T.Y.B.Sc. PHYSICS (CBCS-2018)
SEM.- VI
P-61: CLASSICAL ELECTRODYNAMICS

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 know the concepts of classical electromagnetism and demonstrate aproficiency in the fundamental concepts in this area of Physics
- Students will have strong physical reasoning and problem solving skills and applythese skills to the solution of theoretical and applied problems
- Student will be able to use classical electrodynamics to understand modern science
- Ability to formulate and solve electrodynamics problems
- Student will acquaint with the technique of deriving and evaluating formulae for the electromagnetic fields from very general charge and current distributions

Course Content:

1. Electrostatics: (24)

Electrostatic field in vacuum, principles of superposition, electrostatic potential, potential produced by continuous charge distribution

Gauss Law the average potential over a spherical surface in a charge free region, fields produced by some simple charge distribution such as (1) spherical surface (2) infinite sheet of charge on conducting plate and (3) electric dipole.

Poisson's and Laplace's equations, boundary conditions on potentials and field, solution of boundary value problem in Cartesian and spherical coordinate system. Method of images: a point charge near a conducting grounded infinite plane, a point charge near a grounded conducting sphere and insulated charged sphere

Concept of displacement vector, polarization vector, electric field vector at exterior and interior points of dielectric medium, concepts of true and induced charge density, electric susceptibility and dielectric constant

Boundary conditions at the interface of two dielectric media, Boundary value problems in dielectrics. Calculations of electrostatic field involving dielectric e.g. parallel plate capacitor and sphere.

2. Magnetostatics: (22)

Lorentz force on a point charge moving in magnetic field, Biot-Savart law, magnetic induction B due to a current in long straight wire and a circular loop, magnetic induction between two long current carrying wires and Helmholtz's coil. Axial magnetic field of a solenoid. Magnetic force between two current carrying loops, Ampere circuital theorem, long cylindrical current carrying wire and coaxial cable

Magnetic vector potential A, magnetic energy in terms of B, J, A, V and magnetization vector M, calculation of magnetic field at a point inside and outside the sphere placed in magnetic field.

3. Electrodynamics: (14)

Faraday's laws of induction in integral and differential form, modified amperes circuital law, Maxwell's equations in differential and integral form

Wave equations in free space, solution of wave equation for plane wave in free space. Poynting vector in free space, electromagnetic energy, Reflection and refraction of plane wave form nonconducting boundaries (normal incidence only)

Reference Books:

1. Foundation of electromagnetic theory - by Reitz and Milford.
2. Introduction to electrodynamics - by D. J. Griffiths.
3. Electrodynamics - by Gupta, Singh and Kumar.
5. Electrodynamics - by B. B. Laud.
4. Electrodynamics - by Chopra, Agrawal.
6. Feynman lectures series No. II - by B. J. Publication
7. Classical Electrodynamics – by J. D. Jackson.

T.Y.B.Sc. PHYSICS (CBCS-2018)
SEM.- VI
P-62: ATOMIC & MOLECULAR 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,

- Students will understand the comparing between atomic emission spectroscopy and atomic absorptionspectroscopy
- Concept of Raman Spectroscopy
- Concept of X-ray Spectroscopy
- Student will be able to apply approximation techniques involved in the calculations concerning energy level corrections
- Understand the autoionization process
- Understand the nature of the various internal molecular degrees of freedom

Course Content:

1. **Atomic structure:** **(12)**
   Rutherford model of atom, Electron orbits, Bohr atom, Energy levels and spectra (1 to 4 evision), Vector atom model (Concepts of space and quantization and electron spin), Atomic excitation and atomic spectra, Problems Ref 1 ch4
2. **One and two valence electron systems** (12**)**
   Pauli Exclusion principle and electron configuration, quantum states, Spectral notations of quantum states, Spin-Orbit Interaction (Single valence electron atom), Energy levels of Na atom, selection rules, spectra of sodium atom, sodium Doublet.
3. **Two valence electron systems** (1**0)**
   Spectral terms of two electron atoms, terms for equivalent electrons, LS and JJ coupling schemes, Singlet Triplet separation for interaction energy of LS coupling. Lande'sInterval rule, spectra of Helium atom, Problems Ref 1 ch7 Ref. 2 ch8 and ch12
4. **X ray spectroscopy** **(08)**
   Nature of Xrays, Discrete and continuous Xray spectra, Daune and Hunt's Rule, X-ray emission spectra, Mosley's law and its applications, Auger effect, Problems Ref 2 ch16
5. **Molecular spectroscopy** (**08)**
   Rotational energy levels, Vibration energy levels, Rotational and Vibrational spectra, Electronic spectra of molecules Problems Ref 1 ch8
6. **Raman spectroscopy** **(10)**
   Classical theory of Raman Effect, Molecular polarizability, Quantum theory of Raman Effect Experimental set up for Raman Effect, Applications of Raman spectroscopy Ref 3 ch4

Reference Books

1. Concepts of Modern Physics 4th edition Arthur Baiser (McGraw Hill International edition)
2. Introduction to Atomic spectra White.H.E (McGraw Hill International edition)
3. Fundamentals of Molecular spectroscopy, C.N.Banwell and E.M McCash (McGraw Hill International edition)
4. Modern Physics, J.B.Rajam

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

SEM.- VI

P- 63: NUCLEAR 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,

- Student will be able to understand the basic properties of nuclei and the atomic nucleus
- Describe the radioactivity and related phenomena
- Explain the various interactions of nuclear radiation with matter
- Understand the fission and fusion reactions and their applications
- Understand nuclear interactions and elementary particles involved in the interactions
- Student will also attain practical skills to evaluate specific nuclear physics parameters
- Student will gain basic knowledge about nuclear physics concepts as well as about different possibilities of nuclear physics applications in technology and medicine.

Course Content:

1. **Understanding of Nucleus** **(14)**
   Composition, charge, size, density of nucleus, Nuclear Angular momentum,Nuclear magnetic dipole moment, Electric quadrupole moment, parity andsymmetry, Mass defect and Binding energy, packing fraction, classification of nuclei, stability of nuclei (N Vs Z Curve) and problems.
2. **Radioactivity:** **(14)**
   Radioactivity disintegration, concept of natural and artificial radioactivity, Properties of α, β, γ rays, laws of radioactive decay, half-life, mean life, specific activity and its units, successive disintegration and equilibriumsand radioisotopes)., applications of radioactivity (mechanical, biological etc.) Problems Ref 1 ch (8), Ref 2 – ch (15) Problems Ref 4 ch (27, 29)
3. **Nuclear reactions:** **(10)**
   Theories of nuclear reactions based on nuclear models, conservation laws, Q-value equation, exoergic and endoergic reactions, threshold energy in endoergic reactions,
4. **Nuclear energy:** **(10)**
   Nuclear fission, nuclear fusion, energy available from fission, controlled chain reactions, nuclear reactors (heterogeneous, swimming pool, breeder reactors)
5. **Particle Accelerator and Detectors** **(12)**
   Introduction to particle Accelerators, Linear (electron/proton Linac)Cyclic (Cyclotron), Classification of Nuclear Detector, Gas filled Detectors (G. M. counter), Solid state detectors (NaI(Tl)scintillation counter) Problems Ref 1ch(7,12)

Reference books

1. Introduction to Nuclear PhysicsH.A.Enge (Addition Wesley co.)
2 The Atomic NucleusR.D.Evans (Tata McGraw Hill co.)
3 Concepts of Nuclear Physics – B.L.Cohen (Tata McGraw Hill co.)
4 Schaum's Outline Series Modern PhysicsR.Gautrearu (McGraw Hill co.)
5 Introduction to Nuclear Physics, S. B. Patel
6 Atomic and Nuclear PhysicsShatendra Sharma (Pearson Education,1st Edition)
7 Nuclear PhysicsKaplan (Narosa Publishing House)
8 Introductions to Nuclear PhysicsY.R. Waghmare (Oxford IBH.)

T.Y.B.Sc. PHYSICS (CBCS-2018)
SEM.- VI
P-64: COMPUTATIONAL 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,

- Student will gain the basic knowledge of numerical methods
- Understand the basic programming skills
- Understanding of the applicability of numerical methods for modeling physical systems and its advantages and disadvantages
- Demonstrate skills to use numerical methods for modeling physical systems
- Demonstrate the ability to estimate the errors in the use of numerical methods
- Demonstrate skills to write and develop simple programs in MATLAB

Course Content:

1. **Introduction:** **(14)**
   Introduction to computer, block diagram of computer, introduction to algorithm and flow chart Programming languages (1) lower level languages (machine and assembly language), higher level languages (need and utility against lower level languages, various higher level languages and their applications), History of 'C' language, introduction to C programming language
2. **C fundamentals:** **(12)**
   Structure of 'C' program, C character set, identifies and keywords, data types, constants and variables, array declaration, expressions statements, symbolic operators, Types of operators, library functions.
3. **Data input and output:** **(04)**
   Single character input/output functions - print( ), scan( ), getchar( ), single character function, putchar ( ), get(n), gets( ), puts( )
4. **Control statements:** **(10)**
   The WHILE statement, DO-WHILE statement, FOR statement, nested loop, IF-ELSE statement, BREAK statement, CONTINUE statement, SWITCH statement, GOTO statement, 'C' programming based on control statements
5. **Array and pointers:** **(10)**
   Defining an array, declaring an array, 1D and 2D, processing an array, passing an array to function, multidimensional array, string (character array), fundamentals of pointers, pointer declaration, passing a pointer to a function
6. **Functions and program structure:** **(04)**
   Definition of function, accessing a function, passing an argument to a function, functions prototypes, recursion, storage classes
7. **Computer graphics:** **(02)**
   Introduction to graphics, some simple graphic commands
8. **Computational Physics:** **(04)**
   To find the roots of an algebraic equation, Bisection method, errors in computation, Iterative methods: Discussion of algorithms and flow charts, Writing 'C' programs.

Reference books

1. The C programming language - by B. W. Kerningham and D. M. Ritchie.
2. Programming with C - by Schaum's outline series.
3. Introduction to methods of numerical analysis - by S. S. Shastry.
4. Let us C - by Y. Kanetkar.
5. Computer orientation numerical methods:- V. Rajaraman

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

SEM.- VI

P-65: THERMODYNAMICS & STATISTICAL 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,

- Student will have thorough knowledge on different classical and quantum mechanical distribution functions
- Can explain the procedures for deriving the relation between thermodynamic parameters such as pressure, temperature, entropy and heat capacity from the distribution functions.
- Can explain phase transitions and magnetization in magnetic systems
- Can analyze phase diagrams, phase transitions and explain the different concepts in statistical Physics
- Can apply the methods of statistical physics in other fields of physics and related fields.

Course Content:

1. **Kinetic Theory of Gases** **(12)**
   Introduction, Fundamental assumptions of Kinetic theory of gases, kinetic interpretation of temperature, Mean free path, Transport phenomenon, Viscosity, Thermal conductivity and diffusion, Problems
2. **Maxwell's thermodynamic relations:** **(12)**
   Basic ideas of thermodynamic functions- internal energy, enthalpy, helmholtz free energy fuction, Gibb's potential energy fuction, Maxwell's relations, applications of Maxwell's relations- first, second and third Tdsequations,Energy equations, difference in heat capacity foe ideal gas and real gas, ratio of heat capacities, variation of Cp with volume and variation of Cv with pressure, Problems
3. **Joule-Thomson effect:** **(12)**
   Joule- Thmoson effect and its applications- Production of low temperature, Porousplug experiment, observations and theory for J-T expansion (cooling effect) for ideal gas, expression of inversion temperature real gas, Liquefaction of gases- principle of regenerative cooling, air liquifier, liquification of Helium, strides toward the asolute Zero-adiabatic demagnetization, experimental set up and thermodynamics of the process, Problems
4. **Elementary Concepts of Statistics:** **(10)**
   Probability, distribution functions, Random Walk and Binomial distribution, Simple random walk problem, Calculation of mean values, Probability distribution for large-scale N, Gaussian probability distributions,
5. **Statistical Distribution of System of Particles:** **(08)**
   Specification of state of system, Statistical ensembles, Basic Postulates, Probability calculations, Behaviors of density of states, Thermal, Mechanical and general interactions
6. **Statistical Ensembles:** **(08)**
   Micro canonical Ensemble (Isolated System), Canonical ensembles, simple application of Canonical ensemble, Molecules in Ideal gas, Calculation of mean values in canonical ensemble

Reference books

1. Heat and thermodynamics - by Zeemansky.
2. Heat and thermodynamics - by Brijlal and Subramaniam
3. A text book of heat and thermodynamics - by Shah and Shrivastav.
4. Fundamental of statistical physics and thermal physics - by Reif.
5. Statistical physics - by Laud.
6. Theory and experiment on Thermal physics; P. K. Chakrabarti, New Central Book Agency (P) Ltd.
7. Statistical and Thermal physics, By Lokanathan, R.S. Gambhir,
8. Perspectives of modern physics, - By A. Beiser
9. A primer of Statistical Mechanics, - By R.B. Singh
10. Statistical Mechanics, - By Gupta, Kumar

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

SEM.- VI

P-66: PRACTICAL COURSE – VIII

Total Credits: 02

Course Learning Outcomes:

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

1. Understanding of working of microphone/speaker
2. Study of measurement of unknown frequency of typical tuning fork
3. Determination of wavelength of LASER by grating and cylindrical obstacle method
4. Concept of double refraction using Prism
5. To measure the refractive index of glass and liquid
6. Understanding of concepts of cardinal points and focal length in optics

Course Content:

1. Determination of velocity of sound in liquid by ultrasonic interferometer.
2. Determination of unknown frequency of tuning fork/AC
3. Characteristics of microphone/loudspeaker
4. Frequency response of loudspeaker (twitter, woofer, mid-range)
5. Determination of wavelength of He-Ne laser by using grating.
6. Study of double refraction phenomenon of prism.
7. Determination of wavelength of He-Ne laser by cylindrical obstacle.
8. Study of the characteristics of a laser beam.
9. R.I. of glass and liquid by total internal reflection.
10. Determination of unknown wavelength of a given source using Lloyd's single mirror.
11. To determine the resolving power of granting.
12. To estimate the temperature of sodium flame.
13. Determination of cardinal points of given lens by Searle's Goniometer.
14. Determination of various focal lengths of zone plate and wavelength of light used.
15. Determination of refractive index of liquid using hollow prism.
16. Study of interference by Quinck’s method

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

T.Y.B.Sc. PHYSICS (CBCS-2018)
SEM.- VI
P-67: PRACTICAL COURSE – IX

Total Credits: 02

Course Learning Outcomes:

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

1. Understanding of X-ray diffraction technique
2. Understanding of Enstein's photo-electric relation using photocell.
3. Basics of C-programming for calculation of prime numbers, matrix addition and multiplication, numbers, graphics etc.
4. Study of Nano-particles

Course Content:

1. Study of XRD spectra of any matter
2. Study of optical absorption of nanoparticles.
3. Write a program to find out the first 100 prime numbers
4. Write a program to find Matrix multiplication / addition
5. Verification of Einstein's photo-electric relation using photocell (Determination of h)
6. Position time data using kinematic equations
7. To Find the pressure using Vander Waals' equation of state
8. Write a program to find maximum/minimum number in a set of given numbers.
9. Write a program to sort an array in ascending/descending order
10. Write a program to find the sum of digits.
11. Write a program to find Decimal to binary conversion.
12. Write a program to display the string in reverse order.
13. Write a program to find out whether given number is prime number or not.
14. Write a program for Graphics (line, circle, arc, ellipse, bar, draw poly)
15. **COMPUTER INTERFACED PHYSICS EXPERIMENTS/INSTRUMENTATION**
    1. Charging and discharging of capacitor and RC time constant
    2. Measurement of g using simple pendulum
    3. Velocity of sound
    4. Radiation detection
    5. IV Characteristics of diode
    6. Temperature controller using AD590
    7. Study of IC 7490 as mod 2, mod 5, mod 7 and mod 10 counter

Additional Activities (Any One)

1. One educational tour with report equivalent to two experiments
2. Demonstrations: any two demonstrations equivalent to two experiments
3. Mini project equivalent to two experiments
4. Use of plagiarism software to find plagiarism in research work.

Note: Students have to perform at least one additional activity in addition to eight experiments.

T.Y.B.Sc. PHYSICS (CBCS-2018)
SEM.- VI
P-68: PRACTICAL COURSE – X
(PROJECT WORK)

Total Credits : 02

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

SEM.- VI

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

P-69A: Elective II (A) Renewable Energy Sources

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

Course Learning Outcomes:

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

- Describe the environmental aspects of non-conventional energy resources
- Understanding the need of renewable energy resources, historical and latest developments
- Describe the use of solar energy and the various components used in the energy production
- Understanding the need of wind energy and the various components used in energy generation
- Acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.

Course Content:

1. **An Introduction to Energy Sources:** **(14)**
   Conventional and non-conventional sources of energy, Structure and characteristics of sun, Solar Constant, Electromagnetic energy spectrum, Solar radiations outside earth atmosphere, Solar radiation at the earth surface, problems.
2. **Photothermal Applications:** **(14)**
   Liquid flat plate collector, construction and working, Energy balance equation (without thermal analysis) , Concentrating collectors, Advantage and disadvantage, Solar distillation, Solar drying, Solar cooker(box type), Solar water heating systems.
3. **Photovoltaic systems:** **(12)**
   Introduction , Photovoltaic principle, Power output and conversion efficiency, Limitation to photovoltaic efficiency, Basic photovoltaic system for power Generation, Advantages and disadvantages, Types of solar cells, Application of solar photovoltaic systems.
4. **Energy from Biomass:** **(10)**
   Introduction , Bio -mass conversion technologies , Bio-gas generation Factors affecting bio-digestion (list of factors) , Methods for obtaining energy from biomass, Thermal gasification of biomass , Working of downdraft gasifier , Advantages and disadvantages of biological conversion of solar energy
5. **Wind Energy** **(06)**
   Introduction, Classification and description of wind machines, Wind data
6. **Photocatalysis:** **(04)**
   Introduction, Concept of Photocatalysis, Photocatalysis materials its advantages.

Reference Books:

1. Non-conventional Energy sources, G. D. RAI (4th edition), Khanna Publishers, Delhi.
2. Solar Energy, S.P. Sukhatme (second edition), Tata Mc.Graw Hill Ltd, New Delhi.
3. Solar Energy Utilisation**,** G. D. RAI (5th edition), Khanna Publishers,Delhi.

List of Experiments:

1. Fuel value of wood/charcoal.
2. Study of sensible heat storage using liquid.
3. Selective and Non-selective coatings – Determination of Selectivity ratio.
4. Thermal efficiency of liquid – flat plate collector.
5. Study of box type solar cooker.
6. Determination of instantaneous thermal efficiency of parabolic collector.
7. Efficiency and fill factor of solar cells.

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

SEM.- VI

P-69B: Elective II (B) Physics of Nanomaterials

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 be able to explain the effects of quantum confinement on the electronic structure andcorresponding physical and chemical properties of materials at nanoscale.
- Choose appropriate synthesis technique to synthesize quantum nanostructures of desiredsize, shape and surface properties.
- Ability to correlate properties of nanostructures with their size, shape and surfacecharacteristics.
- Will be able to appreciate enhanced sensitivity of nanomaterial based sensors and their novel applications in industry.
- Student will gain understanding of different characterization techniques

Course Content:

1. **Introduction to nanomaterials:** **(14)**
   Introduction to nano-sized materials and structures, Brief history of nanomaterials and challenges in nanotechnology, Significance of nano-size and properties, classification of nanostructured materials
2. **Methods of synthesis of nanomaterials:** **(14)**
   Bottom-up and Top-down approaches, Physical methods: High energy ball milling, Physical vapour deposition, Ionized cluster beam deposition, sputter deposition, Ultrasonic spray pyrolysis etc. Chemical methods: colloidal method, co-precipitation and sol-gel method Hybrid method: Electrochemical and chemical vapour deposition.
3. **Characterization techniques:** **(12)**
   UV- visible spectroscopy, X-ray diffraction, Scanning electron microscopy, Transmission electron microscopy
4. **Properties of nanomaterials:** **(08)**
   Mechanical, Electrical, Thermal, Optical, solubility, melting point and Magnetic properties
5. **Special nanomaterials:** **(06)**
   Carbon nanotubes, quantum dots, NanocrystallineZnO and TiO2
6. **Applications:** **(06)**
   Nanoelectronics, Medical, Biological, Automobiles, Space, Defense, Sports, Cosmetics, Cloth industry etc

Reference Books:

1. Nanotechnology: Principles and Practices: Sulbha Kulkarni, Capital Publishing Co. New Delhi.
2. Introduction to nanotechnology, by C. P. Poole Jr. and F. J. Ownes, Willey Publications.
3. Origin and development of nanotechnology: P.K.Sharma, Vista International publish house.
4. Nanostructure and nanomaterials synthesis, Properties and applications, by G. Cao, Imperials College Press, London.

List of experiments:

1. Synthesis of metallic nanoparticles by wet chemical method.
2. Study of optical absorption of nanoparticles.
3. Determination of nanoparticles size from X-ray diffraction spectra.
4. Synthesis of silver nanoparticles from silver nitrate by reduction using surfactant

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

SEM.- VI

P-69C: Elective II (C): Digital Electronics II

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 be able to distinguish between analog and digital systems
- Understand the various registers used in the circuits and their operation
- Understanding of how memory devices works
- Knowledge of analog to digital conversion concepts and mechanism

Course Content:

1. **Memory devices and memory Organization (16)**
   Types of Memory – volatile and nonvolatile, SRAM and DRAM, Classification and Working principle of memory devices; RAM,ROM, PROM, EPROM, and EEPROM, UVEPROM, Flash RAM; Concept of Diode Matrix ROM, speed and cost range of memory devices, Memory organization - building the required memory size by using available memory chips, memory address map
2. **Registers (08)**
   Buffer, left shift, right shift, SISO, SIPO, PISO, PIPO Registers Study of IC 74194, 74195, 74198
3. **Information in digital form (08)**
   bit, nibble, byte, word concepts, problems in communication of digital data, codes –Straight binary code, Natural BCD code, Excess-3 ,gray, alphanumeric code, Error detection and correction code
4. **Encoders (08)**
   Construction, working and application, Decoders construction, working and application, Study of encoder & decoder IC
5. **Need and advantages of Digital system (20)**
   Need of analog to digital, digital to analog converters, Parameters for converter, DAC-weighted Resistor and its limitations, R-2R ladder, specification of D/A converter. Calibration of DAC circuit .Study of DAC IC ADC-principle of conversion, sampling theorem, quantization and encoding, parallel comparator A/D , Successive-approximation A/D, Counting A/D, Dual slop, Specifications of A/D converter, calibration, Study of A/D ICs ,

Reference Books

1) Digital Electronics by R.P.Jain
2) Basic Electronics by B.L.Theraja
3) Electronic Principles by Malvino
4) Computer architecture and organization by Rifiqzaman and Chandra
5) The Intel Microprocessor by Barry.B.Brey

List of Experiments:

i) Study of diode matrix ROM
ii) Study of Analog to Digital Convertor
ii) Study of Encoder
iv) Study of IC 7495 as Shift Register.
v) Study of R-2R Digital to Analog Convertor

T.Y.B.Sc. (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - VI
C - 61 : PHYSICAL CHEMISTRY-II

Credits: 04 **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1.Study the rotational, vibrational, electronic and Raman spectra.

2.Write various nuclear reactions and kinetics of each reaction.

3.Analyse the crystal system.

Course Content:

1. Physical Properties and Molecular Structure. (14 Lectures)

Optical activity, polarization – (Clausius – Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment – temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties – paramagnetism, diamagnetism and ferromagnetism.

2. Molecular Spectroscopy (18 Lectures)

Introduction: electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

Rotational Spectrum

Diatomic molecules, energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Vibrational Spectrum

Infrared spectrum : energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of an harmonic motion and isotope on the spectrum, idea of vibrational frequencies of difference functional groups.

Raman Spectrum:

Concept of polarizability, pure rotational and pure vibrational Raman Spectra of diatomic molecules, selection rules.

[Ref, 1: Pages 691-710, Ref, 2: 398-424]

3. Solid State Chemistry (14 Lectures)

Introduction, space lattice, lattice planes, unit cells.

Laws of crystallography: (i) Law of constancy of interfacial angles(ii) Law of rational indices. (iii) Law of crystal symmetry.

Weiss indices and Miller indices.

Cubic lattice and types of cubic lattice, planes or faces of a simple cubic system, spacings of lattice planes.

Diffration of X-rays, derivation of Bragg's equation.

Determination of crystal structure of NaCl and KCl on the basis of Bragg's equation.

[Ref, 1: Pages 67-85]

4. Nuclear Structure and Radioactivity (14 Lectures)

The atom, its nucleus and outer sphere, classification of nuclides, nuclear stability, binding energy, discovery of radioactivity, types of radioactivity, general characteristics of radioactive decay, decay kinetics.

Measurement of radioactivity, gaseous ion collection method, proportional counter, G.M.counter.

Radiochemical principles in the use of tracers, typical applications of radio isotopes as tracers : (a) Chemical investigation (b) Reaction mechanism (c) Structure determination (d) Age determination.

[Ref, 4: Pages 4-15, 117-119, 121-125, 371-378]

Reference Books:

1. Principles of Physical Chemistry by S.H.Marron and C.FPrutton. 4thedition.Oxford and IBH Publishing Co. Pvt Ltd.
2. Elements of Physical Chemistry by S.Glasstone and D.Lewis. 2ndedition.McMillan Education.
3. Physical Chemistry by N. Kundu and S.K. Jain, S. Chand and Co. Ltd. 1987.
4. Essentials of Nuclear Chemistry by Prof. H.J. Arnikar, Willey Eastern Ltd.
5. University General Chemistry, C.N.R. Rao, MacMillan.
6. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
7. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
8. Physical Chemistry Through problems, S.KDogra and S. Dogra, Walley Eastern Ltd.

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T.Y.B.Sc (CHEMISTRY) (CBCS-2018)
SEMESTER - VI
C - 62 : INORGANIC CHEMISTRY –II

Credits: 04 **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Get the knowledge of MOT.

2. Know the electronic of metals and semiconductors.

3. Understand the role catalyst in various chemical reactions.

4. Study the chemistry at Lanthanides and Actinides.

5. Analyze the effect of toxic chemicals and biochemical reactions.

Course Content:

1. Molecular Orbital Theory: (15 Lectures)

L. C. A. O. method (Approach), Combination of s-s, s-p, p-p, p-d and d-d orbitals, Nonbonding atomic orbitals, combination of orbitals, Rules for linear combination of atomic orbitals, Qualitative M.O. energy level diagrams for homonuclear diatomic molecules of first row and second row elements, M.O.energy diagrams for three centre - two electron (3c - 2e) bond, M.O. energy diagrams for heteronuclear diatomic molecules like NO, CO and HCl, M. O. energy level diagrams for CO2, Comparison of V. B. and M. O. bond approach.

Ref. 2: Pages 89-112, 106-117
Ref. 4: Pages 55-72

2. Molecular Orbital Theory (MOT) of Coordination complexes (10 Lectures)

Introduction, M.O. treatment of Bonding in Octahedral complexes without pi bonding , Metal orbitals and Symmetry symbols, M.O. energy level diagram of complexes without pi bonding,Octahedral complexes with pi bonding, Ligand field theory, charge transfer spectra, Merits and Limitations of M.O.T. comparison of VBT, CFT & M.O.T.

Ref. 2: Pages 194 -236
Ref. 8: Relevant Pages
Ref. 9: Relevant Pages

3. Metals and Semiconductors (12 Lectures)

Introduction, metallic properties, Nature and theories of bonding in metals, Band theory of metals with respect to Na, Electronic energy bands, n(E) and N(E) curves,. Electronic conductivity of metals(monovalent, bivalent, trivalent), semiconductors and their types, effect of temperature and impurity on semiconductivity n-type and p-type semiconductors, semiconductivity in ZnO and NiO, Applications of semiconductors.

Ref. 7: Pages 209-221
Ref. 6: Related Pages
Ref. 13: Pages 73-85

4. Homogeneous Catalysis **(10 Lectures)**

Introduction definition, types of homogeneous catalysts, properties of homogeneous catalysts, Catalytic Reactions such as:

a. Wilkinson's Catalysis
b. Zeigler Natta Catalysis
c. Monsanto acetic acid synthesis

Ref. 3: 588-591
Ref. 6: Related Pages
Ref. 12: Pages 650-652 and 656-661

5. Chemistry of f block elements **(08 Lectures)**

A) The Lanthanides:
Introduction, Position of Lanthanides in the periodic table, Electronic configuration, oxidation states, Lanthanide contraction & its effect, Occurrence & separation of Lanthanides by ion exchange method & solvent extraction method, Applications of Lanthanides, Misch metal.

B) The Actinides:
Introduction, Position of Actinides in periodic table, Electronic configuration, oxidation states, General methods of preparation of transuranic elements. Nuclear fuels, Gas mantle.

Ref. 2: Pages 859-863, 865-866, 874 – 875, 879-886, 891-893, 898-900
Ref.13: Pages, 632-642, 645-662

6 Chemical Toxicology: **(05 Lectures)**

Introduction, Toxic chemicals in environment, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium,lead and mercury, Biological methylation
Ref.14: pages 158-167

Reference Books:

1. Introduction to Electrochemistry by Glasstone - 2nd edition.
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, Wiely 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. Principles of Bioinorganic Chemistry by S. J. Lippard and J. M. Berg, Panima Publishing Corporation, 1stEdn.
12. Inorganic Chemistry by J.E. Huheey, 4thEdn, Pearson Education.
13. Modern aspects of Inorganic Chemistry by H.J. Emeleus, A.G. Sharpe,4 th Edn, 6th Indian reprint.

T.Y.B.Sc (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - VI
C - 63 : ORGANIC CHEMISTRY-II

Credits: 04 **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Learn addition of carbanions to Carbonyl (C = O) group**.**

2. Study UV, IR & NMR spectroscopy.

3. Determine structure of compound by spectroscopic methods.

Course Content:

1. Addition of Carbanions to Carbonyl (C = O) group. (12 Lectures)

(a) Carbanion formation and stabilisation.
(b) Carbanion reactions: -
(i) Aldol Condensation.
(ii) Henery reaction.
(iii) Perkin's reaction.
(iv) Claisen – ester Condensation.
(v) Dieckmann Condensation
(vi) Wittig reaction.

Ref.4 Sections: - 8.4.1, 8.4.4, 8.4.5, 8.4.6, 8.4.8, 8.4.11, 10.1 & 10.2 Pages: 219-231, 233, 234, 271–275

2. Introduction to Spectroscopy. (06 Lectures)

(a) Meaning of spectroscopy, Nature of electromagnetic radiation, wavelength, amplitude, wave number and their relationship, frequency, different regions of electromagnetic spectrum.
(b) Interaction of radiation with matter, excitation of molecules with different energy levels such as rotational, vibrational and electronic level.
(c) Types of spectroscopy and advantages of spectroscopic methods.
Ref.6: - Sections: - 1.2, 1.3, 1.6, 1.7, 1.8, & 1.10
Pages: - 1 to 3, 7 to 11

3. Ultraviolet (UV) Spectroscopy. (10 Lectures)

(a) Introduction: - Nature of UV spectrum, Beer's law, absorption of UV, radiations by organic molecules leading to different excitations.
(b) Terms used in UV spectroscopy: - Chromophore, Auxochrome, Bathochromic Shift, Hypsochromic Shift, Hyperchromic and Hypochromic shifts.
(c) Effect of Conjugation on a position of UV band.
(d) Calculation of λ_{max} by Woodward and Fisher rule for dienes and enone systems.
(e) Applications of UV Spectroscopy: -
(i) Determination of structure.
(ii) Determination of stereo chemistry (Cis & trans).
Ref. 6: - Section:- 2.1, 2.3, 2.7 to 2.15 ; Pages: - 13 to 15, 18 to 38

4. Infrared (IR) spectroscopy (12 Lectures)

(a) Introduction: - Principles of IR, spectroscopy, fundamental modes of vibrations, types of vibrations.
(b) Conditions for absorption of IR radiations, vibration of diatomic molecules.
(c) Parts of I.R. Spectrum.
(d) Characteristics of IR absorption of following functional groups such as alkanes, alkenes, alkynes, alcohols, halides, carbonyl compounds, amines, amides, aromatic compounds etc.
(e) Effect of following factors on IR absorption: - Inductive effects, resonance effects & hydrogen bonding.
(f) Applications of I.R. Spectroscopy: -
  (i) Determination of structure.
  (ii) Study of chemical reactions.
  (iii) Hydrogen bonding.
  Ref.6: Sections – 3.1, 3.4, 3.7., 3.8.
  Pages: 46-51, 53, 54, 72 to 81, 86; Ref. 8 Pages : 1095 to 1103

5. Nuclear Magnetic Resonance (NMR) Spectroscopy. (14 Lectures)

(a) Introduction: - Principles of PMR spectroscopy, magnetic & non magnetic nuclei, precessional motion of nuclei without mathematical details, nuclear resonance, chemical shift, molecular structure, shielding & deshielding.
(b) Measurement of chemical shift.
(c) TMS as reference & its advantages.
(d) Spin – spin splitting and coupling constants.
(e) Areas of signals.
(f) Applications of PMR spectroscopy.
Ref. 6 Sections: 4.1 to 4.4 & 4.9
Pages: 95 to 98, 106 to 108
Ref. 8 Pages: 1065 to 1083

6. Spectral problems based on UV, IR & NMR (06 Lectures)

Spectral problems based on UV, I.R., NMR data and relevant problems from Ref. 1 & 8

Note:

(i) Spectral data such as λ_{max} value, IR frequency, chemical shift and coupling constant should be provided to the students.
(ii) Actual UV, IR, NMR spectra of some molecules should be shown to the students.

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.

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T.Y.B.Sc (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - VI
C - 64 : ANALYTICAL CHEMISTRY-II

Credits: 04 **Lectures : 60**

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

1.Study the principle, construction and working of GC.

2. Know the extended applications of chromatography.

3. Understand the theory of solvent extraction.

4..Solve the numerical on chromatography.

Course Content:

1. Solvent Extraction (12 Lectures)

Introduction, Principle of solvent extraction, Distribution coefficient, distribution ratio, Relation between Distribution coefficient and distribution ratio, factors affecting solvent extraction, percentage extracted, solvent extraction method, separation factor, batch extraction, counter current extraction, application of solvent extraction, numerical problems.

References: 3,4,7 relevant pages

2. Chromatography (12 Lectures)

Introduction and classification of chromatographic methods, Principle of chromatographic analysis with match box model, Theoretical plates and column efficiency, Theory, Principle, technique and applications of-Column Chromatography, Thin layer Chromatography, Paper Chromatography, Numerical Problems

Ref. 6,7,8 Relevant pages

3. Gas Chromatography **(12 Lectures)**

Introduction, Theory, Principle, GSC and GLC, Separation mechanism involved in GSC and GLC, Instrumentation of Gas chromatography, Working of gas chromatography, Gas chromatogram and qualitative-quantitative analysis, Applications of gas chromatography

Ref. 1.Pg. 167-174

Ref. 4.Pg. 454-464

Ref. 5 Pg. 624-640

4. High Performance Liquid Chromatography **(12 Lectures)**

Introduction, Need of liquid chromatography, Separation mechanism involved in adsorption and partition HPLC, Instrumentation and working of HPLC, Applications of HPLC, Introduction to super critical fluid chromatography
Ref. 6.Pg. 529-545

5. Flame Emission Spectroscopy : **(12 Lectures)** 3

Introduction, Principle, Theory, Instrumentation, Flame Photometers – single beam & double beam instruments, Evaluation methods, Applications in Qualitative & Quantitative analysis.

Ref. 3, Relevant pages

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

T.Y.B.Sc (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - VI
C - 65 : INDUSTRIAL CHEMISTRY-II

Credits: 04 **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Learn classification, preparation of some commercial polymers and their importance.

2.Know chemistry of pharmaceutical industry .

3 . Understand various processes involved in manufacture nitrogen, phosphate and mixed fertilizers.

4. Study classification& manufacturing of various dyes.

5. Explain manufacturing of soap & types of detergents.

Course Content:

1. Polymer chemistry (12 Lectures)

Classification of Polymers: Organic and Inorganic polymers

(a) Basic concepts, nomenclature, degree of polymerization, classification of polymerization reactions, thermodynamic and transport properties of polymer

b)Commercial polymers and their importance: (a) Nylon, polyesters (terylene and dacron), rubber, vulcanization of rubber, synthetic rubber, Bun 2-N rubber, copolymers of butadiene, PVC, acrylic, teflon, polyethylene and acrylonitrile; (b) Silicone polymers: silicone oils, rubber, grease and resin;

(c)Resins: Phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins, melamine-formaldehyde resins.

Ref. 2,3

2. Chemistry of pharmaceutical industries (12 Lectures)

a. General aspects of drug action: Introduction, classification, nomenclature, structure-activity relationship, action of drugs, factors affecting drug action, metabolism of drugs, chemical structures, methods of production and pharmacological activity.

b. Meaning of the terms: Prescriptions, doses, analgesic, antipyretic, diuretic, anesthetics, antibiotics, anti-inflammatory, anti-viral, tranquilizer, antiulcer, antialargic and bronchodilators, cardiovascular, cold preparations, anti-hypertensive, cough preparation, anti-neoplastic, sedative and hypnotics, steroidal, contraceptive, histamine and antihistamine.

c. Synthesis and uses: Paracetamol, Aspirin, Sulphanilamide, Diazepum, Phenobarbital, Synthetic Penicilline.

Ref.1: P. No.762-775; Ref.4: P. No.803-804, 818-822 ; Ref.5: P. No.987-1011

3. Fertilizer Industry (12 Lectures)

Definition, Importance of fertilizers, N.P & K ratio, Numerical problems on percentage of elements and percentage of purity, various nitrogenous fertilizers, manufacture of urea with flow sheets, various phosphate fertilizers, manufacture of triple super phosphate with flow sheet, mixed fertilizers, manufacture with flow-sheet diagram.

Ref.1 pages 590 – 612

4. Dyes (12 Lectures)

i) Introduction, Nomenclature, Fibers to be dyed, Basic operations of dyeing.

ii) classification of dyes, Classification according to mode of application, Classification according to constitution.

iii) Nitriso dye, Nitro dye, Azo dye, Acid Azo dye, methyl orange, methyl red, Basic azo dyes, Direct azo dye, mordant dye..

Ref. 1: P.No. 8-92; Ref.6: P.No. 15-30;

Ref. www.wikipedia.org/atom economy

5. Soaps & Detergents (12 Lectures)

Soaps: - Introduction, Raw materials, manufacture of soap, varieties of soaps, cleansing action of soaps.

Detergents: - Introduction, classification, Anionic detergents, cationic detergents, Non-ionic detergents, Amphoteric detergents, Builders & Additives.

Ref. 1 and 6

Reference Book:

1) Industrial Chemistry – B.K.Sharma.
2) Chemistry and industry of starch, New York, N.Y., Academic Press, incby Kerr, Ralph Waldo Emerson
3) The Complete Manual Of Small-Scale Food Processing, by Peter Fellows, Practical Action Pub
4) Shreeve's chemical process industries 5th Edition, G.T. Oustin, McGraw Hill
5) Riegel`s hand book of Industrial chemistry, 9th Edition, James A. Kent
6) Emergency Medicine: Chapter 146 Insecticides, Herbicides & Rodenticides, by James Adams
7) Industrial Chemistry. Arora & Singh.

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T.Y.B.Sc (CHEMISTRY) (CBCS-2018 Course)
SEMESTER - VI
C-69A ENVIRONMENTAL CHEMISTRY-II

Credits: 04 **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Understand Composition, Micro-and Macronutrients;

Nitrogen pathways and NPK in soil; Wastes and pollutants in soil.

2. Study details about energy and environment.

3. Learn aspects food quality; The Green revolution; Pest control; Persistence of pesticides; Toxicity of pesticides; Mode of action of pesticides etc.

4.Know solid waste management.

5. Explore role of industries on water pollution

Course Content:

1. Our earth-Lithosphere (10 Lectures)
Composition of Lithosphere/ Soil; Water and air in Soil; Inorganic and organic components in soil; Acid-base and ion exchange reactions in soil; Micro-and Macronutrients; Nitrogen pathways and NPK in soil; Wastes and pollutants in soil; Waste classification and disposal.
Reference 1; Pages 69-79.

2. Energy and Environment (12 Lectures)
Mineral resources; Metals and non-metals; Wood-a major renewable resource; Fuel and energy resources (Coal, Petroleum and natural gas, nuclear fission and fusion, Solar energy, Hydrogen, Gasohol); World energy resources-consumption and conservation; Environmental management.
Reference 1; Pages 328-346.

3. Food and the Sustenance of Life (12 Lectures)
Food Quality; The Green revolution; Pest control; Persistence of pesticides; Toxicity of pesticides; Mode of action of pesticides; Integrated pest management; Energy and agriculture; Carcinogenicity awareness.
Reference 2; Pages 440-469.

4. Solid Waste Management (12 Lectures)
Population X Affluence X Technology; Municipal wastes; Sanitary landfills; Incinerators; Incineration of plastics; Pyrolysis: Biodegradation; Reclamation; Recycling; Reuse; Paper and cellulose fiber; Garbage; Grass and organic matter; Textiles, Plastics and rubber; Glass and ceramics; metals; The entropy ethics and solid waste; Beverage container industry; Automobile industry.
Reference 2; Pages 317-345.

5. Industries and Pollution (14 Lectures)

Sources of industrial water pollution; Heavy metals; Mercury; Minamata diseases, Bioamplification; The mechanism of mercury poisoning; Detection and abatement of mercury pollution; Chlor-alkali production; Paper mills and other industries like sugar industry. Concept of ISO 14000; Environmental clearance;

Reference 1; Pages 298-304, 316-317.

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 Main's Environment, E. D. Fuller, Houghton Mifin Co., Boston, Third Edition, 1974.

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

SEMESTER - VI

C – 69B : NUCLEAR CHEMISTRY-II

Credits: 04 **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:

1. Understand Discovery of nuclear fission, process of nuclear fission, charge distribution, Fission energy & Theory of nuclear fission.

2. Study natural Uranium reactor, The breeder reactor , four factor formula & Classification of reactors.

3. Explain Principle and working of various accelerators.

4.Know Principle and working of Scintillation Counters , Semiconductor detectors & Neutron detectors.

5. Explore Probing by isotopes, typical reactions involved in the preparation of radioisotopes & Analytical applications.

Course Content:

1. Nuclear Fission **(12 Lectures)**

Discovery of Nuclear fission, The process of Nuclear fission, fission fragments, their mass distribution, fission energy ,fission cross-section and thresholds, fission neutrons,

Theory of Nuclear fission.

Ref.1: pages 240 to 259

2. Nuclear Reactors **(10 Lectures)**

Fission energy, the natural Uranium reactor,the four factor formula, classification of reactors. Breeder reactors, Ref.1: pages 266 to 277,

3. Nuclear Accelerators **(10 Lectures)**

Electrostatic Accelerators, The cockcroft-walton Accelerator,The Vande-Graft Accelerator, Cyclic Accelerator, linear Accelerator.

Ref: 2 Pages 290 to 305,325 to 330

4. Detection and measurement of Nuclear radiations . **(10 Lectures)**

Scintillation Counters , Semiconductor detectors, Neutron detectors.

Ref.2 Pages 211 to 222.

5. Applications of Radioactivity **(13 Lectures)**

Probing by isotopes, Typical reactions involved in the preparation of radioisotopes,Szilard- Chalmer reaction, Cow and milk system, Use of charged plates in the collection of radioisotopes, radiochemical principles in the use of tracers,

Analytical applications – Isotope Dilution Analysis, Neutron Activation Analysis, Radiometric Titrations

Ref.1 Pages 358 to 372, 391 to 397,400 to 401

6. Radiation Safety precautions (05 Lectures)

Safety standards, safe working methods, biological effects of radiations

Ref.3 Pages 322 to 328

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
3.Nuclear Physics by Irving Kaplan 2nd edition
4.Introduction to Nuclear physics and chemistry B.G.Harvey

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

SEMESTER - VI

C – 59C : POLYMER CHEMISTRY-II

Credits: 04 **Lectures : 60**

Course Learning Outcomes:

After completion of this course students should be able to:
1. Understand Polymer degradation.
2. Know Chemical &Geometrical structures of polymers.
3. Explain crystallinity in polymers.
4. Explore manufacturing of some important polymers & polymer processing.

Course Content:

1. **Polymer Degradation (05 Lectures)**
   Introduction, Types of degradation, Thermal degradation, Mechanical degradation, Photo degradation.

   Ref 1 : Pages 262 – 277

2. **Chemical and Geometrical structures of Polymer Molecules (03 Lectures)**
   Ref 1 : Pages 136 – 140 , 142 – 149

3. **Glass Transition Temperature and Heat Distortion Temperature (05 Lectures) (Softening Point)**

   Definition, Factors influencing the Glass transition temperature, Glass transition temperature and molecular weight, Glass transition temperature and plasticizers, Glass Transition Temperature and Crystalline melting point (Tm), Importance of Glass transition temperature.

   Ref 1 : Pages 150, 163 – 169 , 171 – 172, 219

   Ref 5 : Relevant pages Ref 9 : Page 06

   Ref 10 : Pages 98,205

4. **Crystallinity in polymers (05 Lectures)**
   Introduction, Degree of Crystallinity, Crystallisability, crystallites, Factors affecting crystallisability, Effect of crystallinity on the properties of polymers. Ref 1 : Pages 173-177, 180-183, 189-191

5. **Analysis and testing of polymers (09 Lectures)**
   - **a)** Chemical analysis of polymers, degradation.
   - **b)** Spectrochemical methods : IR, NMR
   - **c)** Thermal analysis
   - **d)** Physical testing : mechanical properties, Thermal properties, Optical properties, Electrical properties, Chemical properties.

Ref 2 : Pages 141-143, 229-237, 242-252

6. Some Important Polymers (10Lectures)

Polypropylene, Polyacrylonitrile, Polyvinyl acetate and Polyvinyl alcohol, Polyisoprene, Polychloroprene, Phenol formaldehyde resin (Novalac), Urea formaldehyde & Melamine formaldehyde resins , Polyethylene glycol & Polypropylene glycol, Polyurethanes, Epoxy polymers. Silicone Polymers.

Ref 1 : Pages 217-218, 220, 229-231, 242-256

Ref 3 : Relevant Pages.

7. Some Special Polymers (05 Lectures)

Polymer blends, Biomedical polymers, Biodegradable polymers, Liquid crystalline polymers, Thermally Stable polymers, Conducting polymers.

Ref.9 : Pages 718-720

Ref.10 : Pages 262-284, 281-283, 285-299

Ref 11 : Pages 179,185,197

8. Polymer Processing (18 Lectures)

a) Plastic Technology

1) Molding 2) Extrusion 3) Other processing methods – Calendering, Casting, Coating, Foaming, Forming, Laminating & low pressure molding, Compounding.

Ref 2 : Pages 457-469, 474-475.

Ref 1 : Relevant pages

b) Fibre Technology

1) Introduction, Textile & Fabric properties
2) Spinning- Melt spinning, Dry spinning , Wet spinning, Other spinning methods.
3) Fibre after treatments : Scouring, Lubrications, Sizing, Dyeing, Finishing,

Texture yarns, Nonwoven fabrics.

Ref 2 : Pages 486-501
Ref 1 : Relevant pages

c) Elastomer Technology

1) Introduction, Vulcanisation
2) Reinforcement

Ref 1 : Pages 506-518
Ref 2 : 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.
3. A Wiely-Interscience Publication John Wiely & Sons New York 1984.
4. Introductory Polymer Chemisrty by G.S.Misra New Age International Ltd. Publisher 1996.
5. Introduction to Polymer Chemistry by Raymond Saymour International Student Edn. 1971.
6. Polymer Chemistry by Malcom P. Stevens Oxford University Press 1990.
7. Inorganic Polymers by G.R.Chatwal Himalaya Publishing House 1st Edn.1996
8. Principles of Polymerisation by George Odian 3rd Edn. John Wiely & Sons New York.
9. Polymer Cemistry by M.G.Arora, M.Singh.
10. Introduction to Polymer Science and Technology by S.D. Dawande.
11. Principle of Polymer Science by P. Bahadur, N.V.Sastry.
12. Polymer Science – A Text Book by V.K.Ahluwalia, A. Mishra

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

C-66: PRACTICAL COURSE - VIII
(PHYSICAL CHEMISTRY)

Credits: 02
Course Learning Outcomes:

After completion of this course students should be able to:

Course Content:

1.Compare the strength of HCl and

H_2SO_4. 2.Determine molecular wt. of

high polymer.

3. Use the modern instruments such as colorimeter, potentiometer, conductometer

etc. 4..Determine the effect of addition of salt on CST.

GROUP-I

NON - INSTRUMENTAL EXPERIMENTS

A Chemical Kinetics

1. To compare the relative strength of HCl and $H_2SO_4$by measuring the rates of hydrolysis of an ester.
2. To investigate the kinetics of hydrolysis of acetate using a dialatometer.
3. Investigate the influence of ionic strength on the rate constant between potassium persulphate and potassium iodide.
4. To study the energy of activation of second order of reaction between $K_2S_2O_8$ and KI. (Equal concentration)
   (Any two experiments)

B Viscosity

1. To determine the molecular weight of a high polymer using its solutions of different concentrations.

C Phenol-Water

1. To study the effect of addition of salt on critical solution temperature of phenol-salt system.

GROUP-II

INSTRUMENTAL EXPERIMENTS

A Potentiometry

1. Determination of P^H of unknown buffer solutions by potentiometric measurements.
2. Determination of dissociation constant of given monobasic acid by potentionetric titration.

(Any one experiments)

B Colorimetry.

1. Determine the λ_{max} and concentration of given$CuSO_4$- NH_3 complex.

C Conductometry

1. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
2. To study the effect of substituent on dissociation constant of weak acid w.r.t. acetic acid &monochloroacetic acid.

D. P^HMetry.

1. Determination of the dissociation constant of given weak acid by pH metric titration.

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.

G Polarimetry.

1. Study of kinetics of inversion of cane sugar using same strength of two acids.

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.7^{th} Edition.
4. Findlay's Practical Physical ChemistryB.P.Levitt.9^{th} 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 - VI

C-67: PRACTICAL COURSE - IX (INORGANIC CHEMISTRY)

Credits: 02

Course Learning Outcomes:

After completion of this course students should be able to:

1. Study the gravimetric and volumetric analysis..
2. Estimate Mn by Volhard's method .
3. Determine Cu in $CuSO_4$ using std. 0.1N $AgNO_3$ solution

Course Content:

A) Gravimetric Estimations (Any Three)

1. Estimation of Ni as Ni – DMG
2. Estimation of Pb as $PbCr_2O_4$
3. Estimation of Al as Aluminum oxide
4. Estimation of Ba as $BaSO_4$ using homogeneous precipitation method.
5. Estimation of Fe as Fe_2O_3

B) Volumetric Estimations (Any Three)

1. Estimation of Mg from talcum powder
2. Analysis of Brass-Estimation of copper by Iodometry
3. Estimation of % purity of given sample of Sodium Chloride
4. Estimation of Mn by Volhard's method
5. Estimation of Copper in the given $CuSO_4$ crystals using standard 0.1N $AgNO_3$ solution.

C) Colourimetric Estimations (Any One)

1. Iron by thiocyanate method.
2. Cobalt by using R-nitroso salt method.

D) Column Chromatography (Any Two mixtures)

To separate cations of a given binary mixtures by Column chromatography.

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

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

C-68: PRACTICAL COURSE - X (ORGANIC CHEMISTRY)

Credits: 02

Course Learning Outcomes:

After completion of this course students should be able to:

1.Perform Binary mixtures

Course Content:

1. **Organic Qualitative Analysis of Binary Mixtures** (Minimum 8 mixtures)
   (i) Solid – Solid (4) (ii) Solid – liquid (2) (iii) Liquid – liquid (2)
   At least one mixture from each of the following types
   (Acid-Base, Acid – Phenol, Acid – Neutral, Base – Neutral, Neutral - Neutral)
   Note:
   Students should report – nature, type, separation of mixture, physical constants of purified compounds, detection of elements, functional group tests (Name and structure of compound is not expected)

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)

T.Y.B.Sc.
(BOTANY)
(C.B.C.S. 2018
Course)
SEMESTER- VI

B-61: BIOLOGY OF CRYPTOGAMES(BRYOPHYTES AND PTERIDOPHYTES)

Core Course – Theory; Credits- 04 Total lectures-
60 L Course Learning Outcomes :

On completion of this course, students are able to:

- Become aware of the status of higher cryptogams as a group in plant kingdom.
- Understand the habit and habitat of the higher cryptogams in the field.
- Understand the distinguishing features, interrelationships, phylogeny and evolutionary
- To understand tendencies of selected orders with their affinities.
- Realize the economic importance of higher cryptogams plants.

1. Bryophytes 24 L

Classification of Bryophytes.
Comparative account of classes of Bryophytes.
Evolution of gametophyte and sporophyte.
Ecological and economic importance of
Bryophytes. Study of life histories
of……

- *Marchantia* (ii) *Anthoceros* (iii) *Polytrichum*

2. Pteridophytes 24 L

Origin of vascular
cryptogames. Classification
of Pteridophytes.
Stydy of life histories of *Psilotum, Lycopodium, Equisetum, Marsilea* and *Adiantum.*
Heterospory and seed habit.
Alternation of generations.
Telome theory and stelar
evolution

3. Fossil Pteridophytes 12 L

(a) Fossil – Definition and types; Process of fossil formation.
(b) Study of external and internal morphology of following fossil Peridophytes.
(i) *Rhynia*(ii) *Lepidodendron*(iii) *Lepidostrobus*
(iv) *Lepidocarpon*(v) *Calamites*

- Pteridosperms - characters and significance

Reference Books:

1. Gifford, E.M. and Foster, A.S. 1989. Morphology and Evolution of Vascular Plants.W.H. Freeman &Co., New York.
2. Puri. P. 1985.Bryophytes.Atmaram& Sons, Delhi.
3. Parihar, N.S. 1991. Bryophyta.Central Book Depot. Allahabad.
4. Parihar, N.S. 1996. Biology & Morphology of Pteridophytes. Central Book Depot,Allahabad.
5. Sporne, K.K. 1991. The Morphology of Pteridophytes. B.I. Publishing Pvt. Ltd.,Bombay.
6. Stewart, W.N. and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants.Cambridge University Press.

T.Y.B.SC.
(BOTANY)
(C.B.C.S. 2018
Course)

SEMESTER- VI

B – 62: BIOLOGY OF SEED PLANTS (GYMNOSPERMS AND PALEOBOTANY)

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

Course Learning Outcomes :

On completion of this course, students are able to:

1. Understand Gymnosperms with respect to distinguishing characters, comparison with Angiosperms, economic importance and classification.
2. Understand the life cycles of Pinus and Gnetum.
3. Know the scope of Paleobotany, types of fossils and geological time scale
4. Understand the various fossil genera representing different fossil groups
5. Understand the diversity of Gymnosperms in India.
6. Know the evolutionary trends and affinities of living gymnosperms with respect to external and internal characters .
7. Understand the important fossil types in different groups of plants and Indian fossil records.
8. Understand the important fossil types in different groups of plants and Indian fossil records.
9. Realize the applied aspects of Paleobotany.

Course Content:

1. **Phanerogams**:The seed bearing plants. General characters and types **06 L**

2. Introduction to gymnosperms **13 L**

General characters.

Distribution in India.

Classification according to BirbalSahani and Chamberlain. Structure of ovule, megasporogenesis female gametophyte.

Pollination, fertilization, embryogeny, maturation of seed & structure of seed.

3. The living cycads **11 L**

Distribution.

Vegetative organography & anatomy.

Reproductive cycle upto seed development with reference to *Cycas* &*Zamia*.

4. Fossil Cycads: - Cycadeoidea (Bennettitles) **07 L**

Important characters.

Morphology and anatomy of vegetative and reproductive structures.

5. The Coniferales **10 L**

General organography and anatomy.

Reproductive cycle upto seed development with reference to *Pinus* &*Thuja*

6. The Gnetales **13 L**

a) Habit and distribution.

b) Reproductive cycle and advanced features with reference to *Gnetum*

Reference Books:

1) Bhatnagar S.P. and Moitra A. 1996. Gymnosperms, New age international Pvt. Ltd. New.Delhi.

2) K.R.Sporne. The morphology of Gymnosperms.

3) P.C.Vashishta – Gymnosperms.

4) Coulter J.M. & Chamberlain C.J. Morphology of Gymnosperms.

5) Cronquist, A. 1968. The evolution and classification of flowering plants. Thomas Nelson(Printers) Ltd., London &
Edinburgh.

6) Delevoryas Th. 1965. Plant Diversification.modern biology series, Halt, Rinehart &Winston, New York.

7) Foster, A.S. and Gifford, A.E.M., Jr. 1967. Comparative Morphology of Vascular Plants.Vakils.Peffer& Simons
Pvt. Ltd.

8) Spome, K.R. 1977. The Morphology of Angiosperms. B.I. Publication, Bombay.

9) Bhowani. S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, 4th revisedand enlarged edition. Vikas
publishing house, Deihi.

10) Johri B.M.1984, Embryology of Angiosperms. Springer-Verlag, Berlin.

T.Y.B.Sc. (BOTANY) (C.B.C.S. 2018 Course) SEMESTER-VI

B -63: ENVIRONMENTAL BOTANY

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.
- Realize the impact of human activities on environment.
- Understand global issues concerned with
- Know the sustainable development and care of environment.
- Understand the connection between material wealth & resources exploitation.
- Worth the relationship between economic growth and environmental degradation.

1. Introduction **06 L**

a) Inter-relationship between the living world and environment

b) The components and dynamism c) Homeostasis, relevance to man

2. The environment **10 L**

a) Soil - general account and adaptations b) Water – general account and adaptations

c) The atmosphere – general account and adaptations

d) Living world – biotic components of environment

e) Types of biotic interactions f) Fire as an ecological factor

3. Organism ecology (Bioticcomponents) **03 L**

a) Individuals, species, populations b) Communities and their characteristics

4. Ecosystem **07 L**

a) Concept of ecosystem, homeostasis

b) Structure and function of ecosystem

c) Transfer of energy and minerals via grazing and detritus chains and role of microorganisms

d) Cycles (hydrologic and gaseous)

e) Role of human in maintaining biogeochemical cycle.

5. Diversity of ecosystem **06 L**

a) Aquatic (Freshwater) b) Terrestrial (Forest / grass land) c) Manmade ecosystem

6. Phytogeography **05 L**

a) Introduction b) Endemism c) Static and dynamic plant geography

d) Short account of vegetation of India

7. Human Ecology and ecological Management **07 L**

a) The human population, renewable and non- renewable natural

b) Resources and their management
c) Conservation of biodiversity, endangered species
d) Conventional and non-conventional energy sources

8. Impact of human activities **06 L**

a) Pollution of air, water & soil.
b) A brief account of environmental toxicology
c) Evidences of noise, thermal and radioactive pollution
d) Control of pollution
e) Global warming, desertification and ozone depletion

9. Role of national international organization in environmental management **04 L**
Formulation of optimal models.

10. Bio-indicators – concept, types and examples. **03 L**

11. Environmental impact assessment - A brief account

03 L Reference Books:

1. Ambasht, R.S. 1988. A text book of plant Ecology.Students Friends Co. Varanasi.
2. Botkin, D.B. and Keller, E.A. 2000. Environmental Planet (2nded.) John.Wiley&SonsInc. New York.
3. Chapman, J.L. and Resis.M.J. 1995. Ecology; Principal and application. CambridgeUniversity Press.
4. Cunningham W.P. and Saigo, S.W. 1997.Envionmental Science; A Global Concern.WCB McGraw Hill.
5. Dash, M.C. 1993.Fundamental of Ecology.Tata McGraw Hill Publication Co. Ltd. NewDelhi.
6. Daubermire, R.F.1974. Plant and Environmental – a text book of Ecology (3rdEd.). JohnWiley & Sons,

i. New Delhi.

7. Kendeigh,S.C.1980. Ecology with special Reference to animals and Man. Prentice Hallof India Pvt Ltd.

i. New Delhi.

8. Kumar,H.D. 1996. Modern concept of Ecology (4thed.)Vikas Publication House Pvt.Ltd., Delhi.
9. Kumar,H.D. 1997. General Ecology Vikas Publication House Pvt. Ltd., Delhi.
10. Kormondy, E.J. 1996. Concept of Ecology Prentice Hall of India Pvt Ltd. New Delhi.

11. Miller,W.R. and Donahue,R.L. 1992. Siols- An introduction of soil and Plant a Growth (6th Ed.)Prentice
i. Hall of India Pvt Ltd. New Delhi.
12. Odum, E.P. 1996. Fundamental of Ecology.NatrajPublisher , Dehradun.
13. Pickering K.T. and Owen L.A. 1997. An introduction to Global Envionmental Issues (2nd) Butter and
i. Tanner Ltd. Great Britain.
14. Smith L.R. 1996. Ecology and field Biology (5thEd.) Harper Collins College Publisher,USA.
15. Smith L.R. and Smith, T.M. 1998Elements of Ecology (4thEd.) An imprint of AddisonWesley,
i. Longman Ink.,California.
16. 16.Tylar, M.G., Jr. 1997. Environmental science ; Working with Earth (6thed.) Wadsworth Publication
i. Co. Weaver J.E. and Clements, S.E. 1996.Plant EcologyTata McGraw Publication Co. Ltd.Bombay.

T.Y.B.Sc. BOTANY (C.B.C.S. 2018 Course) SEMESTER-VI
B – 64: PALYNOLOGY AND PLANT BREEDING

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

On completion of this course, students are able to:

- Understand the science of plant breeding.
- Know branch of plant breeding for the survival of human being from starvation.
- study the techniques of production of new superior crop verities.
- Understand the modern strategies applied in Genetics and Plant Breeding to sequence and analyze genomes
- Get the detail knowledge about modern strategies applied in Plant Breeding for crop improvement i.e. Mass selection, Pureline Selection and Clonal selection.
- Know about exploitation of Heterosis, hybrid and variety development and their release through artificial hybridization.
- Understand the role plants in human welfare. . .

Palynology

1. Pollen and Spore Morphology - **08 L**
size and shape, polarity, apertures (NPC),exine stratification, exine excrescences, construction of a palynogram.

2. Study of different types of pollen grains with the help of acetolysis method (Any fourlocally available materials). **04 L**

3. Application of Palynology in honey industry, coal and oil exploration and forensicscience. Aeropalynology and pollen allergy. **06 L**

4. Pollen viability and storage – Causes for loss of pollen viability, Tests for pollenviability, Pollen storage. **07 L**

5. Germination and growth of the pollen tube, factors affecting pollen tube growth. **04 L**

PLANT BREEDING

6. Types of plant reproduction **06 L**

a) Vegetative, sexual reproduction and apomixis.

b) Their effect on generating and fixing genotypic variation.

7. Methods of plant improvement **11 L**

a) Pure line and mass selection, clonal selection advantages and disadvantages.

b) Hybridization in self and cross pollinated crops – steps in hybridization, variousmethods and their advantages. Pedigree method, bulk method, back-cross method,multiple or composite cross method, single cross method, three way cross method,double cross method, top cross method,

8. Mutations and polyploidy as methods of plant improvement **07 L**

a) Applications of mutation in plant improvement.

b) Polyploidy – types and characters, role of polyploidy in evolution of new species.

c) Achievement in rice, wheat and tobacco.

9. Plant tissue culture for crop improvement **07 L**

a) General aspects – somaclonal and gametoclonal variant selection.

b) Genetic variations and crop improvement.

c) Source, material and culture conditions.

d) Forms of somaclonal variation.

e) Detection and isolation of somaclonal variants.

f) Applications in plant breeding.

g) Cybrid production and its advantages.

Reference books:

1. Poehimann, J.M. and sleeper, D.R. 1995. Breeding field Crops. PanimaPublishingHouse, New Delhi.

2. Russel, P.J. 1998. Genetics (5th Edition).The Benjamin/Cummings Publishing Co., Inc.,USA.

3. Simmonds, N.W. 1979. Principles of Crop Improvement.Longman, London and NewYork.

4. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics (2nd Edition).John Wiley& Sons, Inc.,
USA.

5. Sharma.J.R. 1994. Principles and Practice of Plant Breeding. Tata McGraw-HillPublishing Co. Ltd., New
Delhi.

6. Purohit S.S. – 2003. Plant tissue culture.

7. S.Narayanswamy – 1994. Plant cell and tissue culture.

8. Chaudhary R.C. – Introduction to plant breeding.

9. Chaudhary A.K. – Elementary principles of plant breeding.

T.Y.B.Sc. BOTANY (C.B.C.S. 2018 Course) SEMESTER-VI

B – 65: INDUSTRIAL BOTANY- II

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

Course Learning Outcomes :

On completion of this course, students are able to:

- Understand the importance and scope of botanical science in the industries.
- Understand the role of microbial plants in fermentations process.
- Understand technique of plant tissue culture and its application.
- Gain thorough knowledge about various plant groups from primitive to highly evolved plants.
- Become aware of applications of different plants in various industries.
- highlight the potential of these studies to become an entrepreneur.
- equip with skills related to laboratory as well as industries based studies.

1. Introduction **04 L**

Idefinition& scope of biotechnology.

2. Micropropogation **12 L**

a) Concept and history.
b) Totipotency and cell differentiation.
c) Somatic embryogenesis.
d) Protoplast isolation and culture.
e) Applications of plant tissue culture.

3. Fermentation Technology **10 L**

a) Types of bioreactors.
b) Process of fermentation.
c) Manufacture of Citric acid, Vit. B-12, Penicillin.
d) Products and byproducts of fermentation.

4. Agriculture Biotechnology **09 L**

a) Haploids in agriculture.
b) Green house technology.
c) Commercialization of micropropagation.
d) Organic farming, Biofertilizers.

5. Industrial Biotechnology **08 L**

a) Biotechnology based Business.
b) Hybridoma technology.
c) Applications of enzymes in Industry & Medicine.
d) Immobilization of enzymes and application.
e) Intellectual property rights, patents, Applications for patent andsignification.

6. Biofuels **09 L**

a) Concept and types.

b) Biogas production, merits, demerits and types of Biogas plants.
c) Bioethanol & Applications.
d) Petrocrops – a brief account.

7. Environmental Biotechnology **08 L**

a) Degradation of wastes & oil spills.
b) Concept of bioplastic.
c) Conservation of genetic resource.
d) Plants for pollution control.

Reference books:

1. Collins, H.A. and Edwart S. 1998. Plant cell culture.
2. Bhojwni, S.S. 1990. Plant tissue culture and limitations.
3. Vasil, I.K. and Thorpe, T.A. 1994. Plant cell and tissue culture.
4. Kaylan Kumar De. Plant tissue culture.
5. M.J.K.Jons. Plant biotechnology in Agriculture.
6. Rev. Fr. Dr.S.Ignacimuthu, S.J. Applied plant biotechnology.
7. T.N.More, K.N.Dhumal, et.al. 2003. A Text book of Botany – Plant Biotechnology.
8. Cheris Lewis – Biological fuels.
9. K.C.Khandelwal, S.S.Maheli. Biogas technology volume 1.
10. L.E.Casita Jr. Industrial Microbiology.
11. W.C.Frazier and D.C.WestfoodFoodmicrobiology.
12. E.E.Conn, P.K.Stumpt. – Outlines Biochemistry.

T.Y.B.Sc. BOTANY (C.B.C.S. 2018 Course) SEMESTER-VI

B-66- PRACTICAL COURSE – VIII

(Based on B-61 Biology of Cryptogams & B- 62 Biology of Seed Plants) (Any 10 Practical's to be covered)

Course Learning Outcomes:

On completion of this course, students are able to:

- Study qualitative assessment of microelements in plant ash.
- understand few higher cryptogams with suitable examples and effect of hormones on germinating seeds..
- Study Demonstration, working and uses of ecological instruments.
- Study morphological and anatomical adaptation in locally available hydrophyte and xerophyte.
- Measure water quality based on – hardness, Dissolved oxygen, free CO2, Chloride, total alkalinity.
- Study *Pinus* &*Gnetum* life cycle
- Study factors promoting self-pollination & cross pollination

Practical course ;

1) Study of life cycle of *Anthoceros* and demonstration of vegetative and reproductivestructures of *Marchantia.* **1 P**

2. Study of life cycle of *Polytrichum.* **1 P**

3. Comparative study of Morphology, Anatomy and reproductive structure in *Psilotum, Lycopodium, Equisetum* and *Marsilea* with help of specimens and permanent slides.**2 P**

4. Study of life history of *Adiantum.* **1 P**

5. Study of fossil pteridophytes with the help of specimens and permanent slides (As per syllabus) **1 P**

6. & 7. Study of Life history of *Cycas* **2 P**

(a) Morphological and anatomical characters (T.S. of leaflet & rachis – double staining)

(b) Structure of reproductive bodies – megasporophyll, ovule, male cone &pollengrain.

8. & 9.Study of Life history of *Pinus.* **2 P**

(a) Morphological & anatomical characters (T.S, T.L.S. & R.L.S. of stem, T.S. of needle by double staining technique)

- Structure of Reproductive bodies – male cone, female cone, ovule & pollen grains.

10. & 11.Study of Life history of *Gnetum.* **2P**

(a) Morphological & anatomical characters (T.S. T.L.S. & R.L.S. of stem, T.S of leaf by double staining technique).

- Structure of reproductive bodies – male cone, female cone & ovule. **2P**

T.Y.B.Sc. BOTANY (C.B.C.S. 2018 Course) SEMESTER-VI
- PRACTICAL COURSE – IX
(Based on B-63 Environmental Botany & B-64 Palynology and Plant Breeding) (Ant 10 Practical's to be covered)

Course Learning Outcomes :

On completion of this course, students are able to:

- study the effect of temperature on activity of enzyme amylase.
- study the principle and working and uses of spectrophotometer, calorimeter, centrifuge, Autoclave,Laminar air flow, Hot air oven, Incubator etc.
- Study Isolation and estimation of lipids from oil seeds by using Soxhlet apparatus.
- study the lipase activity by using germinating oily seeds.
- Study detection of adulteration in plant products using suitable tests.
- Study preparation of *Aloe vera* jel & Jaswand jel.
- Understand and study botanical name and uses of plant material in forensic science

Course Content:

1. Mechanical analysis of soils by sieve method. **1 P**
2. Determination of soil porosity and density (sand and pit method). **1 P**
3. Determination of water holding capacity and field capacity of soil. **1 P**
4. Titrimetric estimation of total carbonates of soil samples. **1 P**
5. Quantitative determination of soil organic matter by Walklay and Black's rapid titrationmethod. **1 P**
6. Analysis of the herbaceous vegetation for frequency, density and abundance. **1 P**
7. Study the height spectrum of herbaceous vegetation by line transect method. **1 P**
8. Estimation of biomass of aerial parts of herbaceous plants (fresh weight and dry weight). **1 P**
9. Analysis of different water samples for pH, oxygen, carbon-dioxide(titrimetricestimation), turbidity and temperature. **1 P**
10. Study of pollen morphology (NPC Analysis) of the following by Chitley's Method
a) *Hibiscus* b) *Datura* c) Labiatae d) *Crinum* e) *Pancratium* f) *Canna*
11. Determination of pollen viability
12. Pollen analysis from honey sample – unifloral and multifloral honey
13. Field exploration for detection of male sterile plants and estimation of their pollenfertilityin locally grown crop plants e.g. *Sorghum*,*Lycopersicum*(omato) and *Linum*. **1 P**
14. Estimation of pollen ovule ratio and its bearing on pollination system. **1 P**
15. Emasculation and bagging of flowers of Brassicaceae / Poaceae / Paplionaceae /Malvaceae / Linaceae, pollinating them manually and estimating fruit and seed setting. **1 P**

T.Y.B.Sc. BOTANY (C.B.C.S. 2018 Course) SEMESTER-VI
B- 68 PRACTICAL COURSE – X
(Based on B-65 Industrial Botany II & B-69 (A) Horticulture & Gardening / B-69(B) Pharmacognosy / B-69 (C) Seed Technology) (Any 10 Practical's to be covered)

Course Learning Outcomes :

On completion of this course, students are able to:

- Understand the preparation of tissue culture media, sterilization and inoculation of plant material.
- Understand the techniques of in vitro culture of various explants.
- Understand technique of plant tissue culture and its application.
- Gain thorough knowledge about raising of spawn for mushroom cultivation and cultivation of Dhingri (Oyster) mushroom.

1. Preparation of tissue culture media, sterilization and inoculation of plant material. **1 P**
2. Demonstration of techniques of in vitro culture of various explants. **2 P**
(shoot tip culture, Excised root culture, nodal sector culture).
3. Raising of spawn for mushroom cultivation. **1 P**
4. Cultivation of Dhingri (Oyster) mushroom. **1 P**
5. Demonstration of fermentation process and study of organism involved in it **1 D**
6. Demonstration of Petrocrops and working of biogas plant (field visit) **1 D**

PRACTICAL COURSE content
B-69 (A) Horticulture & Gardening Course Learning Outcomes :

On completion of this course, students are able to:

- Understand garden implements and their uses.
- understand propagation practices by seed, cutting, layering, budding, grafting.
- Gain knowledge about preparation of Bonsai, Bottle garden / Terrarium / Hanging baskets.
- Know how to carry Indian, Japanese and Western style flower arrangement.
- Study how to prepare Jams, Jellies, Squashes / Syrups, Pickle.

Course Content:

7. Garden implements and their uses. 1P
8. Propagation practices by seed, cutting, layering, budding, grafting. **1 P**
9. Method for preparing Bonsai, Bottle garden / Terrarium / Hanging baskets. **1 P**
10. Flower arrangements – Indian, Japanese and Western. **1 P**
11. Preparation of Jams, Jellies, Squashes / Syrups Pickle. **1 P**
12. Study of varieties of the following fruits and vegetables : **1 P**

Vegetables : Tomato, Okra, Brinjal Spices / Condiments –
Chilli Fruits:- Banana, Grapes, Mango, Watermelon.

Practials based on B-69 (B) Pharmacognosy Course Learning Outcomes :

On completion of this course, students are able to:

- Understand and study determination of extractive value of a crude drug.
- Understand and study determination of ash value, total ash value, acid insoluble ash value and water soluble ash value of a crude drug.
- Study determination of the length and width of fibers in powdered crude drug.
- Study determination of moisture (Loss on drying) of a powdered crude drug and swelling factor.

Course content:

1. Determination of extractive value of a crude drug.	**1P**
2. Determination of ash value of a crude drug.	**1P**
3. Determination of total ash value of a crude drug.	**1P**
4. Determination of acid insoluble ash value of a crude drug.	**1P**
5. Determination of water soluble ash value of a crude drug.	**1P**
6. Determination of the length and width of fibers in powdered crude drug.	**1P**
7. Determination of moisture (Loss on drying) of a powdered crude drug.	**1P**
8. Determination of swelling factor.	**1P**

Practical's based on B-69 (C) Seed Technology

Course Learning Outcomes :

On completion of this course, students are able to:

- study the methods of treatments used for breaking of dormancy in seed.
- determine seed viability by tetrazolium test

1. To study the methods of treatments used for breaking of dormancy in seeds **1P**

2. To determine seed viability by tetrazolium test. **1P Project:**

Each student should individually present a project related to any horticulture topic. It should be duly certified presented for at practical examination.

Visits:

To Gardens / Parks / Nurseries / Exhibitions / Horticulture industries / Research Stations and record of visits should be duly certified and presented at the time of practical examination.

T.Y.B.Sc. BOTANY (C.B.C.S. 2018 Course)

SEMESTER-VI

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

B – 69 (A): HORTICULTURE & GARDENING

Course Learning Outcomes :

On completion of this course, students are able to:

- understand scope , importance & disciplines of horticulture.
- familiar with horticultural zone of Maharashtra & India.
- understand different horticultural practices & methods.
- study role played by green & playhouses in horticulture.
- understand production technology, harvesting techniques.
- understand methods of preservation & preparation of preserve product.
- Study of Garden tools and Equipments.

1. Landscape Gardening 07 L

Principles of landscaping and garden design. Important garden features. Paths andAvenues, hedges and Edges, Lawn, flower beds, Arches and pergolas, Fencing, Waterbodies, rocks,.Plants suitable for different locations and climates. Indoor GardenTerrarium, Soil less garden, Bottled dish garden.

2. Artificial methods of plant propagation 07 L

a) Layering – Definition, Types:- simples, compound (Serpentine) Air.

b) Grafting – Definition, Advantage / disadvantage, types Stem – detachedscion – aplice,whip /tongue, slide, veneer, cleft, bark, attached scion, approach, inarching,bridge,bracing, root grafting, epicoty, stone grafting. Budding – Definition,advantage,disadvantage type – T –

c) Budding, shield, patch, ring / angular, skin budding in situ, After care ofbudded paints.

3. Different styles of Gardens 08L

Hindu, Buddhist, Mughal, English, Japanese ,Important Gardens of India – Shalimar(Shrinagar), Vrindavan (Mysore), Dnyaneshwar Udyan (Paithan), Jayakwadi Nagar(Paithan), Veer Jijamata Udyan (Mumbai); P.L.Deshpande, Udyan (Pune).

4. Floriculture 09 L

Scope and importance, Soil and climatic requirementAnd cultivation practices for Gladiolus, Gerbera, Rose and Marigold.Propagationtechnique, packaging and marketing, enhancing and delaying period of bloom by specialmethods.

5. Commercial production of the following 10 L

i) Tubers - Potato and Arum

ii) Vegetables - Tomato & Okra (Lady's finger)

iii) Fruits - Mango & Grapes

iv) Spices / Condiments - Chilly and Ginger

v) Aromatic Plants - Citronella and Mint

6. Post – Harvest Technology 08 L

i. Maturity – Factors responsible for maturity and ripening, methods used for delaying ripening.

ii. Harvest – Time of Harvest, harvesting and handling of harvested products.
iii. Storage - Types of storages preservation of fruits and vegetables – canning, freezing,drying
(Dehydration) picking, food preservatives, anti-oxidants,
iv. Marketing – Grading, packing and transportation. Ways of increasing the marketvalue and shelf
life of horticulture produce.

7. Horticulture business, management and entrepreneurship development 08 L

i. Horticulture, as a business definition and nature, organization,
ii. Planning and operations of horticulture farm business.
iii. Recycling of farm wastes.
iv. Entrepreneurship development

8. Lawn 03 L

(i) Purpose of preparation of Lawn & Lawn Plants.
(ii) Production and use – purpose and preparation, management.

Reference Books:

1. Fundamental of Horticulture – J.D.Edmond et al.
2. Some beautiful Indian c limbers & Shrubs – M.L.Bor&M.B.Raizada
3. Floriculture in India – G.S.Randhawa&A.Mukhopadhyan.
4. Plant propagation – H.T.Hartmann et al.
5. The Rose in India – B.P.Pal
6. Horticulture and Gardening – M.R.Khan.
7. Hand book of Horticulture – K.L.Chanda (ICAR).
8. Commercial Flowers – Bose & Yadav.
9. Lawn & Gardens – S.L.Gindal.
10. Gardening – J.Erickson.
11. Manual of Soil, Plant, Water & fertilizer analysis – R.M.Upadhayay&M.L.Sharma.
12. Flowering Shrubs in India – S.L.Gindal
13. Floriculture – Chatterji& Bose

T.Y.B.Sc. BOTANY (C.B.C.S. 2018 Course)

SEMESTER-VI

B – 69 (B): PHARMACOGNOSY

Core Course – Theory; Credits- 04 **Total Lectures-**

60 L Course Learning outcomes:

On completion of this course, students are able to:

- understand concept of active principle, and major metabolic pathway leading to the production of therapeutically active chemical constituents.
- understand concept of active ayurvedic and therapeutically active chemical constituents.
- understand the cultivation, collection and processing of herbal drugs
- understand importance of pharmacognosy.

1. Introduction to Pharmacognosy **12L**

History, definition and Scope of Pharmacognosy.Traditional and alternative systems of medicine Classification of crude drugs.Concept of active principle, and major metabolic Pathway leading to theProduction of therapeutically active Chemical Constituents.

2. Ayurvedic Pharmacy **10 L**

Introduction, Tridosha concept, Humoral, Indigenous Systems of medicine (Ayurveda, Siddha,Unani,Tibi)Ayurvedic principles- Ras.Guna, Vipaka, Virya, Prabhava,Ayurvedic formulations –Asava, Arishta, Kvatha, Churna, Ksharas, Leha, Vatika, Taila,Bhasma,Nutraceuticals&Cosmeuticals

3. Analytical Pharmacognosy **07L**

Drug adulteration.Methods of drug evaluation- Morphological, Microscopic, Chemical and Physical methods.Biological and chemical evaluation of drugs.

4. Cultivation, collection and processing of herbal drugs

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9 L Cultivation- Methods, Factors affecting cultivation. Collection and Processing. Collection, harvesting, drying, garbling, packing, storage of crude drugs.

5.Study of drugs **12 L**

Study of drugs w.r.t. occurrence, distribution cultivation, microscopic characters,constituents and uses of the following.

Root Rhizome drugs :-*Glycyrrhiza , Asparagus*

Stem drugs: - *Ephedra,*

Tinospora Bark drugs: -

Cinnamon, Cinchona Leat

drugs: - *Aloe, Adathoda* Flower

drugs: - *Woodfordia*, Clove
Fruit drugs: - *Coriandrum*,
Amla Seed drugs: - *Myristica*,
Isabgol, Unorganized drugs :-
Acacia.

6. Ethno botany **10 L**

Introduction, Definition, concepts and relevance.Branches of Ethno botany.Methodology, importance of Ethnobotany in research and conservation.Ethnic Societies of India and world & their contribution.Ethnobotany of *Aeglemarmelos, Buteamonosperma*, Neem (*Azadirachta indica*) *Ficusbengalensis*w.r.t. Taxonomic description, distribution, phytochemistry anduses, Social & religious practices.

References:-

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4. Trease G.E. and Evans. W.C. Pharmacognosy ELBS Twelfth Edition
5. Tyler V.E Brady L,R and Robbers J.E. Pharmacognosy Lea and Febiger. Philadelphia.8th edition KM
Varghese and Co.Mumbai,
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8. AshalotaRazarioetal.A Hand Book of Ethno biology KalyaniPablishes
1999 9.Sinha R.R.&Sinha , 2005 Ethnobiology.

T.Y.B.Sc. BOTANY (C.B.C.S. 2018 Course)

SEMESTER-VI

B – 69 (C): SEED TECHNOLOGY

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

Course Learning outcomes:

On completion of this course, students are able to:

- Understand the theoretical orientation of seed development
- Analyse the different ways of seed processing in different plants
- Examine the various methods of Seed testing
- Understand the method of seed production in different plants
- Explain the concept of hybrid seed production

1. Introduction **05 L**

a) Concept of seed technology. b) Objectives of seed technology.
c) Seed industries in India and its present status.

2. Seed **06 L**

a) Structure b) Texture c) Types **d)** Collection and selection of seeds.

3. Seed processing **10 L**

a) Seed drying – sundry forced air drying and its advantages.
b) Seed cleaning – principles and methods.
c) Seed treatment –
i) Importance and necessity.
ii)Types of seed treatment and precautions in seed treatment.

4. Seed storage **09 L**

a) General principles and stages. b) Factors affecting on seeds during storage.
c) Pest and diseases in seed storage and their control measures.
d) Quality control in seed storage.

5. Seed testing methods **09 L**

a) Objectives. b) Equipments for seed testing.
c) Methods – i)Purity test. ii)Germination test – (According to ISTA rules).
d) Methods for inducing seed germination.

6. Seed viability **08 L**

a) Definition. b) Topographical, tetrazolium test. **c)** Embryo exigent test

7. Seed health testing **08 L**

a) Important methods. b) Examination without incubation.
c) Examination after incubation.

8. Seed certification **05 L**

a) Objectives. b) Steps in seed certification.

Reference Books

1) Seed technology- Agarwal R.L.
2) Viability of seeds- Roberte E.H.
3) Germination of seeds- Mayor, Polgakoff, Mayber
4) Physiology and Biochemistry of seeds- Bewley and Black

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T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)

SEMESTER-VI

MB 61-Chemotherapy and Biomedical Instrumentation.

Total credits 04 **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to -

- Acquire the knowledge of Gene Therapy
- Know the principles of Chemotherapy, mode of action of Drugs& Drug resistance
- Generate a detailed study of human micro-Organisms
- Have awareness on using various biomedical instruments

Course Content

I. Gene Therapy **10**

i. Gene Therapy of Severe combined Immunodeficiency
ii. Gene therapy of Alzheimer Disease

II. Introduction to chemotherapy. **20**

A. **General Principles of Chemotherapy**.
B. Mode of Action of following
i. Penicillin
ii. Tetracyclin
iii. Acyclovir
iv. Rifampicin
v. Actinomycin D
vi. Griseofulvin
vii. Nystatin
viii. Sulfonamides
ix. Sulphated polysaccharides

III. Mechanism of the drug resistance for the above drugs. **05**

IV. Causes of variable and unpredictable drug response. **05**

V. Detailed study of following organisms: **08**

1. *Staphylococcus spp.*

2. *Streptococcus spp.*

3. *Treponema pallidum*

4. *Mycobacterium tuberculosis*

V. Biomedical instrumentation & measurements:-

Principle and use of following biomedical instruments – 12

i. Blood cell counter,

a) Conductivity (Coulter) type.

b) Dark field type.

ii. Electrocardiograph (ECG Transducer)

iii. EEG Transducer

iv. Sphygmomanometer.

References:-

1. Bernard R. Hick, Terry L. Delvitch, Cherryl L. Patten 2014, Medical Biotechnology, ASM Press Washington D.C. (Topic I)
2. David H. Persing et.al. Molecular Microbiology:, Diagnostic Principles and Practice 2004, ASM Press Washington DC,USA. (Topics IV and V)
3. Hugo W.B., Russell A.D. Ninth Edition, 2014, Pharmaceutical Microbiology, Blackwell Science Ltd. USA. (Topics II and III)
4. Leslie Cromwell, Fred, Weibell, Erich A Pfelffer 2004, Biomedical Instrumentation & measurements, 3rd edition Pearson education Inc. Singapore. (Topic VI).
5. P. Primoo 2015, A Textbook of Medicinal Chemistry, CBS Publishers and Distributors New Delhi, India. (Topic II)

T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)

SEMESTER-VI

MB 62 : Immunology

Total credits 04 **Total 60 Lectures**

Course Learning Outcomes :

On completion of Course Students are able to -

- Understand the antigens, antibodies & the various theories related to antibody formation
- Have a detailed knowledge about the cells of the immune system
- Know the role of cytokines, monoclonal antibodies, their production & applications
- Understand the mechanism of Hypersensitivity

Course Content

I. Antigen: - **10**

i. Concept of Epitope,
ii. Types of Epitope,
iii. Carrier molecule,
iv. Factors affecting antigenicity.

II. Antibody: - **15**

i. Concept of paratope,
ii. Allotypes of immunoglobulin,
iii. Concept of idiotopes and idiotypes,
iv. Early hypothesis for antibody formation,
v. Direct template theory for antibody formation,
vi. Indirect template theory for antibody formation,
vii. Burnet's clonal selection theory for antibody formation,
viii. Cellular mechanism of antibody formation
    a. Antigen presentation
    b. Cytokine signaling for antibody formation
    c. Antibody production

III. Cells of the immune system: - **06**

i. Cytology & functions of Microphages,
ii. Cytology & functions of
    a) T cells,
    b) B cells,
    c) NK cells.

IV. Cytokines: - **10**

i. Interleukin 1,
ii. Interleukin 10,
iii. Tumor Necrosis Factor (TNF),
iv. Interferons
    a) α Interferons

b) β Interferons

c) γ. Interferon

V. Hypersensitivity:- 14

Mechanism & examples of

i. Type – I Hypersensitivity
ii. Type – II Hypersensitivity,
iii. Type – III Hypersensitivity,
iv. Type – IV Hypersensitivity.

VI. Concept of Monoclonal antibodies, their production and Applications 05

References

1. Abul K. Abbas, 2006, Cellular and Molecular Immunology 5th Edition, ELSEVIER Saunders Publications, An imprint of Elsevier, Philadelphia., USA, (Topics IV, VI and VII)
2. David Male, Jonathan Brostoff, David B Roth, Ivan Roitt, 2006, Immunology, 7th edition Mosby ELSEVIER, Canada. (Topics I, II and III)
3. Ian R Tizard 2004, Immunology, An introduction, 4th Edition, Saunders College Publishing. U.K. (Topics III, IV and VI)
4. Ivan M. Roitt, Peter J. Delves, 2001, Roitt's Essential Immunology, 10th Edition, 2001, Blackwell publishing Company, USA. (Topics III and VI)
5. Keith Wilson & John Walker (Ed.) 2005, Principles & Techniques of Biochemistry and Molecular Biology, Cambridge University Press, New York, USA. (Topic VII)
6. Shetty Nandini 2006, Immunology… Introductory Textbook, New Age International Publishers New Delhi, India. (Topic II)
7. Stites D.P. & A.I. Terr 1990, Basic & Clinical Immunology, Prentice Hall, New York (Topics III)
8. Thomas J. Kindt et.al.2007, Kuby Immunology, Sixth Edition, W.H. Freeman and Company, New York, USA. (Topics IV and VI)

T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)

SEMESTER-VI

MB 63 Biotechnology

Total credits 04 **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to -

- Develop the skills in Strain Improvement
- Study the production of solvents, Organic Acids, Vitamins & Amino Acids
- Detect & assess the various fermentation products
- Understand the role of Quality control department in testing of products & the concept of patents

Course content

I Classical Fermentations **20**

i. Alcohol (Ethyl alcohol)
ii. Wines
iii. Organic Acid – Citric acid,
iv. Microbial enzyme – Amylases
v. Vitamin – Vitamin B_{12}
vi. Amino acid – Lysine
vii. Biomass production: yeast Biomass, Baker's and Distillers Yeast

II Strain Improvement (Techniques with suitable examples) **12**

i Mutation approach
a. Use of auxotrophic,
b. Resistant mutants for the production of primary and secondary metabolites
c. Revertant mutants for the production of primary and secondary metabolites.

ii Recombination techniques
a. Protoplast fusion technique.
b. Genetic manipulation technique.

III Detection and assay of fermentation products. **08**

i. Chromatographic assays.
ii. Biological assays.

IV Quality Control. **12**

i. Chemical assay
ii. Pyrogen testing
iii. Sterility testing
iv. Carcinogenicity testing-Ames Test
v. Toxicity testing
vi. Allergy testing

V Fermentation Economics 08

i. Market potential.
ii. Fermentation and Product recovery costs.
iii. Patents and Secret Processes**.**
   a. History of patent concept.
   b. Subject matter and characterization of a patent.
   c. Inventor.
   d. Patents in India and other countries.

References:

1 Casida L.E. Jr. (1983) – Industrial Microbiology, Wiley Eastern Limited, New Delhi.

2 Hunt, R and J Shelly (1995) – Computer and common sense, 4th edition, Prentice – Hall of India Private Ltd., New Delhi.

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5 Peppler H.H. (Ed) (1979) – Microbial Technology Vol. I and II, UU Academic Press, New York.

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8 Rajaraman V. (1996) – Fundamentals of Computers, 2nd edition, Prentice – Hall of India Private Ltd., New Delhi.

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10 Subbarao, N.S. (1993) – Biofertilizers in Agriculture and Forestry, 3rd edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

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T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)

SEMESTER-VI

MB 64 Genetics of Eukaryotes and Gene Manipulation

Total credits 04 **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to –

- Develop broader perspective in Non Mendelian Inheritance
- Know the recent developments in DNA technology & their applications
- Understand the role of cloning vectors & joining DNA Molecules
- Get equipped with the procedure of Electrophoresis & PCR

Course content

I. Extra nuclear Inheritance.

A. In Eukaryotes. (Non Mendelian inheritance.) **10**

i. Rules of extra nuclear inheritance.
ii. Organization of extra nuclear genomes.
iii. Origin of mitochondria and chloroplast.
iv. Mitochondrial genome.
v. Chloroplast genome.
vi. Other Examples of extra nuclear inheritance.
   a. Chloroplasts in 4'0 clock plant and corn.
   b. Streptomycin resistance in *Chlamydomonas*
   c. Respiratory deficiencies—Petites in yeast *Saccaromyces cerevisiae*
   d. Poky mutants in *Neurosporacrassa.*
   e. Human genetic diseases and mitochondrial DNA defects

B Infectious heredity **04**

i. Killer yeast.
ii. Killer Paramecia

C Maternal effect. Examples: **06**

i. Pigmentation in Flour moth,
ii. Inheritance of coiling in some snails
iii. Maternal effects in humans

II. Recombinant DNA technology.

A. Introduction-Historical: Asilomer conference and NIH guidelines **01**

B .Cutting DNA molecules05

i. Nucleases cut Nucleic Acids.
ii. Restriction and modification of DNA.
iii. Recognition of DNA by Restriction Endonucleases.
iv. Naming of restriction enzymes
v. Cutting of DNA by restriction enzymes
vi. Types of restriction enzymes

C. Joining DNA molecules

i. Joining of DNA fragments by DNA ligases **07**
ii. Joining of DNA fragments by addition of homopolymers
iii. Blunt end ligation-T4 ligase

iv. Linkers and Adaptors

D. Cloning vectors. **10**

I. Plasmids

a) Plasmid detail studies
b) General properties of plasmids
c) Detection of plasmids
d) Purification of plasmid DNA
e) *In Vitro* Plasmid Transfer:chemical transformation,Elecrotransformation
f) Plasmid Replication :Use of host proteins in plasmid replication,
g) Control of copy number ,control of copy number by antisense RNA
h) Concept.-Plasmid families andIncompatibility,*The par systems*
i) Replication inhibition by acridines
j) Properties and Advantages Of Particular Bacterial Plasmids:
   i. F plasmid, Drug resistance plasmid, Colicinogenic plasmids,
   ii. *Agrobacterium* plasmid (Ti plasmid),broad host range plasmids, other plasmids

II. Inserting Genes into Vectors.
III. Detecting Insertions in vectors.
IV. Moving genes between organisms: Shuttle vectors
V. Bacteriophage Lambda vectors.
VI. Cosmid vectors
VII. Yeast Artificial Chromosomes.
VIII. Bacterial and P1 Artificial Chromosomes.

E. Cloning Strategies **04**

I. Cloning genomic DNA
II. cDNA cloning
III. Genomic library and c DNA library
IV. Screening Strategies

F. Basic Techniques **06**

I. Agarose gel electrophoresis
II. Blotting techniques
III. Transformation in suitable host
IV. Polymerase Chain Reaction.

G. Applications of Recombinant DNA Technology. **07**

I. Nucleic acid sequences as diagnostic tools
II. Biotechnology: Commercial Products.
III. Synthetic and edible vaccines
IV. Genetic Engineering of plants and animals
   - Plants as bioreactors
   - Animals as bioreactors

References.

1. Norris, J.R. and D.W. Ribbons. (1972).Methods in Microbiology, Volume 7, Part Academic Press.
2. Clark D. P. (2005) Molecular Biology. Understanding the Genetic Revolution. Elsevier publishers.
3. David A. Jackson, Stephen P. Stitch, (1979). Recombinant DNA Debate
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11. Trun N and J Trempy (2004) Fundamental Bacterial Genetics. Blackwell publishing.
12. Watson, J. D. (2007) Recombinant DNA: Genes and Genomes: A Short Course Publisher, W. H. Freeman, Edinburgh: Blackwell Scientific Publications.
13. William Hayes, The Genetics of Bacteria and their Viruses (1968) 2nd Edition Oxford- by Prentice Hall.
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T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)
SEMESTER-VI
MB 65 Microbial Metabolism and Biochemical Evolution

Total credits 04 **Total 60 Lectures**

Course Learning Outcomes:

On completion of Course Students are able to –

- Understand the Microbial transport systems
- Have knowledge regarding the laws of Thermodynamics, Concept of Entropy, Enthalpy, free energy changes in Biological systems
- Understand the various modes of respiration & Intermediary mechanisms involved
- Have conceptual knowledge of the biosynthetic & degradative pathways
- Discuss the Evolutionary aspects of Biomolecules

Course Content

I. Introduction to metabolism 02

II. Biological membrane & transport mechanisms. 08

A. An overview of Biological membrane structure

B. Functions of Membrane

i. Transport mechanisms.

a) Passive transport – Diffusion, osmosis, facilitated transport.
b) Active transport – Transport systems in bacteria.
c) Group translocation – Group translocation of sugars into bacteria.
d) Ionophores.

ii. Signal transduction: concept

III. Bioenergetic considerations 10

i. Laws of thermodynamics, free energy, standard free energy change, additive nature of standard free energy charge, enthalpy and entropy.
ii. High energy compounds
iii. Electron transport chain components and electron flow:
iv. Electron carriers in respiratory chain : Complex I, II, III, IV-structure Oxidative phosphorylation, Chemiosmotic control mechanism
v. Bioluminescence, biochemistry of bioluminescence and applications in biosensors

IV. TCA cycle as central metabolic pathway 08

i. Stoichiometry and energitics of citric acid cycle
ii. Control of TCA cycle
iii. Anaplerotic reactions
iv. Amphibolism
v. Stickland reaction.

V. Metabolism of biomolecules 25

A. Nucleotide metabolism

i. Synthesis of purine nucleotides.
ii. Synthesis of pyrimidine nucleotides.
iii. Degradation of nucleotides

B. Lipid metabolism

i. Role of Acetic acid as precursor of lipids
ii. Acyl carrier protein and β- keto acyl synthase
iii. Synthesis of triacylglycerol
iv. Synthesis of glycerophospholipids
v. Degradation of fatty acids - β oxidation
vi. Fate of acetyl CoA derived from fat breakdown
vii. Peroxisomal oxidation of fatty acids

C. Metabolism of Amino acids

i. The synthesis of Amino acids

a. Synthesis of glutamic acid
b. Synthesis of aspartic acid
c. Synthesis of glycine
d. Synthesis of serine
e. Synthesis of valine
f. Synthesis of isoleucine
g. Synthesis of aromatic amino acids by ‘Shikimic acid pathway’
h. Deamination of amino acids
i. Fate of keto acids formed after deamination

ii. Synthesis of proteins.

a. Initiation
b. Elongation
c. Termination
d. Antibiotics inhibiting protein synthesis

D. Carbohydrate metabolism

i. The synthesis of oligosaccharides and polysaccharides

a. Synthesis of starch
b. Synthesis of glycogen
c. The synthesis of peptidoglycan,Antibiotics inhibiting peptidoglycan synthesis

E. The synthesis of isoprenoids

i. Isoprene formation
ii. Polyprenyl compounds
iii. Carotene formation
iv. Synthesis of heme v.

VI. Biochemistry of biological nitrogen fixation. 02

i. Biogenesis of Ammonia
ii. Nitrogen fixation mechanism
iii. Nitrogenase complex

VII. Biochemical Evolution. 05

i. The primordial cloud theory.
ii. Primitive atmosphere & primitive seas.
iii. Monomer formation.
iv. Periodic condensing agents.
v. Periodic formation of polypeptides.
vi. The periodic origin of enzymatic activity.
vii. The prebiotic origin of nucleotides & nucleic acids.
viii. Coacervate droplets.
ix. The gene hypothesis : Life without proteins

References:-

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8. Subbarao, N.S. (1979) Recent advances in biological Nitrogen fixation. Oxford IBH Publishing Co. Private ltd, New Delhi.

T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)
SEMESTER-VI
MB 66 Practical Course – VIII

Total credits 02 **Total number of**

Experiments: 15 Course Learning Outcomes:

On completion of Course Students are able to –

- Measure the rate of fall & increase of erythrocytes & PCV
- Identify the Antigen, Antibody reactions
- Get the significance of total blood count & differential blood count
- Determine Koch's postulates & its importance

1. Identification of an Antigen – Antibody complex by 2
   a. Gel diffusion analysis (Immunodifusion or Ouchterlony plate method)
   b. The Ring Test
2. Total Blood cell count – WBC, RBC, platelet. 3
3. Differential blood count 1
4. Estimation of Total Hemoglobin 1
5. Determination of ESR and PCV 1
6. RBC indices and its significance 1
7. Determination of Koch's postulates by using a pathogen either on plant or animal. 3
8. Determination of antibiotic peak levels attainted in body fluids. 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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9. Sharma K. (2005) Manual of Microbiology Tools & Techniques Ane Book New Delhi.

T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)

SEMESTER-VI

MB 67 Practical Course – IX

Total credits 02 **Total number of**

Experiments: 15 Course Learning Outcomes:

On completion of Course Students are able to –

- Get the advantages of Biofertilizers over Chemical Fertilizers & their preparation methods
- Have the information about the standardization of many Therapeutic agents, which either inhibit the growth of Micro-Organisms or are essential for their growth by assay method
- Identify the Fungi & observing various aspects by slide culture techniques
- Have knowledge of applications of yeast in various industries
- Get equipped with an overview of citric acid production from *Aspergillus niger*

1. Microbiology of soil. 7
    1. TVC : estimation of R:S ratio
    2. Isolation of *Rhizobium*sp from root nodules.
    3. Isolation of *Azotobacter*sp
    4. Preparation of bio fertilizers.
2. Study of Fungi 2
    1. Culture of Baker's yeast – with different carbon and energy sources.
    2. Slide culture technique
3. Industrial Microbiology. 6
    1. Production, estimation and tests of Citric acid or wine
    2. Microbiological Assays of
    a) Vitamin- B_{12}
    b) Antibiotic- Penicillin and or Streptomycin

References:–

1. Benson H.J. (1990) Microbiological Applications A Laboratory manual in General Microbiology, 5th Edition Wm. C Brown Publisher.
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T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)

SEMESTER-VI

MB 68 Practical Course – X

Total credits 02 **Total number of Experiments: 15 Course Learning Outcomes:**

On completion of Course Students are able to –

- Understand the method for the determination of total cholesterol, Urea, glucose, protein, Billrubin in serum
- Know the principle & practice of Agarose Gel electrophoresis & its application
- Have significance of conjugation & transformation, its application.
- Get the knowledge of the principle & applications of electrophoresis.

1. Gel Electrophoresis – Isolation of DNA and Plasmids (demonstration)	2
2. Polyacrylamide Gel electrophoresis-Isolation of protein (demonstration)	1
3. Bacterial conjugation (demonstration)	1
4. Bacterial transformation (demonstration)	1
5. Polyploidy (demonstration)	1
6. Phosphatase test.	1
7. Estimation of serum Glucose.	1
8. Estimation of serum Urea.	1
9. Estimation of serum Cholesterol	1
10. Estimation of serum Protein	1
11. Estimation of serum Bilirubin and or SGOT/SGPT	3
12. Estimation of Riboflavin in human urine	1

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T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)
SEMESTER-VI
MB (69-A) Agricultural and Environmental Microbiology.

Total credits 04 **Total 60 Lectures.**

Course Learning Outcomes:
On completion of Course Students are able to –

- Generate the basic skills in the preparation of Bioinoculants
- Know the importance of Biomonitoring & recycling of Agricultural wastes
- Understand the scope of Geomicrobiology & production of Biogas
- Have an awareness on taking efforts in controlling the water & marine pollution

Course Content

I. Agricultural Microbiology. 28

i. Biomonitoring
   a. A concept – basis of biomonitoring.
   b. Advantages and disadvantages of biomonitoring.

ii. Marker methods for ecological studies of soil microorganisms
   a. Microscopic visualization
   b. Phage markers
   c. Resistance markers
   d. Nutritional and enzymatic markers

iii. Recycling of agriculture waste
   a. Composting – Materials for composting, types of composting, composting process and Methods

iv. Bioinoculants
   a. Concept and different types
   b. Examples: Azo and Rhizo, Azospirillum, Mycorhiza, Phosphate solubilizers
   c. Methods of preparation
   d. Methods of Inoculation

v. Microbes as plant pathogens
   a. Historical background
   b. Host parasite relationship
   c. Diseases – Citrus canker& TMV:- Causative agent, Symptoms and physiology of disease, Mode of entry of pathogen and Control measures.

II. Environmental Microbiology.

A .Geomicrobiology 08

i. Scope of Geomicrobiology
ii. *In-situ* process
iii. Bioleaching and beneficiation processes

B. Biogas production 08

i. Concept
ii. Biochemistry underlying production
iii. Methods of production
iv. Energy generated
v. Role in pollution control

D. Water 08

Definition and types of pollution

i. Effect of various pollutants on water
ii. Organic pollutants
iii. Inorganic pollutant
iv. Radioactive pollutants
v. Petroleum and oil pollutants

E. Marine pollution 08

i. Sources of marine pollution
ii. Point sources.
iii. Non point sources
iv. Types of marine pollution.
v. Efforts to control and protect marine environment
vi. Microbial approach in remediation of oil contaminated marine sites.

References:–

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2 Maier R.M. Pepper I.L. Gerba C.P. (2004), Environmental Microbiology, Academic Press.

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6 Rana SVS, (2006), Environmental Pollution, Health and Toxicology, Narosa publishing House, New Delhi.

7 Sharma B.K. and Kaur H. (1994) Water pollution. GoelPublishing House,Merrut.

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9 Thakur Indu (2006) Environmental Biotechnology., I.K. International Pvt. Ltd., New Delhi.

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11 SubbaRao, N.S. (1999), Soil Microbiology 4thEdnSoil Microorganisms and Plant growth, Oxford and IBH publishers, New Delhi.

T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)

SEMESTER-VI

MB 69-B Applied Microbiology-II

Total credits 04 **Total 60**

Lectures

Course Learning Outcomes:

On completion of Course Students are able to –

- Understand the various guidelines & basic principles of Quality Control ,Quality Assurance & Concepts of NABL Accreditation
- Study the safety guidelines in the laboratory & introduction to code of practice
- Analyze the policy documents regarding micro-organisms
- Develop the fundamentals of clinical trials &

knowing the theories of Bioethics **Course Content**

I. Introduction to the role of regulatory bodies and basic principles of Quality control & Quality assurance 02

II. NABL (National Accreditation Board for Testing and Calibration Laboratories) 10
Guidelines
i. Concept of Accreditation
ii. Need of Accreditation
iii. Introduction to NABL
iv. Significance tasks for NABL Accreditation

III Laboratory Bio safety: W.H.O. views & guidelines 10

i. Introduction to code of practice

a) Access guidelines in laboratories
b) Personal protection
c) Procedures
d) Laboratory working areas

ii. Laboratory design & facilities
iii. Introduction to biological safety cabinets & types of biological safety cabinets (Introductory level only)
iv. Chemical germicides for cleaning of laboratory materials

v. Risk assessment for GMO (Genetically Modified Organisms)

IV. Policy Documents regarding Microorganisms 1

i. National Biodiversity Authority & its role in conservation & exploitation of microorganisms

ii. Patenting microorganisms in India

a. Introduction
b. Subject matters of patentability
c. Invention Vs. Discovery
d. Patenting in the perception of TRIPS agreement & Patent Act , 1970 as amended in June 2002
e. Legal sustainability of the microbial patent

V Fundamentals of Clinical Trials 15

i. What is clinical trial

ii Clinical

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a) Phase I
b) Phase II
c) Phase III
d) Phase IV

VI. Bioethics 08

i. Introduction
ii. Theories of bioethics: Deontology theory, Virtue theory
iii. Experiments of animals

References:–

1. Friedman Lawrence M, Curt D. Furberg, David l. DeMets (1998), Fundamentals of Clinical Trials. 3rd Edition Springer International

2. Kanagasabapathy A.S & Pragna Rao Laboratory accreditation - Procedural Guidelines, Indian Journal of Clinical Biochemistry, 2005, 20 (2) 186-188

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T.Y.B.Sc. MICROBIOLOGY (C.B.C.S. 2018 Course)
SEMESTER-VI
MB 69-C Advanced Techniques in Microbiology-II

Total credits 04 **Total 60**
Lectures.
Course Learning Outcomes:
On completion of Course Students are able to –

- Acquire the techniques in the enumeration of viruses & serology
- Adapt the techniques in the purification & characterization of Enzymes
- Understand the process of recovery & purification of fermentation products
- Get an in depth Knowledge

of the Enzyme assay methods

Course Content

I. Techniques In Immunology

A. Enumeration of viruses **06**

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.)

B. Serology **20**

i. Agglutination
ii. Immunodiffussion
iii. Oudin Tube Technique
iv. SRID
v. Ouchterlony Technique
vi. Immunoelectrophoresis
vii. Radioimmunoassay and its applications
viii. Immunofluorescence
ix. ELISA: Direct,Indirect

II. Techniques In Enzymology

A. Purification and characterization of enzymes **10**

i. Methods of purification based on Molecular size:
   a. Dialysis
   b. Gel exclusion chromatography
   c. Centrifugation based on Solubility differences.

ii. Electric charge.
   a. Ion exchange chromatography
   b. IEF

iii. Specific binding property and selective adsorption.
   a. Affinity chromatography

iv. Criteria for purity.
v. Determining molecular weight of protein

B. Enzyme assays **10**

i. Principles of enzyme assays.

ii. Assay techniques with suitable examples.

a. Electrode method
b. Manometric
c. Spectrophotometric
d. Fluroscence spectroscopic
e. Radiochemical assay

ii. Coupled kinetic assay

C. Purification of viruses **04**

i. Differential centrifugation.
ii. Density gradient centrifugation.
iii. Precipitation.

III. Recovery and purification of fermentation products. 10

i. Foam separation.
ii. Precipitation.
iii. Filtration and Ultrafiltration.
iv. Centrifugation.
v. Solvent extraction.
vi. Solvent recovery.
vii. Adsorption and elution.
viii. Drying
ix. Crystallization

References

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3) David E. Metzler, Vol I & II 2nd edition (2006) Biochemistry "The Chemical Reactions of Living cells", Academic Press
4) David Male, Jonathan Brostoff , David B Roth, Ivan Roitt, 2006, Immunology, 7th edition Mosby ELSEVIER,Canada. (Topics I, II and III)
5) David Nelson & Michael M. Cox Lehniger, A.L. (1975), (2013)Biochemistry 2nd , 6thedition. Kalyani publisher, New Delhi.
6) Dimmock N.J. A. J. Easton and K.N. Leppard (2001) Introduction to Modern Virology Blackwell science
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8) Ian R Tizard 2004, Immunology, An introduction, 4th Edition, Saunders College Publishing. U.K. (Topics III, IV and VI)
9) Ivan M. Roitt,PeterJ.Delves, 2001, Roitt's Essential Immunonology,10th Edition, 2001, Blackwell publishing Company, USA. (Topics III and VI)
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