rapid Plasma Reagin Test (for diagnosis of Syphilis)

5. Enzyme Linked Immunosorbent Assay (Demonstration)   1

References:–

1. Benson H.J. (1990) Microbiological Applications A Laboratory manual in General Microbiology, 5th Edition Wm. C Brown Publisher.

2. Bradshaw L. Jack (1979) Laboratory Microbiology, Third Edition W.B. Saunders co Philadelphia, London, Toronto.

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B. Sc. Part III (T.Y.B.Sc.) MICROBIOLOGY
To Be Implemented From Academic Year 2020 – 2021
SEMESTER-V
MB 57   Practical Course – VI

Total credits 02   **Total number of Experiments: 15**

Course Learning Outcomes:

On completion of Course Students are able to -

- **Study the Micro-Organisms that are associated with milk & milk products in all aspects**

- **Understand the basic Microbiology of Food & Dairy products**

- **Evaluate the Microbiology quality of raw milk**

- **Have the information on the microbial content of milk can be used to judge its sanitary quality & the conditions of production.**

- **Study the Micro-Organisms that inhibit, Create or Contaminate food**

Course Content

A]   A Milk Microbiology   5
     1.   Dye Reduction tests – Methylene Blue and Resazurin
     2.   Test for Mastitis.
     3.   TVC of milk.
     5.   Specific gravity of milk.
     6.   Direct microscopic count.
     7.   Estimation of fat content of milk.

B]   Microbiology of Food.   6
     1. TVC of food.
     2. Preparation of fermented products (Curd, Idli batter) and Isolation of Lactic cultures.
     3. Isolation of anaerobes

C]   Plant Pathology.   4
     1.   Enrichment of *Xanthomonas* spp.and its isolation.
     2   Spot test to detect the presence of plant pathogenic bacteria
        a) Detection of PHB granules – Nile blue staining, Sudan Black staining.
        b) Detection of EPS

References:–

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B. Sc. Part III (T.Y.B.Sc.) MICROBIOLOGY
To Be Implemented From Academic Year 2020 – 2021
SEMESTER-V
MB 58   Practical Course – VII

Total credits 02   **Total number of Experiments: 15**

Course Learning Outcomes:

On completion of Course Students are able to -

- **Review the Coliphages as possible indicators of fecal contamination**

- **Interpret the UV survival curve of *E-Coli***

- **Know the protocol for determining & analyze activity**

- **Understand the importance & concentration of niacin in food items**

1. UV survival curve.	2
2. Isolation of bacteriophage	2
3. Detection of iron in food stuff by α,α' dipyridyl method	2
4. Detection of niacin in food stuff.	1
5. Assessment of antibiotic like substances from culture filtrate	2
6. Amylase assay.	3
7. Effect of different parameters on amylase activity.	3

References:–

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2. Bradshaw L. Jack (1979) Laboratory Microbiology, Third Edition W.B. Saunders co Philadelphia, London, Toronto.

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B. Sc. Part III (T.Y.B.Sc.) MICROBIOLOGY
To Be Implemented From Academic Year 2020 – 2021
SEMESTER-V
MB 59-A Food and Dairy Microbiology

Total credits 04   **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to -

- **Understand the basic microbiology of foods. Processing & Importance of Microbes in food**

- **Get the beneficial activities of microbes in food & spoilage of food**

- **Acquire the skills of preservation of milk, milk products & food**

- **Have awareness of preservation & microbiology of fermented milk products**

Course Content

I.   Microbes in food.
      A.   Evolution of Food Microbiology   01
      B   Micro-organisms and food materials.   03
               i.   Principles that influence microbial growth, survival and death of microbes in food:-
               ii.   Intrinsic factors and substrate limitations: Nutrient content, pH & Antimicrobial barriers.
               iii. Environmental limitations: temperature & gaseous environment.
      C. Processing of food   10
               i.   Asepsis
               ii.   Heat Processing
                        a. Pasteurization, Appertization & Sterilization
               iii. High pressure processing
               iv.   Irradiation – traditional method, UV and Ionizing Radiations
               v.   Role of FDA
      D. Importance of Microbes in food   12
      1.   Food Borne Infections and Intoxications.
               i.   Gram negative bacteria – Salmonellosis
               ii.   Gram positive bacteria – Staphylococcal food poisoning

2. Beneficial Activities of Microbes in food:-
    i. Microbial metabolism of food components.
    ii. Fermented foods:
        a. General methods of production
        b. Starter cultures, enzymes
        c. Traditional fermented foods
        d. Microbiology of process
        e. Fermented food – Idli
        f. Fermented milk and milk products – Curd, Yoghurt
        g. Concepts of genetically modified foods

.   E. Spoilage of Food   08
    i. General Principles underlying spoilage
    ii. Important food spoilage bacteria
    iii. Sequence of events in spoilage
    iv. Factors governing spoilage of food.
        a. Number and type of microbial load.
        b. Type of food
        c. Succession.
        d. Storage conditions – Temperature & humidity.

F. Spoilage of food commodities:-
    i. Meat – Structure and composition, primary processing, spoilage of fresh meat.
    ii. Fish – Structure and composition, primary processing, spoilage of fresh fish.
    iii. Plant Products – Fruits and vegetables.
    iv. Canned foods.
    v. Fermented foods.

G. Preservation and storage   08
i. Low temperature storage, Chilling, Freezing.
ii Chemical Preservatives.
        a. Natural antimicrobials.
        b. Organic acids.
iii. Hurdle Technology.
iv. Aseptic packaging, modified atmosphere packaging, controlled atmosphere packaging.
v Detection of microbes in food.
vi Indicator micro-organisms and microbiological criteria.

II   Microbiology of milk   18

A. Microbiology of market milk

       i.   Market milk industry in India & abroad

      ii.   Indian standards of market milk

     iii.   Common microorganisms in market milk

     iv.   Detrimental effects of microbial growth in market milk

B. Microbiology of special milk

       i.   Sterilized milk – Method of manufacture

      ii.   Homogenized milk- Method of manufacture

     iii.   Soft curd milk - Method of manufacture

C. Cheese – Types & microbial spoilage

D. Microbiology of fermented milk products

       i.   Starter Lactic acid bacteria – Mesophilic & Thermophilic

      ii.   Secondary flora of fermented dairy products

     iii.   Bacteria, Moulds, Yeasts examples

     iv.   Acidification , texture development & flavor contribution by starter Lactic acid bacteria

      v.   Significance of secondary flora

References :

1   Adam M.R. and Moss M.O. (2003) Food Microbiology, 2[nd]edition, Panima Publishing Corporation, New Delhi.

2   Banwart G.J. (1987) Basic food Microbiology CBS Publishes, New Delhi.

3   Day. S. (1980) Outlines of Diary Technology, Oxford University Press, New Delhi.

4   Doyle M.P.,Beuchet Z.R.& Montville T.J. (1997) Food Microbiology Fundamental and Frontiers, ASM Press, Washington D.C.

5   Frasier W.C. and Westhoff D.C. (1996) Food Microbiology 4th edition, Tata Mac Graw Hill, New Delhi.

6   James Jay (1986), Modern food Microbiology – 3rd edition, CBS publishes, New Delhi

7   Ralph Early (1998), the Technology of Dairy Products. 2nd Edition Springer International.

B. Sc. Part III (T.Y.B.Sc.) MICROBIOLOGY
To Be Implemented From Academic Year 2020 – 2021
Semester V
MB-59B Applied Microbiology-I

Total credits 04   **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to -

- **Analyze the role of bio control agents & understand the bioremediation techniques**

- **Develop a broader perspective of the disciple of microbial diversity**

- **Have ability to acquire the art of publishing the new micro-Organisms & knowing microbial culture collection centers**

- **Have awareness of biomarkers, biosensors, nanotechnology & space microbiology**

Course Content

I   Biopesticides   06
- a. Historical Background.
- b. Bio-control agents – Bacteria, fungi and viruses
- c. Preparation and application of Biopesticides

II Bioremediation   08
- i. Nature of environmental contaminants
- ii. Bioremediation techniques
- iii. Microbes involved in bioremediation
- iv. Degradation of Xenobiotics.

III Environmental Genomics   07
- i. Discovery of Novel microorganisms and genes from extreme environments
- ii. Exploring & exploiting the uncultivable microbial diversity

IV Microbial Diversity   08
- i. Determination of microbial diversity
- ii. Potential applications in bioremediation
- iii. Bioremediation of radioactive waste from nuclear power reactor effluents – Present status & future perspectives

V   Microbial Culture Collection Centers   08
- i) Overview of global culture collection centers
- ii) Overview of National Culture Collection Centers

iii)   Introduction to MALDI-TOF & its significance

VI. Art of publishing the new microorganisms for its inclusion in Bergey's Manual   03

VII. Environment Impact Assessment   05
    i.   Environmental monitoring

VIII Space Microbiology   04
  i. Aims and objectives of Space research.
  ii. Studies on microorganisms in spacecraft, list of microorganisms tested
in outer space
  iii. Monitoring of astronauts microbial flora:
  iv. Alterations in the load of medically important microorganisms,
  v. Organizations associated in space research
IX   Nanotechnology   04
    Application of nanoparticles in molecular biology, industry agriculture and
environment
X. Biosensors   04
  Biosensors in food,
  ii. Environmental impacts and their assessments using bio indicators, biomarkers,
  iii. Biosensors and toxicity testing
  iv. Environmental laws and policies in India   03

References:
1. Lindsay G. Stevenson Rapid Identification of bacteria in positive blood culture broths by MALDI-TOF Mass Spectrometry 2010,Journal of Clinical Microbiology vol 48(2)(444-447)
2. Maheshwari D.K. &R.C.Dubey (2001), Innovative Approaches in Microbiology. Gajendra Singh Gahlot Dehra Dun, India.
3. RajendranP., P. Gunasekaran (2006), Microbial Bioremediation . MJP Publishers, Chennai.
4. Satyanarayana .T., B. N. Johri (2005), Microbial diversity Current Perspectives & Potential Applications . I.K. International Pvt. Ltd. Mumbai.
5. Understanding the biological diversity act 2002 - explanatory notes
http://nbaindia.org/content/565/56/1/explanatory note.html
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7. Microbiology And Molecular Biology Reviews, 2010, p. 121–156 Vol. 74, No. 1, American Society for Microbiology. 8 Gerda Horneck,1 David M. Klaus,2 and Rocco L. Mancinelli3 *Space Microbiology

B. Sc. Part III (T.Y.B.Sc.) MICROBIOLOGY
To Be Implemented From Academic Year 2020 – 2021
SEMESTER-V
MB 59-C Advanced Techniques in Microbiology-I

Total credits 04   **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to -

- **Present the knowledge of mapping of genes in bacteria, bacteriophages & certain eukaryotes**

- **Apply the tools in molecular biology for the diagnosis of diseases**

- **Adapt the skill of DNA sequencing**

- **Diagnose the Transmissible agents**

Course Content
I Mapping of Genes
    A. Mapping of Genes in Bacteria   10
        i. Mapping by Transformation
        ii. Cotransduction And Linkage
       iii. Mapping by Cotransduction
       iv. Interrupted mating and Time-Of –Entry Mapping
        v. Rate of chromosome transfer
       vi. Hfr mapping: Mapping of selected and "Unselected" markers
    B. Mapping of Genes in Bacteriophages.   06
      i. Fine structure Analysis of a Bacteriophage Gene – Benzer's spot test
      ii. Recombination Analysis of T_4 r ll mutants
     iii. Deletion mapping
     iv. Defining Genes by complementation Tests
    C. Mapping of Genes in *Streptomyces coelicolor* 06
      i. Life cycle of *Streptomyces coelicolor.*
      ii. Three fertility types of *Streptomyces coelicolor.*
     iii. Characters of different crosses
     iv. Different plasmids of *Streptomyces coelicolar.*
      v. Preliminary detection of linkage
     vi. 4 on 4 Test

D. Linkage and mapping in Eukaryotes (Haploid mapping)   10
      i. **Tetrad Analysis in *Neurosporacrassa.***
- a. Life cycle of *Neurosporacrassa.*
- b. Cross over events: single and double
- c. Arrangement of ascospores with respect to mating types
- d. Calculating Gene – centromere distance in organisms with linear Tetrads : Based on PD's, NPD's, and T's Strands
- e. Two, Three and Four strand double cross overs
- f. segregregation pattern revealed by tetrad analysis
- g. Using Tetrad Analysis to map Two Linked Genes

   ii. **Mitotic Recombination in *Aspergillus nidulans***
- a. Parasexual cycle
- b. Mechanism of mitotic crossing over.
- c. Mapping by Mitotic Recombination in *Aspergillus nidulans.*

II. Tools in molecular biology and diagnostic applications   10

  A. Molecular Techniques used for diagnosis of diseases
- i. Polymerase Chain Reaction
- ii. R.F.L.P. [Restriction Fragment Length. Polymorphism]
- iii. RAPD [Randomly Amplified Polymorphic DNA Technique.]
- iv. 16S-rRNA Gene sequencing
- v. Fluorescence *In Situ* (FISH) in diagnostic Microbiology

  B. Sequencing and mutagenesis   08
- i. Basic DNA sequencing
- ii. DNA sequencing techniques
- iii. Analyzing sequence data
- iv. Changing genes-site directed mutagenesis.

C. Microbial Infection Imaging, a novel diagnostic approach   04

D. Diagnosis of 'Transmissible Spongiform Encephalopathy Agents'   06

References

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3. David A. Jackson, Stephen P. Stitch, (1979). Recombinant DNA Debate

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**T.Y.B.A.; B.Sc.; B.Sc. Computer Science and Commerce
(CBCS 2018 COURSE) SEMESTER – V: Foundation Course
UGF 51: Soft Skills**

Credits: 02   **Lectures : 30**

Course Learning Outcomes:

After completion of this course students should be able to:

Course Content:

Soft Skills: Meaning and definition; Employability skills, Life skills, Corporate skills.

1. Developing positive attitude: Ethics, Values, Manners & Etiquettes
2. SWOT analysis   and Career Planning: Strengths, Weaknesses, Opportunities and Threats
3. Communication: Concept of communication; Written as well as Spoken; body language
4. Curriculum Vitae, Resume, Bio-Data: Types of personal and educational information, preparing CV according to the job requirements
5. terview Techniques: Types of interviews, Personal appearance, basic research, Confidence, knowledge preparation, interview style
6. Time Management: Competency-building skills; identifying use of time, management of on-time task, identifying reasons for poor time management, and taking corrective action; overall time-planning; and learning where to go for information or guidance
7. Stress Management: coping with stress and anger; recognizing/understanding others' point of view; problem solving; peer negotiation and resistance; conflict management; active listening and effective communication; acceptance and/or tolerance of diversity groups; and telephone skills
8. Teamwork and Leadership: Group discussion, effective communication skills, Group behaviour, helping nature
9. Developing work culture: sincerity, negotiation techniques, summarizing information; summarizing information about specific points; organizing studies

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Reference
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2. Carnegie Dale, *How to win Friends and Influence People*, New York: Simon & Schuster, 1998.
3. Daniel Coleman, *Emotional Intelligence*, Bantam Book, 2006
4. Fredrick H. Wentz, *Soft skills Training – A workbook to develop skills for employment*
5. Barun K. Mitra *Personality Development and Soft skills*, Oxford University Press