Board of Studies in Physics

FACULTY OF SCIENCE

GONDWANA UNIVERSITY, GADCHIROLI

Syllabus of

M.Sc. Second Year (Semester Pattern) (Choice Based Credit System)

SUBJECT - PHYSICS

Semester III & Semester IV

Syllabus for M. Sc. Physics

Choice Based Credit System (Semester Pattern)
Gondwana University, Gadchiroli
Effective from 2016-2017

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in subjects Physics
Semester III;

Core	Theory / Practical	Teaching Scheme Hrs/ week			Credit	Examination Scheme					
						hrs. Duration	Max. Marks			Minimum Marks	
		Theory	Practical	Total			External	Internal	Total	Theory	Practical
Core 9 (PSCPHYT09)	Paper 9 Quantum Mechanics II	4	-	4	4	3	80	20	100	40	
Core 10 (PSCPHYT10)	Paper 10 Solid State Physics and Spectroscopy	4	-	4	4	3	80	20	100	40	
Core Elective I (PSCPHYT11)	Paper11 Material Science I OR Nanoscience and Nanotechnology I OR Atomic and Molecular Physics I	4	-	4	4	3	80	20	100	40	
Foundation Course I (PSCPHYT12)	Paper 12 Fundamental of Spectroscopy OR Fundamental of Nanoscience and Nanotechnology	4	-	4	4	3	80	20	100	40	
Practical.5	Practical 5 (Based on Core 9 & 10)	-	8	8	4	3-8*	80	20	100		40
Practical. Elective I	Practical 6	-	8	8	4	3-8*	80	20	100		40
Seminar 3	Seminar 3	2	-	2	1			25	25	10	
TOTAL		**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

Semester IV:

Core	Theory / Practical	Teaching Scheme			Credit	Examination Scheme					
		Hrs/ week				Duration in hrs	Max. Marks		Total	Minimum Marks	
		Theory	Practical	Total			External	Internal		Theory	Practical
Core 11 (PSCPHYT11)	Paper 13 Nuclear and Particle Physics	4	-	4	4	3	80	20	100	40	
Core 12 (PSCPHYT12)	Paper 14 Solid State Physics	4	-	4	4	3	80	20	100	40	
Core Elective II (PSCPHYT15)	Paper 15 Material Science II OR Nanoscience and Nanotechnology II OR Atomic and Molecular Physics II	4	-	4	4	3	80	20	100	40	
Fundation Course II	Paper 16 Spectroscopic Applications OR Optics and Optical instruments	4	-	4	4	3	80	20	100	40	
Practical.	Practical 7 (Based on Core11,12and Elective II)	-	8	8	4	3-8*	80	20	100		40
Project	Project	-	8	8			80	20	100		40
Seminar 4	Seminar 4	2	-	2	1			25	25	10	
TOTAL		**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

Seminar

Guidelines for Students, Supervisors and Examiners

In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.

The students should submit the seminar report typed and properly bound in one copy to the head of the department. The said shall be evaluated by the concerned supervisor / head of the department. The marks of the seminar shall be forwarded to the university within due period through head of the Department. The record of the seminar should be preserved till the declaration of the final result.

Internal Assessment:

1. The internal assessment marks shall be awarded by the concerned teacher.
2. The internal assessment marks shall be sent to the University after the Assessment in the prescribed format.
3. For the purpose of internal assessment the University Department / College shall conduct any three assignments described below. Best two scores of a student in these tests shall be considered to obtain the internal assessment score of that student.
4. If the student does not appear for the Practical Exam he shall be declared failed in Practical Examination irrespective of marks obtained in Internal Practical Assessment. However the Internal Practical Assessment marks will be carried forward for his next supplementary Practical Exam.
5. General guidelines for Internal Assessment are:
   a) The internal assessment marks assigned to each theory paper as mentioned in Appendix 1 shall be awarded on the basis of assignments like class test, attendance, home assignments, study tour, industrial visits, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice / activity.
   b) There shall be three assignments (as described above) per course.
   c) There shall be no separate / extra allotment of work load to the teacher concerned. He/ She shall conduct the internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.
   d) The concerned teacher / department / college shall have to keep the record of all the above activities until six months after the declaration of the results of that semester.
   e) **At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method he / she propose to adopt and the scheme of marking for internal assessment. (Prescribed in syllabus of respective Subjects).
   f) Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD / Principal.

Practical Examination

1. Each practical carries 100(80 Pr+20 Int) marks. The scheme of marking shall be as per given in the syllabi of respective subjects.
2. Practical performance shall be jointly evaluated by the External and Internal Examiner. In case of discrepancy, the External Examiner's decision shall be final.
3. Duration of practical examination will be as per given in the syllabi of respective subjects.
4. The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department. If the student fails to submit his / her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he / she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.

5. The certificate template shall be as follows:

C E R T I F I C A T E

Name of the college / institution _

Name of the Department: _

This is to certify that this Practical Record contains the bonafide record of the Practical work of Shri / Shrimati / Kumari _ of M. Sc. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ Semester _ _ _ _ _ _ _ _ _ _ during the academic year _ _ _ _ _ _ _. The candidate has satisfactorily completed the experiments prescribed by Gondwana University Gadchiroli for the subject _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Dated _ _ _ / _ _ _ / _ _ _ _ _

Signature of the teacher who taught the examinee Head of the Department

1. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

2. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

General Rules and Regulations regarding pattern of question paper for the semester end examination:

A) Pattern of Question Paper

1. There will be four units in each paper.
2. Maximum marks of each theory paper will be 80.
3. Question paper will consist of five questions, each of 16 marks.
4. Four questions will be on four units with internal choice (One question on each unit).
5. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

M.Sc. Physics Semester III

1. (Core 9) Paper 9: Quantum Mechanics-II
2. (Core 10) Paper 10: Solid State Physics and Spectroscopy
3. Any one of the Elective papers from the following list. Paper 11 (Core Elective 1)

E1.1 Materials Science I
E1.2Nanoscience and Nanotechnology I E1.3. Atomic and Molecular Physics I
E1.4Applied Electronics I

4. Foundation course 1
Any one of following courses: Paper 12

F1.1 Fundamentals of Spectroscopy
F1.2 Fundamentals of Nanoscience and Nanotechnology

M.Sc. Physics Semester IV

1. (Core 11) Paper 13: Nuclear and Particle Physics
2. (Core 12) Paper 14: Solid State Physics
3. One of the elective papers from list below Paper 15 (Core Elective 2)

E2.1 Materials Science II
E2.2 Nanoscience and Nanotechnology II E2.3 Atomic and Molecular Physics II
E2.4 Applied Electronics II

4. Foundation course II
Any one of the following courses: Paper 16
F2.1Spectroscopic Applications
F2.2Optics and Optical Instruments

Semester III Paper 9 (Core 9) Quantum Mechanics II

Unit- I

Time independent perturbation theory, First order perturbation theory applied to non-degenerate states, second order perturbation extension to degenerate state, Application of perturbation theory to the ground state energy, He atom (calculation given in Pauling and Wilson), Normal and anomalous Zeeman effect, First order Stark effect in the ground and first excited states of H atom and second order Stark effect of H atom, and harmonic oscillator.

Unit II

Time dependent perturbation theory, transition state, Fermi Golden rule, constant perturbation harmonic in time, radiative transitions, absorption and induced emission, atomic radiation, dipole approximation, Einstein's atomic radiation, Einstein's A and b coefficients and their calculations.

Approximation methods: W. K. B. method and its application to barrier penetration.

Variational principle and its application to simple cases like ground state of He atom and deuteron in Yukawa potential.

Unit III

System of identical particles, exchange and transposition operators, totally symmetric and antisymmetric wave function and their expressions for a system of non-interacting particles, statistics of systems of identical particles, Relation of statistics with spin, Ortho and para states of the helium atom and their perturbation by Coulomb repulsion.

Hamiltonian of a molecule, Born-Oppenheimer approximation, outline of Heitler-London theory of the hydrogen molecule.

Scattering theory, scattering cross-section in laboratory and centre of mass system, scattering by a central potential, Partial wave method, phase shifts and their importance, scattering by a square well potential and a perfectly rigid sphere, resonance scattering.

Unit IV

Relativistic wave equation, the Klein-Gordon equation and initial difficulties in interpreting its solutions, Dirac's relativistic equation, Dirac's matrices, explanation of the spin of the electron, equation for an electron in an electromagnetic field and explanation of the magnetic moment due to the electron spin, spin-orbit interaction, solution for hydrogen atom in Dirac's theory, negative energy states and their qualitative explanations.

Text and References Books:

1. E. Merzbacher, Quantum Mechanics (Wiley and Sons-Toppon)
2. J. L. Powell and B. Crasemann, Quantum mechanics (B I Publications)
3. L. I. Schiff, Quantum Mechanics (McGraw-Hill)
4. Quantum Mechanics: Aruldhas
5. Pauling and Wilson, Introduction to Quantum Mechanics
6. A.K. Ghatak and Lokanathan, Quantum Mechanics (Macmillan, India)
7. Quantum Mechanics: 500 problems with Solutions: Aruldhas (PHI)

Semester III Paper 10 (Core 10) Solid State Physics and Sprectroscopy

Unit I: Order in Solids-Crystal classes and system, 2d and 3d lattices, Space groups, Concept of point group, bonding of common crystal structure; reciprocal lattice, diffraction and structure factor, Miller and Bravais indices, Bonding, diffraction and structure factor in solids, short and long range order in liquids and solids, liquid crystals, quasicrystals and glasses

Unit II

Defects: Vacancies, Point defects, line defects and stacking faults, Burgers vector andBurger circuit, presence of dislocation, dislocation motion, perfect and imperfect dislocations, slip planes and slip directions, dislocation reactions

Dielectric Properties: -Polarization mechanisms, Clausius-Mossotti equation, piezo,pyro and ferroelectricity

Unit III

Atomic Structure and Atomic Spectra : Quantum states of an electron in an atom.Electron spin.Spectrum of helium and alkali atom. Some features of one-electron and two electron atoms, Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Inner shell vacancy, X-rays and Auger transitions.chemical shift. Frank-Condon principle.

Unit IV

Molecular Structure and Molecular Spectra : Types of molecules, Electronic,rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Morse potential energy curve, Molecules as vibrating rotator, Vibration spectrum of diatomic molecule, PQR branches. Elementary discussion of Raman, ESR and NMR spectroscopy, chemical shift

Reference Books:

1. Physics of Atoms and Molecules: Bransden and Joachain.
2. Introduction to Atomic Spectra: H.E. White.
3. Solid State Physics, Charles Kittel, John Willey & Sons
4. Molecular Spectra and Molecular Spectroscopy (Vol. 1), G. Herzberg
5. Introduction to Atomic Spectra: HG Kuhn
6. Fundamentals of molecular spectroscopy, C.B. Banwell
7. Introduction to molecular Spectroscopy , G. M. Barrow
8. Introduction to Solid State Physics: C. Kittle
9. Materials Science and Engineering: V. Raghavan
10. Solid State Physics: S. O. Pillai (New Age International 2006)
11. FerroelectricityJona and Shirane

Semester III Practical 5

Practical 5 (Core 9 and Core 10)

1.Determination of ionization potential of lithium

2.X-ray diffraction by TELEXOMETER.

3.Study of emission spectra of iron (Iron arc).

4.Determination of Dissociation Energy of Iodine Molecule by photography of the absorption band of Iodine in the visible region.

5.Study of Stark effect

6.Study of Molecular Spectra

7.Determination of Rydberg's constant

8.Determination of Plank's constant

9. Study of Crystals

10. Study of line spectra

Note: Instructor can introduce new and relevant experiments which are not in the list.

Semester III Paper 11 (Core Elective E1.1) Materials Science I

Unit- I

Equilibrium and kinetics: Stability and metastability, Basic thermodynamic functions,Statistical nature of entropy, Kinetics of thermally activated process.

Phase diagrams: The phase rule, free energy composition diagram, correlation betweenfree energy and phase diagram, calculation of phase boundaries, thermodynamics of solutions, single component system (water), two component system containing two phases and three phases, Binary phase diagrams having intermediate phases, Binary phase diagrams with eutectic system. Lever principle, maximum, minimum, super lattice, miscibility gap, microstructure changes during cooling, application to zone refining.

Unit – II

Phase transformations: Time scale for phase changes, peritectic reaction, eutectoid andeutectic transformations, order disorder transformation, transformation diagrams, dendritic structure in alloys, transformation on heating and cooling, grain size effect on rate of transformation at constant temperature and on continuous cooling, grain size effect on rate of transformation, nucleation kinetics, growth kinetics, interface kinetics leading to the crystal growth.

Unit-III

Diffusion in solids: Fick's laws and their solutions, the Kirkendall effect, mechanism ofdiffusion, temperature dependence of diffusion co-efficient, self diffusion, interstitial diffusion, the Snoek effect in diffusion, diffusion in ionic crystals, diffusion path other than the crystal lattice, thermal vibrations and activation energy, diffusion of carbon in iron.

Solid State Ionics: Definition, classification and characteristic properties of solidelectrolytes. Complex impedance spectroscopy, Arrhenius theory of ionic conductivity. Chemical sensors: Nernst equation, potentiometer and amperometric sensors for various gases, electrochemical redox-reaction, advantages of electrochemical sensors.

UNIT-IV

Solid state energy devices: Fundamental of Solar cells, Primary and secondary solidstate cells, advantages of lithium batteries, ion intercalation compounds for secondary cell, open circuit voltage and short circuit current, intercalation compounds for secondary cell, open circuit voltage and short circuit current, Energy density, power density. Fuel cells – advantages and disadvantages, classification, efficiency- emf of fuel cells, hydrogen/oxygen fuel cell, criteria for the selection electrode and electrolyte, methanol fuel cell, solid oxide fuel cells, phosphoric acid fuel cells, molten carbonate fuel cell, proton exchange membrane fuel cell, biochemical fuel cell.

Text and Reference books:

1. Vanvellak: Materials Science.
2. V. Raghvan: Materials Science.
3. D. Kingery: Introduction to ceramics.
4. R. E. Reedhil: Physical metallurgy.
5. Martin Start Sharger: Introductory materials.
6. Sinnot: Solid state for engineers.
7. Kelly and Groves: Crystal and defects.
8. Kittel: Solid state physics, Vth edition.
9. M. A. Azaroff: Elements of crystallography
9. Introduction to solid state theory: Modelung.
10. Fuel Cells – A. Mcdougall, Macmillan 1976 Ch 3,5,7,8 and 11.

Semester III Paper 11 (Core Elective E1.2) Nanoscience and Nanotechnology I

Unit I:

*Introduction to Nanoscience**:***

Free electron theory (qualitative idea) and its features, Idea of band structure, Density ofstates for zero, one, two and three dimensional materials, Quantum confinement, Quantum wells, wires, dots, Factors affecting to particle size, Structure property relation, Size dependence properties. Determination of particle size, Increase in width of XRDpeaks of nano-particles, Shift in photoluminescence peaks, Variation on Raman spectra of nano-materials.

Unit II:

Synthesis of Nanomaterials:

Physical methods**:** High energy Ball Milling, Melt mixing, Physical vapour deposition, Ionised cluster beam deposition, Laser ablation, Laser pyrolysis, Sputter deposition, Electric arc deposition, Photolithography.

Chemical methods**:** Chemical vapour deposition, Synthesis of metal & semiconductor nanoparticles by colloidal route, Langmuir-Blodgett method, Microemulsions, Sol-gel method, Combustion method, Wet chemical method

Unit III:

Nanomaterials Characterizations:

X-ray diffraction, UV-VIS spectroscopy, Photoluminescence spectroscopy, Raman spectroscopy, Transmission Electron Microscopy, Scanning Electron Microscopy, Scanning Tunnelling Electron Microscopy, Atomic Force Microscopy, Vibration Sample Magnetometer, Spintronics

Unit IV:

*Special Nanomaterials and Properties**:***

Carbon nanotubes, Porous silicon, Aerogels, Core shell structures. Self assemblednanomaterials. Metal and semiconductor nanoclusters

Mechanical, Thermal, Electrical, Optical, Magnetic, Structural properties of nanomaterials

Text and Reference books:

1. Nanotechnology: Principles &Practicals. Sulbha K. Kulkarni ,Capital Publishing Co.New Delhi.

2. Nanostructures &Nanomaterials Synthesis, Properties & Applications**.**Guozhong Cao, Imperials College Press London.

3.Nanomaterials: Synthesis, Properties & Applications**.**Edited by A.S. Edelstein &R.C.Commorata.Institute of Physics Publishing, Bristol & Philadelphia.

4. Introduction to Nanotechnology. C.P. Poole Jr. and F. J.Owens, Wiley Student ed.

5. Nano: The Essentials. T.Pradeep , McGraw Hill Education.

6. Handbook of Nanostructures: Materials and Nanotechnology. H. S. NalwaVol 1- 5, Academic Press, Bostan.

7. Hand Book of Nanotechnology, Bhushan

8. Nanoscience and Technology: Novel Structure and Phenomena. Ping and Sheng

Semester III Paper 11 (Core Elective E1.3) Atomic and Molecular Physics I

Unit I

Quantum states of an electron in an atomic Electron spin, spectrum of hydrogen, Helium and alkali atoms, Relativistic corrections for energy levels of hydrogen; Basic principles of interaction of spin and applied magnetic field.

Concepts of NMR spectroscopy concepts of spin-spin and spin-lattice relaxation, chemical shift; spin-spin coupling between two and more nuclei; chemical analysis using NMR.

Mossbauer effect-Recoil less emission of gamma rays, chemical shieft, magnetic hyperfine interaction,

Unit II

electron spin resonance, experimental setup, hyperfine structure and isotopic shift,width of spectral lines, LS & JJ coupling, Zeeman, Paschen Back & Stark effect. Spontaneous and Stimulated emission, Einstein A & B Coefficients; LASERS, optical pumping, population inversion, rate equation, modes of resonators and coherence length, Role of resonant cavity, three and four level systems, Ammonia MASER, ruby, He-Ne, CO_2, dye and diode lasers, Lasers applications

Unit III

Rotational, vibrational and Raman spectra of diatomic molecules, Quantum theory, Molecular polarizability, Intensity alteration in Raman spectra of diatomic molecules, Experimental setup for Raman spectroscopy in the structure determination of simple molecules. polyatomic molecules, symmetric top asymmetric top molecules. Hunds rule.

Unit IV

Electronic spectra of diatomic molecules, Born Oppenheimer approximation, Vibrational Coarse structure of electronic bands, intensity of electronic bonds, Franck Condon principle, and selection rules,dissociation and pre dissociation, dissociation energy, rotational fine structure of electronic bands. General treatment of molecular orbitals, Hund's coupling cases.

Text Book and References:

1. Molecular Spectroscopy: - Jeane L. McHale.
2. Mossbauer spectroscopy –M. R. Bhide.
3. NMR and Chemistry – J. W. Akitt.
4. Structural Methods in inorganic chemistry, E.A V.Ebsworth, D. W. H.Rankin, S.Crdock.
5. Introduction to Atomic Spectra – H. E. White.
6. Fundamental of Molecular Spectroscopy – C. B. Banwell.
7. Spectroscopy Vol. I, II and III, Walker and Straghen.
8. Introduction to Molecular Spectroscopy – G. M. Barrow.
9. Spectra of diatomic molecules – Herzberg.
10. Molecular spectroscopy – Jeanne L. McHale.
11. Molecular spectroscopy – J. M. Brown.
12. Spectra of Atoms and Molecules – P. F. Bemath.
13. Modern Spectroscopy – J. M. Holkas.
14. Laser spectroscopy and instrumentation- Demtroder

Semester III Paper 11 (Core Elective E1.4) Applied Electronics I

Unit – I

Operational Amplifiers, Block diagram of a typical operational amplifier, analysis, open loop configuration, inverting and non-inverting amplifiers, operational amplifier with negative feedback,voltage series feedback, effect of feedback on close loop gain, input resistance output resistance bandwidth and output offset voltage, voltage follower. Practical operational amplifier, input offset voltage, input bias current, input off set current, total output off set voltage, CMRR, frequency response, dc and ac amplifier, summing, scaling and averaging amplifier, instrumentation amplifier, integrator and differentiator.Application of Op-Amp as fixed and variable voltage regulator. Oscillators principles- Barkhausen criterion for oscillations, The phase shift oscillator, Weinbridge oscillator, LC tunable oscillator, multi-vibrators, mono-stable and astable, comparators, square wave and triangular wave generators

UNIT II

Communication electronics: Amplitude modulation , generation of AM waves, demodulation of AM waves, DS BSC modulation, generation of DSBSC waves, coherent detection DSBSC wave, SSB modulation, generation and detection of SSB waves, Vestigial sideband modulation, frequency division multiplexing (FDM).

Microwave communication: Advantage and disadvantage of microwave transmission, loss in free space propagation of microwaves, atmospheric effect on propagation, Fresnel zone problem, ground refection,fading sources, detector components, antennas used in microwave communication systems

Unit – III

Microprocessor: Introduction to microcomputers, Memory. Input-output devices, interfacing devices.8085 CPU, architecture, bus timing, de-multiplexing, the address bus, generating control signals,instruction set, addressing modes, illustrative programmes, assembly language programmes, looping, counting and indexing, counters and timing delay, stack and sub routings. read only memory (ROM) and applications. Random access memory (RAM) and applications,

Digital to analogue converters. Ladder and weighted register types, analog to digital converters, ,successive approximations and dual slop converters, application of DAC and ADC,

Unit – IV

Microwave devices: Klystrons, magnetrons, and travelling wave tubes, velocity modulation, basic principle of two cavity klystrons and reflex klystrons, principle of operation of magnetrons, Helix travelling wave tubes, wave modes, transferred electron devices, gunn effect, principle of operation,modes of operation, read diode, IMPATT diode, TRAPATT diode..

Text and Reference Books:

1. Electronic devices and circuit theory: RobortBoylested and L. Nashdsky (PHI, New Delhi).
2. OP-Amps and linear integrated circuits: Ramakanth A. Gayakwad (PHI 2nd Edn).
3. Digital principles and Applications: A. P. Malvino and D. P. Leach (Tata Ma-Graw Hill).
4. Microprocessor architecture, programming and Application with 8085/8086, Ramesh S. Gaonkar(Wiley-Estern).
5. Microelectronics: Jacob Millman (Mc-Graw Hill International).
6. Optoelectronics: Theory and Practices: Edited by Alien Chappal (McGraw Hill).
7. Microwaves: K. L. Gupta (Wiley Ester New Delhi).
8. Advanced electronics communication systems: Wayne Tomasi (Phi Edn).
9. Fundamentals of microprocessors and Micro-computers: B. Ram. (DhanpatRao and Sons.).

Semester III Practical 6 and 7 for elective papers

Practical 6 and 7 (elective)

Materials Science

1. Crystal structure determination by powder diffraction.
2. Study of microstructures of metal alloys.
3. Dislocation in alkali halide crystals.
4. Crystal growth from slow cooling of the melt.
5. Thermal analysis of binary alloy.
6. Differential thermal analysis of $BaTiO_3$-$PbTiO_3$ solid solution.
7. To study electrochemical method of corrosion control.
8. Dielectric behaviour of $LiNbO_3$ and $BaTiO_3$ in crystals and ceramics.
9. Electrical conductivity of ionic solids.
10. To test hardness of a material by Brinell hardness tester.
11. Photo elasticity study.
12. Multiple beam interferromentric study of surfaces.
13. Thermal conductivity of bad conductor. 14. Thermal expansion coefficient of metals.
15. Study of transport property in solid electrolytes.
16. Verification Nernst law/Oxygen sensor.
17. Determination of Thermoelectricity Power.

Nanoscience and Nanotechnology

1. Synthesis of metal oxide nanoparticles by wet chemical method.
2. Deposition of thin films by spray pyrolysis technique.
3. Synthesis of inorganic nanomaterials by combustion method.
4. Synthesis of nanomaterials by sol-gel method.
5. Synthesis of conducting polymer nanofibres by chemical oxidation method.
6. Study of optical absorption of nanoparticles.
7. Determination of particle size of nanomaterials from x-ray diffraction.
8. Study of photoluminescence of well known luminescent nanoparticles.
9. Deposition of thin films by spin coating method.
10. Thermoluminescence study of nanomaterials.
11. Deposition of thin films by dip coating technique.
12. Study of particle size effect on luminescence.
13. Electrical characterization of nanostructured materials.
14. Synthesis of metal oxide nanoparticles by hydro-thermal method.
15. Deposition of thin film in vacuum.
16. Electrical resistivity of nanomaterials using four probe method
17. Photoluminescence study of prepared red/blue/green luminescent nanomaterials.
18. Characterization of nanomaterials using SEM/TEM.
19. Computer modelling methods for studying materials on a wide variety of length and time scales.

Atomic and Molecular Physics

1. Study of line spectra on photographed plates/films and calculation of plate factor.
2. Verification of Hartman's dispersion formula.
3. Study of sharp and diffuse series of potassium atom and calculation of spin orbit interaction constant.
4. Determination of metallic element in a given inorganic salt.
5. To record the spectrum of CN violet bands and to perform vibrational analysis.
6. To record the visible bands of ALO and to perform vibrational analysis.

7. To photograph and analyse the reddish glow discharge in air under moderate pressure.
8. To photograph the analyse the whitish glow discharge in air under reduced pressure.
9. To perform vibrational analysis of a band system of N2.
10. To perform vibrational analysis of band system of C2
11. To photograph and analyse the line spectrum of Calcium atom.
12. To record/analyse the fluorescence spectrum of a sample.
13. To record/analyse the Raman spectrum of a sample.
14. Study of Hyperfine structure of the green line of mercury.
15. To photograph the (O, O) band of CuH and to perform rotational analysis.
16. Flashing & quenching in Neon Gas.
17. E/m of electron.
18. Experiments on Prism/Grating Spectrometer.
19. Wavelength of laser light.
20. Faraday effect with laser.
21. Michelson interferometer.
22. Analysis of ESR Spectra of transition metals.
23. Analysis of H-atom spectra in minerals.
24. Measurements of dielectric constant of polymer sheet at low frequency.
25. E.S.R. of DPPH.
26. To measure the dielectric constant and polarisation of unknown liquid.
27. To measure the dielectric constant of unknown wood at microwave frequency
28. To measure the ultrasonic velocity in unknown liquid.
29. He-Ne Layer
30. To study polarisation of sodium light
31. To study polarisation of light using Babinet compensator.

Applied Electronic

1. Pulse amplitude modulation/demodulation
2. Pulse position/Pulse width modulation/demodulation
3. FSK modulation/demodulation using Timer/PPL
4. Microwave characterization and measurements.
5. PLL circuit and application.
6. Fibre Optics Communication.
7. Design of active filters.
8. BCD to seven segment display.
9. A/D and D/A conversion.
10. Experiments using various type of memory elements.
11. Addition, Subtraction, Multiplication and Division using 8085/8086.
12. Wave form generation and storage Oscilloscope.
13. Frequency Temperature voltage measurements.
14. Motor speed temperature control using 8086.
15. Trouble shooting using signature analyzer.
16. Assembly language programming on PC.
17. Experiment based on Computer aided design.
18. OPAMP as a integrator and differentiator.
19. OPAMP as a Schmitt trigger generator.
20. Construction and study of astable, monostable and bistablemultivibrator.
21. Study of OPAMP as fixed and variable voltage regulator.

Note: Instructor can introduce new and relevant experiments which are not in the list.

Semester III Paper 12 (Foundation course F1.1) Fundamentals of Spectroscopy

Unit I

Atomic Spectra: The hydrogen atom and the three quantum numbers*n*,*l*and*ml*.– electronspin -Vector atom model-electron spin-Stern-Grelach experiment spectroscopic terms. Spin-orbit interaction, fine structure in sodium atom, selection rules.Lande g-factor, normal and anomalous Zeeman effects, Paschen–Back effect,Stark effect in one electron system. L S and j j coupling schemes (vector diagram) – examples

Unit II

Molecular Spectra:MicrowaveSpectra: Rotational spectra of rigid diatomic molecules -effect of isotopic substitution. Non–rigid rotor – rotational spectra ofpolyatomic molecules

IR Spectra: Vibrating diatomic molecule as anharmonic oscillator, diatomic vibrating rotor – break down of Born-Oppenheimer approximation - vibrations of polyatomic molecules - overtone and combination frequencies - analysis by IR technique - Fourier transform IR spectroscopy.

Unit III

Raman Spectroscopy: Pure rotational Raman spectra - linear and symmetrictop molecules - vibrational Raman spectra – Raman activity of vibrations - structure determination from Raman and IR spectroscopy.

Unit IV

Electronic Spectroscopy: Electronic spectra of diatomic molecules -progressions and sequences - intensity of spectral lines. Franck – Condon principle - dissociation energy Rotational fine structure of electronic-vibrational transition - Fortrat parabola – Pre dissociation energy-fluorescence and phosphorescence.

Reference Books:

1. Introduction of Atomic Spectra, H.E. White, McGraw Hill
2. Spectroscopy (Vol. 2 & 3), B.P. Straughan& S. Walker, Sciencepaperbacks 1976
3. Raman Spectroscopy, D.A. Long, McGraw Hill international, 1977
4. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill
5. Molecular Spectra and Molecular Structure, Vol. 1, 2 & 3. G.Herzberg, Van Nostard, London.
6. Elements of Spectroscopy, Gupta, Kumar & Sharma, PragathiPrakshan
7. The Infra Red Spectra of Complex Molecules, L.J. Bellamy,Chapman& Hall. Vol. 1 &2
8. Laser Spectroscopy techniques and applications, E.R. Menzel, CRCPress, India

Semester III Paper 12 (Foundation course F1.2) Fundamentals of Nanoscience and Nanotechnology

Unit-I Basics of Nanoscience

Introduction to quantum physics, electron as waves, wave mechanics, Schrödinger equation and particle in a box, Heisenberg's uncertainty principle, exclusion principal, Free electron theory (qualitative idea) and its features, Idea of band structure, Density ofstates for zero, one, two and three dimensional materials, Quantum confinement, Quantum wells, wires, dots, Factors affecting to particle size

The p-n-junction and bipolar transistor, Metal semiconductor and metal insulator, semiconductor junction, field effect transistor.

Unit-II Properties of Nanomaterials

Mechanical, Thermal, Electrical, Optical, Magnetic and Structural.

Carbon nanostructures- Fabrication, structure, electrical properties and mechanical properties.

Unit-III Synthesis of Nonmaterial's

Physical methods**:** Bottom up-Ball Milling, Melt mixing, Physical vapour deposition, Ionised cluster beam deposition, Laser pyrolysis, Sputter deposition, Electric arc deposition, Gas evaporation.

Chemical methods**:** Hydrothermal combustion, bath deposition with capping techniques and top down,Chemicalvapour deposition, Synthesis of metal & semiconductor nanoparticles by colloidal route, Microemulsions, Sol-gel method, Combustion method, Wet chemical method

Unit-IV Bionanotechnology

Biological building blocks, nanostructure, protein nanoparticles, DNA double nanowire. Bionanostructures- Micelles, vesicles, multilayer films, biological interactions, bilayers, bioelectronics and bioscensors.

Text and Reference Books:

1. Nanotechnology: Principles &Practicals. Sulbha K. Kulkarni, Capital Publishing Co.New Delhi.
2. Carbon nanotechnology..recent developments in Chemistry, Physics, materials science and device applications, -Elsevier Science
3.Nanostructures&Nanomaterials Synthesis, Properties & Applications. Guozhong Cao, Imperials College Press London
4. Physics, Chemistry and Application of Nanostructures, world scientific co.
5. Nanomaterials: Synthesis, Properties & Applications. Edited by A.S. Edelstein &R.C.Commorata. Institute of Physics Publishing, Bristol & Philadelphia.
6.Introduction to Nanotechnology. C.P. Poole Jr. and F. J.Owens, Wiley Student Edition.
7.Nano: The Essentials. T.Pradeep , McGraw Hill Education.
8. Handbook of Nanostructures: Materials and Nanotechnology. H. S. NalwaVol 1-5, Academic Press, Boston.
9.Nanoscience and Technology: Novel Structure and Phenomena. Ping and Sheng
10. Hand Book of Nanotechnology, Bhushan

Semester IV Paper 13 (Core 11) Nuclear and Particle Physics

UNIT 1 ;

Basic nuclear properties; size, radii, shape, and charge distribution, spin, parity, mass, binding energy, semi-empirical mass formula, liquid drop model, nuclear stability, laws of radioactive decay. Nature of nuclear force, elements of deuteron problem, n-n scattering, charge independence and charge symmetry of nuclear forces.Electric and magnetic moments of nuclei.Evidence for nuclear shell structure, single particle shell model-its validity and limitations.

UNIT 2 :

Elementary properties of alpha-, beta-, and gamma-, decay of nuclei, their classification, characteristics and selection rules. Elementary theories of alpha-, beta-, and gamma-, decay. Nuclear reactions- conservation laws, mechanism, and cross section. Nuclear reaction mechanism, compound nucleus, direct reactions. Fission and fusion reactions, nuclear energy, elements of nuclear power.

UNIT 3 :

Interaction of charged particles and electromagnetic radiation with matter. Principles of nuclear radiation detectors: G-M counter, proportional counter, Na(Tl) scintillation detector, semiconductor detectors. Elementary principles of particle accelerators: linear accelerators, Van de Graaf, cyclotron, betatron, synchrocyclotron, ion beam accelerators.

UNIT 4 :

Classification of elementary particles, strong, weak and electromagnetic interaction.Gellmann-Nishijima formula Properties of hadrons, baryons, mesons, leptons, and quarks- their quantum numbers, charge, mass, spin, parity, iso-spin, strangeness etc. Symmetry and conservation laws.Elements of quark model and standard model.Higgs boson.

Text-books recommended:

1) Introductory Nuclear Physics,: Kenneth S Krane, Wiley, New York ,1988.
2) Nuclear and Particle Physics: Brian Martin.
3) Atomic and Nuclear Physics: S.N. Ghoshal.
4) Introduction to Particle Physics : D. Griffiths.
5) Introduction to Nuclear Physics: F. A. Enge, Addison Wesley (1975)
6) Introductory Nuclear Physics: Burcham

Semester IV Paper 14 (Core 12) Solid State Physics

Unit I: Band Theory: Bloch theorem, the Kronig- Penney model, construction of Brillouinzones, extended and reduced zone schemes, effective mass of an electron, tight binding approximation. Fermi surface.

Magnetic Properties:

Quantum theory of paramagnetism, magnetism of iron group and rare earth ions,.exchange interactions. Pauli paramagnetic susceptibility

Unit II

Lattice Dynamics: Energy of atomic motions, adiabatic principle, harmonic approximation,cyclic boundary condition.Lattice vibrations of linear monoatomic and diatomic chains.Dispersion relations, acoustic and optical phonons.

Theories of lattice specific heat, Dulong and Petit'slaw, Einstein and Debye models, T^3 law, Born procedure, anharmonicity and thermal expansion.

Unit III: Free Electron Theory: Electrons moving in one and three dimensional potentialwells, quantum state and degeneracy, density of states, electrical and thermal conductivity of metals, relaxation time and mean free path, the electrical resistivity of metals, thermonic emission. Seebeck effect, thermoelectric power.

Semiconductors: Free carrier concentration in semiconductors, Fermi level and carrierconcentration in semiconductors, effect of temperature on mobility, electrical conductivity of semiconductors, Hall effect in conductors and semiconductors.

Unit IV

Superconductivity, Type I and II super conductors, Meissner effect, isotope effect, London equation, coherence length, elements of B. C. S. theory, tunnelling DC and AC Josephson effect, Ginzberg-Landau Theory macroscopic quantum interference. Josephson junction.high temperature superconductor (elementary).

Text and Reference books:

1. C. Kittle: Introduction to Solid State Physics (2nd and 4th Edition).
2. A. J. Dekker : Solid State Physics.
3. Kubo and Nagamiya : Solid State Physics.
4. Feynman Lectures: Vol. III.
5. Board and Huano : Dynamical Theory of Crystal Lattice.
6. N. W. Ashcroft and D. Mermin: Solid State Physics.

Semester IV Practical 7 for core papers

Practicals based on core 11 and core 12

1. Measurement of resistivity of a semiconductor by four probe method at two different temperatures and determination of band gap energy.
2. Measurement of Hall coefficient of given semiconductor: identification of type of semiconductor and estimation of charge carrier concentration.
3. Determination of Hall life of 'In".
4. Determination of range of Beta-rays from Ra and Cs.
5. G-M counter
6. Magnetoresistance by Hall effect
7. Determination of Dielectric constant
8. Random decay of nuclear disintegration using dice (or simulation)

In all 7 practicals, instructor can introduce new and relevant experiments which are not in the list.

Semester IV Paper 15 (Core Elective E2.1) Materials Science II

Unit –I

Mechanical response of Materials : Elasticity, model of elastic response, inelasticity,viscoelasticity, stress-strain curves, concept of various mechanical properties such as hardness, yield strength, toughness, ductility, yield toughness, ductility, brittleness, stiffness, young modulus, shear modulus, shear strength, Frenkel model, Peierls-Nabarro relation, Plastic deformation,

Corrosion and degradation of materials –electrochemical considerations–passivity formsof corrosion – corrosion inhibition.

Spintronics and Photonics: Spin glass, magnetic bubbles, domain walls, magneticmultilayers, magnenites, GMR and CMR, DMS materials. Photonic band gap materials.

Unit – II

Concept of Synthesis: Concept of equilibrium and nonequilibrium processing and theirimportance in materials science.

Synthesis of materials: Physical method–Bottom up: cluster beam evaporation, Ion beamdeposition, Gas evaporation, Chemical method – Hydrothermal, combustion, bath deposition with capping techniques and top down: Ball milling. Solvated metal atom dispersion – thermal decomposition – reduction methods – colloidal and micellar approach.

Unit-III

Processing of materials: Metallic and non metallic, Ceramics and other materials. Onlybasic elements of powder technologies, compaction, sintering calcination, vitrification reactions, with different example, phenomenon of particle coalescence, porosity.Quenching : concept, glass formation

structural characterization:

Diffraction techniques: interpretation of x-ray powder diffraction patterns, Identification & quantitative estimation of unknown samples by X-ray powder diffraction technique Electron and neutron diffraction.

Unit –IV

Structural determination by fluorescent analysis. Theory and method of particle size analysis. Integral breadth method, Warren-Averbach's Fourier method, profile fitting method.

Microscopic techniques –TEM, SEM & STEM.AFM, EDX and XPS.

Text and Reference Books:

1. Basic Solid State Chemistry, 2nd Edition, Anthony R. West, John Wiley & Sons, 1996.
2. New Directions in Solid State Chemistry, C. N. R. Rao and J. Gopalkrishnan, Cambridge University Press, Cambridge, 1986.
3. Chemical approaches to the synthesis of inorganic materials, C. N. R. Rao Wiley Eastern Ltd.1994.
4. Materials Science and Engineering – An Introduction, W. D. Callister Jr. John Wiley & Sons,1991.
5. Materials Science, J. C. Anderson, K. D. Leaver, R. D. Rawlings and J. M. Alexander, 4th Edition, Chapman & Hall (1994).

Semester IV Paper 15 (Core Elective E2.3) NanoScience and Nanotechnology II

Unit – I:

Nanophotonics:

Fundamentals of photonics and photonic devices, Lasers, CFLs, LEDs, OLEDs, Wall paper lighting, Display devices, X-ray imaging nanophosphers, Photo therapy lamps and its applications, Nanomaterials for radiation, Dosimetery special for thermoluminescence. Optical stimulated luminescence, Luminescence solar concentration.

Unit – II:

Nanomagnetics:

Basics of Ferromagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, nanopore containment, giant and colossal magnetoresistance, applications in data storage, ferrofluids, Superparamagnetism, effect of grain size, magneto-transport, Magneto-electronics, magneto-optics, spintronics.

Unit – III:

Nanoelectronics:

Top down and bottom up approach, CMOS Scaling, Nanoscale MOSFETs, Limits to Scaling, System Integration, Interconnects;

NanoDevices: Nanowire Field Effect Transistors, FINFETs, Vertical MOSFETs, Other Nanowire Applications, Tunneling Devices, Single Electron Transistors, Carbon nanotube transistors, Memory Devices,

Unit – IV:

Nanocomposites:

Classification of nanocomposites, Metallic, ceramic and polymer nanocomposites, Tribology of polymeric nanocomposites, Nano ceramic for ultra high temperature MEMS, Optimizing nanofiller performance in polymers, Preparation techniques, Graphene/Fullerene/Carbon nanotube (CNT) polymer nanocomposites, One dimensional conducting polymer nanocomposites and their applications

Text and reference books:

1. H.S.Nalwa; Hand book of Nanostructure materials and nanotechnology; (Vol.1-5), Acad. Press, Boston, 2000
2. C.P.Poole Jr., F.J.Owens; Introduction to Nanotechnology, John Wiley and sons, 2003
3. C. Furetta; Hand book of thermoluminescence; World Scientific Publ.
4. S.W.S. McKEEVER; Thermoluminescence in solids; Cambridge Univ. Press.
5. Alex Ryer; Light measurement hand book; Int. light Publ.
6. M.J.Weber; Inorganic Phosphors; The CRC Press.
7. T.J.Deming; Nanotechnology; Springer Verrlag, Berlin, 1999
8. W.D.Kalister Jr., Materials Science and Engineering, 6th Eds, WSE Wiley, 2003
9. Gusev; Nanocrystalline Materials
10. C. Delerue, M.Lannoo; Nanostructures theory and Modelling
11. Fausto, Fiorillo ; Measurement and Characterization of Magnetic materials
12. Bhushan; Hand Book of Nanotechnology
13. Janos H., Fendler; Nanoparticles and Nanostructured Films
14. T.Pradip; Nano: The Essentials

15. Liu; Hand Book of Advanced Magnetic Materials (4 Vol.)
16. Lakhtakia; Nanometer Structure
17. Banwong, Anurag Mittal; Nano CMOS Circuit and Physical Design
18. G.W.Hanson: Fundamental of Nanoelectronics
19. Edward L. Wolf (2nd Ed.), *Nanophysics & Nanotechnology: An Introduction toModern Concepts in Nanoscience*, WILEY-VCH, 2006
20. S. Sakka; Sol-gel science and technology processing, characterization and applications; Kluwer Acad. Publ.
21. Goser et al, "*Nanoelectronics&Nanosystems: From Transistor to Molecular & Quantum Devices"*
22. SupriyoDatta, "*From Atom to Transistor*"
23. John H. Davies, *The Physics of Low Dimensional Semiconductors: An Introduction",* Cambridge University Press, 1998.
24. Hari Singh Nalwa, "*Encyclopedia of Nanotechnology*"
25. A. A. Balandin and K. L. Wang, "*Handbook of Semiconductor Nanostructures&Nanodevices*"
26. Cao Guozhong, "*Nanostructures &Nanomaterials - Synthesis, Properties &Applications*

Semester IV Paper 15 (Core Elective E2.4) Atomic and Molecular Physics II

Unit I

Time dependence in quantum mechanics, Time dependent perturbation theory, rate expression for emission, perturbation theory, calculation of polarizability.Quantum mechanical expression for emission rate.

time correlation function and spectral Fourier transform pair, properties of time correlation functions and spectral time shape,

Fluctuation dissipation theorem rotational correlation function and pure rotational spectra, Re-orientational spectroscopy of liquids.

Unit II

Saturation spectroscopy, Burning and detection of holes in Doppler broadened two level systems, Experimental methods of saturation spectroscopy in laser, Ramsey fringes, Saturation techniques for condensed matter application,

Laser optogalvanicspectroscopy.Two photon absorption spectroscopy, Selection rules, Expression for TPA cross section –photo acoustic spectroscopy, PAS in gaseous medium, Roseneweig and Greshow theory, Thermally thin, thick samples, Typical experimental set up, Application in Spectroscopy,

Unit III

Stimulated Raman scattering, Quantum mechanical treatment, Raman Oscillation Parametric instabilities, Electromagnetic theory of SRS.Vibronic interaction, Herzberg Teller theory, Fluorescence spectroscopy, Kasha's rule, Quantum yield, Non-radioactive transitions, Jablonski diagram, Time resolved fluorescence and determination of excited state lifetime.Light detectors, Single photon counting technique, Phase sensitive detectors.

Unit IV

Matrix isolation spectroscopy, Fourier transforms spectroscopy, Laser cooling. Molecular symmetry and group theory, Matrix representation of symmetry elementsof a point group,

Reducible and irreducible representations, and character tables specially for C_{2v} and C_3 point group molecules, Normal coordinates normal modes, Application of group theory to molecular vibrations.

Text Book and References:

1. Molecular Quantum Mechanics: P. W. Alkins and R. S., Fridman.
2. Quantum electron – A. Yariv.
3. Introduction to non-linear laser spectroscopy – M. D. Levenson.
4. Photoacoustics and its applications, Roseneweig.
5. J. M. Hollas, High resolution spectroscopy.
6. Cotton, Chemical Applications of Group Theory.
7. Herzberg, Molecular spectra and molecular structure II and III.
8. Demtroder, Laser spectroscopy and instrumentation.
9. King, Molecular spectroscopy.
10. Lakowicz, Principles of fluorescence spectroscopy.
11. Molecular Quantum Mechanics: P. W. Alkins and R. S., Fridman.

Semester IV Paper 15 (Core Elective E2.5) Applied Electronics II

Unit – I:

An Overview of Electronic Communication system ; block diagram of an digital electronic Communication system, Pulse modulation systems, sampling theorem, lowpass and band-pass signals,PAM channel bandwidth for a PAM signal, Natural sampling, flat top sampling, signal recovery throughholding, quantization of signals, quantization, differential PCM delta modulation, adoptive delta modulation CVSD. Digital modulation techniques: BPSK, DPSK, QPSK, PSK, QASK, BFSK, FSK, MSK. Mathematical representation of noise, sources of noise, frequency domain representation of noise, Noise in Pulse Code and Delta modulation system, PCM transmission, calculation of quantization of noise, out pit signal power effect of thermal noise, outr signal to noise ratio in PCM, DM, quantization noise in DM, out put signal power, DM oput-put, signal to quantization noise ratio, effect of thermal noise in delta modulation, output signal to noise ratio in DM.

Unit – II

Computer communication systems: Types of networks, design features of communication network,examples, TYMNET, ARPANET, ISDN, LAN.Mobile radio and satellite - time division multiplex access (TDMA) frequency division multiplex access(FDMA) ALOHA, Slotted ALOHA, Carrier sense multiple access (CSMA) Poisson distribution protocols.

Unit – III

Microprocessor and Micro-computers: Microprocessor and architecture, Pin out and pin functions of 8086/8088 Internal microprocessor architecture, bus buffering and latching ,Bus timings, ready and wait states, minimum mode versus and maximum mode. Real and protected mode of memory addressing, memory paging, addressing modes, data addressing modes, programme memory addressing mode, stack memory addressing modes, instruction sets, data movement instruction, arithmetic and logic instruction, programme control instruction, clock generator (8284A),

Unit –IV

Memory and I/O Interface : Memory devices, ROM,RAM.,DRAM, SRAM, Address decoding , 3 to 8 line decoder 74LS138, 8086, and 80386(16 bits) Memory interface, , Introduction to I/O interface , Interfacing using 8255, Introduction to PIT 8254, Basic Communication device(UART) pin diagram and functioning of 16550 Interrupts: Basic interrupt processing, Hardware interrupt, expanding the interrupt structure, 8259A PIC.

Text and Reference books.

1. Principles of communication systems :Taub and Schilling (ii Edn THM ,1994)
2. Principles of communication systems: Taub and Schilling GoutamSaha Third Edition
3. Communication systems : Simon Haykin (iii Edn John Wiley & Sons)
4. The intel microprocessors 8086/80188,80386,80486, Pentium and Pentium processor architecture, programming and interfacing : Barry B. Brey (PHI iv Edn, 1999)
5. Microprocessor and interfacing ,programming and hardware : Douglas V. Hall (ii Edn, McGrawHill International edn. 1992)
6. The 80x86 IBMPC compatible computer: Muhammad Ali Maxidi and J .G. Mazidi (ii Edn.Prentice –Hall International.)

Semester IV Paper 16 (Foundation course F2.1) Spectroscopic applications

Unit-I

Principle of spectroscopic instruments, UV-VIS visible: Absorption of light, radiation sources, sample holder, monochromator, radiation detectors, samples holder, monochromator, radiation detector, single and double beam experiment.

Infrared and Raman spectroscopy, predicting number of active modes of vibration, analysis of representative spectra of metal complexs with various functional groups at the coordination sites, organic and inorganic functional group identification through IR spectroscopy.

Unit-II

NMR phenomenon, spin ½ nuclei, (^{1}H, ^{13}C, ^{31}p and ^{1}9F), ^{1}H NMR, Zeeman splitting, effect of magnetic field strength on sensitivity and resolution, chemical shift , chemical and magnetic equivalence of spins, spin-spin coupling constant J.

Electronic spectroscopy, basic principle, electronic transitions in organic, inorganic and organometalic molecules and application to structure elucidation.

Unit-III

Electron paramagnetic resonance (EPR) spectroscopy of inorganic and organic compounds with unpaired electrons, determination of electronic structure, Zeeman splitting, g values hyoerfine and superhyperfime coupling constant.

Mossebauer spectroscopy-Mossebauer effect, recoilless emission and absorption, hyperfine interaction, chemical isomer shift, magnetic hyperfine and quadrupole interaction and interpretation of spectra.

Unit-IV

Mass spectroscopy, basic principles, ionization techniques, isotope abundance, molecular ion, high resolution MS, soft ionization methods, ESI-MS and MALDI-MS, illustrative example from macromolecules and supramolecules studies of inorganic/coordination and organometallic representative compounds.

Text books

1 Electronic paramagnetic transitions of metal ions, A Abragam, B Bleaney, Oxford University Press, 1970.

2. Physical methods for chemist, R S Drago, Saundevis 1992.

3.Fundamentals of molecular spectroscopy, C. N. Bawell and E.M. Mc cash, 4thed, MCGRAW-Hill, 1994.

4.NMR spectroscopy, H. Gunther, 2nd edition John Wileny and Sons, 1995.

Semester IV Paper 16 (Foundation course F2.2) Optics and Optical Instruments

Unit-1

General theory of image formation, Cardinal points of an optical system, thick lens and lens combination, telescopic combinations, telephoto lens and eyepieces, Abration in images; chromatic aberration, monochromatic aberration and their reductions, aspherical mirrors and correction plates, meniscus lens, entrance and exit pupil, need for multiple eyepiece, Ramsden and Huygens eyepiece, microscope and telescope, astronomical telescope.

Unit-2

Principal of superposition, coherence optical path retardation, fringes in thin film, localized fringes, two slit interference, Newton's rings and applications, Michelson interferometer and its applications,

Diffraction; Fresenel type- half period zone, rectilinear propogation, straight edge, Fraunhofer type-Diffraction at a slit, half period zone, circular aperature , plane transmission, reflection, blazed and concave grating, resolving power of grating, Raileigh criterion of resolution, resolving power of prism and grating.

Refraction- refraction in uniaxial crystal, double image prism, plane, circular and elliptical polarized light, Nicols prism, optical rotation in liquid crystals.

Unir-3

Optical instruments- magnifying glass, principal of pho camera, pinhole, lens and SLR camera, video camera, angular magnification, aperature, camera lucida, collimator and compound microscope, lens, periscope, binocular, field glass, jeweler's glass, projector, eyeglasses and its principal, prism spectroscope.

Unit-4

Holography: Importance of coherence, Principle of holography and characteristics, Recording and reconstruction, classification of hologram and application, non-destructive testing, optical fibre waveguides (step index, graded index, single mode), attenuation in fibre, couplers and connectors, LED,

X-ray –Principal and process of X-ray image (radiographs) production, factors affecting radiographs, Computed Tomography, principal and working of fluoroscopy, principal and working of CT-scanning, Ultrasound, working principal, imaging by us waves, Doppler ultrasound, magnetic resonance imaging, its working principal.

References;

1. Optics by Ajay Ghatak
2. Fundamental of optics by Jetkins and white
3.Optics and spectroscopy by R. Murugeshan, kiruthignsivaprakash.
4.Basic physics of X-ray imaging, Carl A Carlsson and Gudrun AlmCarlsson, 1996
5.Collaborative radiology by Chales De Kahn, 2013

GONDWANA UNIVERSITY, GADCHIROLI

M.Sc.-II Semester III, IV (Chemistry)

(Effective from 2017-18) (CBCS)

1. There will be four theory papers in every semester which will carry 80 marks each of 3 hrs. duration.
2. In semester III student will opt for special paper from four options available.
3. In semester IV student will opt for an elective paper out of the five options available.

4. There will be internal assessment of 20 marks per paper per semester.

5. Each paper per semester with total of 100 marks(80+20 i.e. theory+internal assessment) will carry 4 credits.

6. The internal assessment will be based on Attendance, Home assignment, Unit test Terminal test and participation in departmental activities.

7. There will be two practical examinations in semester III i.e. Pract I(special) and Pract II(Elective) of 6-8 hours duration of 80 marks with 4 credits each.Every practical will be having 20 internal practical marks.
8. In semester IV there will be one practical (Special) and another as Project of 80 marks each.

9. In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. This will carry 25 marks per seminar with one credit.

10. So, the total marks allotted to the Chemistry subject per semester is 625 marks: Theory (320 marks) + Internal assessment (120 marks) + Practicals (160 Marks)+ Seminar (25Marks)= 625marks (total)

11. Each theory paper consists of four units of fifteen hours per unit.

The following syllabi are prescribed on the basis of four hours per week of each paper and nine practical periods per batch per week.

General scheme for distribution of marks in practical examination

Time : 6-8 h (One day Examination) Total Marks : 80)
Exercise-1 - 30 Marks
Exercise-2 - 20 Marks
Viva-Voce -15Marks
Record -15 Marks

Scheme of Examination for M.Sc. (Chemistry) SEM III and IV

Semester III	Internal Assessment	Total Marks	Credits
PSCHT09: Paper IX (Spectroscopy)	20 Marks	80 Marks	4 Credits
PSCHT10: Paper X **Special I**-Inorganic/ Organic Chemistry/Physical/Analytical	20 Marks	80 Marks	4 Credits
PSCHT11: Paper XI **Special II**-Inorganic/ Organic Chemistry/Physical/Analytical	20 Marks	80 Marks	4 Credits
PSCHT12: Paper XII**Elective** Applied Analytical /Nuclear/ Environmental /Polymer/Medicinal Chemistry)	20 Marks	80 Marks	4 Credits
PSCHP07: Practical-VII**Special**Inorganic/ Organic Chemistry/Physical/Analytical	20 Marks	80 Marks	4 Credits
PSCHP08: Practical-VIII**Elective**- Applied Analytical Nuclear/ Environmental /Polymer/Medicinal)	20 Marks	80Marks	4 Credits
PSCHP09: Seminar-III ---- --	25 Marks		1 Credit
Total:	**120 Marks**	**505 Marks**	**25 Credits**

Semester IV

PSCHT13: Paper XIII (Spectroscopy)	20 Marks	80 Marks	4 Credits
PSCHT14: Paper XIV**Special I**-Inorganic/ Organic Chemistry/Physical/Analytical	20 Marks	80 Marks	4 Credits
PSCHT15 Paper XV **Special II**-Inorganic/ Organic Chemistry/Physical/Analytical	20 Marks	80 Marks	4 Credits
PSCHT16 Paper XVI**Elective**- Applied AnalyticalNuclear/ Environmental / Polymer/Medicinal Chemistry)	20 Marks	80 Marks	4 Credits
PSCHP10 Practical-XSpecial (Inorganic / Organic/Physical/Analytical)	20 Marks	80 Marks	4 Credits
PSCHP11 Practical-XI Project	20 Marks	80 Marks	4 Credits
PSCChP12 Seminar-IV ----	25 Marks		1 Credit
Total:	**120 Marks**	**505Marks**	**25 Credits**

Syllabus prescribed for M.Sc. Chemistry Semester III

PSCChT09: Paper IX (Spectroscopy)

60 h (4 h per week): 15 h per unit 80 Marks

Unit - I: Symmetry properties of molecules and group theory:**15h**

Symmetry elements and symmetry operations. Properties of group. Point groups and Schoenflies symbols. Symmetry operations as a group. Matrix representations of groups. Multiplication table for C_2v, C_3v and C_2h. Reducible and irreducible representations. Similarity transformation. Classes of symmetry operations. Great Orthogonality Theorem. Derivation of character tables for H_2O and NH_3 using Great Orthogonality Theorem. Application of character tables in selection rules of IR, Raman and Electronic spectroscopy.

Unit - II: 15h

A] Mass spectrometry: Theory, ion production(EI, CI, FD, FAB), ion analysis, ion abundance, isotopic contribution, N-rule, types of fission processes, high resolution mass spectrometry, metastable peak, molecular ion peak, Mclaffferty rearrangement, mass spectral fragmentation of organic compounds alkanes, alkenes, alkynes, alcohols, amines, amides, acids, aldehydes, ketones, halides, Structure determination of organic molecules by mass spectrometry

B] Mossbauer spectroscopy: Basic principle, experimental techniques, recoil emission and absorption, source, absorber, isomer shift, quadrupole interaction, magnetic hyperfine interaction, applications in determining electronic structure, molecular structure, crystal symmetry, magnetic structure, surface studies, biological applications.

Unit - III: 15h

A] Microwave spectroscopy: Classification of molecules on the basis of M.I., rigid and non rigid rotor, effect of isotopic substitution on transition frequencies, stark effect, microwave spectrometer, application in deriving: molecular structure, dipole moment, atomic mass and nuclear quadrupole moment.

B] ESR spectroscopy: Introduction, principle of ESR, ESR spectrometer, hyperfine coupling, zero field splitting, factors affecting g values, Kramer's degeneracy, application of ESR spectra to study free radicals like hydrogen, methyl radical, 1,4 semibenzoquinone, naphthalene, transition metal complexes, biological systems.

Unit IV: 15h

A] Infrared spectroscopy: Diatomic molecules: 1) Molecules as harmonic oscillator, Morse potential energy function, vibrational spectrum, fundamental vibrational frequencies. Force zero pointenergy, isotope effect. The Anharmonic oscillator, the interactions of rotations and vibrations. P,Q,R branches, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies, overtone and combination frequencies. Structure determination of organic molecules by IR spectroscopy.

B] Raman Spectroscopy: Rayleigh scattering. Raman Scattering, classical and quantum theories of Raman effect. Rotational Raman Spectra for linear and symmetric top molecules. Vibrational Raman Spectra, rotational fine structure. Selection rules, coherent antiStokes Raman spectroscopy, Structure determination from Raman and Infra-red spectroscopy.

List of books

1] Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril, John Wally

2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely

3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall

4] Organic Spectroscopy-William Kemp, ELBS with McMillan

5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi

6] Organic Spectroscopy-RT Morrison and RN Boyd

7] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin

8] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming

9] Fundamentals of Molecular Spectroscopy-CN Banwell

10] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro

11] Photoelectron Spectroscopy-Baber and Betteridge

12] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten

13] NMR –Basic Principle and Application-H Guntur

14] Interpretation of NMR spectra-Roy H Bible

15] Interpretation of IR spectra-NB Coulthop

16] Electron Spin Resonance Theory and Applications-W gordy

17] Mass Spectrometry Organic Chemical Applications, JH Banyon

INORGANIC CHEMISTRY SPECILIZATION
PSCChT10: Paper X **(Special I-Inorganic Chemistry)**

60 h (4 h per week): 15 h per unit 80 Marks

Unit -I 15h

A) Essential and trace metals in biological systems: Biological functions of inorganic elements, biological ligands for metal ions. Coordination by proteins, Tetrapyrrole ligands and other macrocycle. Influence of excess and difficiency of V, Cr, Mn, Fe, Co, Cu,& Zn. Genetic defects in the absorption of trace elements. Regulation and storage of trace elements. Role of minerals. Toxic effects of metals.

B) Metal storage, transport and biomineralization with respect to Ferritin, Transferrin and Siderophores, Na+ /K+ pump. Role of Ca in transport and regulation in living cells.

C) Medicinal use of metal complexes as antibacterial, anticancer, use of cis-platin as antitumor drug, antibiotics & related compounds. Metal used for dignosis and chemotherapy with particular reference to anti cancer drugs.

Unit-II 15h

A) Bio-energetics and ATP cycle: DNA polymerization, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water, Model systems.

B) Electron transfer in Biology: Structure and functions of metalloproteins in electron transfer proteins, cytochromes & Fe-S proteins, Non-heme iron proteins; Rubredoxins, Synthetic models. Biological Nitrogen fixation (in vitro and in vivo)

Unit-III 15h

Transport & Storage of Dioxygen: Heme proteins & oxygen uptake, structure and functions of haemoglobin, myoglobin, hemocyanins & hemerythrin. Perutz mechanism showing structural changes in porphyrin ring system. Oxygenation and deoxygenation. Model compounds. Cyanide poisoning

and treatment. Vanadium storage and transport.

Unit-IV 15h

Metallo enzymes: Apoenzymes, Haloenzyme & Coenzyme. The principle involved and role of various metals ini) Zn-enzyme:- Carboxyl peptidase & Carbonic anhydrase. ii) Fe-enzyme:- Catalase Peroxidase & Cytochrome P-450 iii) Cu-enzyme:-Super Oxide dismutase iv) Molybdenum:-Oxatransferase enzymes, Xanthine oxidase,Co-enzyme Vit.B12, Structure of

vitamin B12 Co-C bond cleavage, Mutase activity of co- Enzyme B-12, Alkylation reactions of Methyl Cobalamin. Synthetc model of enzyme action, stability and ageing of enzyme.

List of Books:

1. Akhmetov, N.: General and Inorganic Chemistry.
2. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
3. Bertini, et al: Bioinorganic Chemistry (Viva)
4. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).
5. Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
6. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
7. Fenton, David E.: Biocoordination chemistry, Oxford
8. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
9. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).

PSCChT11: Paper XI (Special II-Inorganic Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I 15 h

Crystal Structure of Some Simple Compounds:

i) Ionic Crystals &Their structures, radius ratio rule, effect of polarization on crystals.

ii) Covalent structure type- Sphalerite & Wurtzite.

iii) Geometry of simple crystal AB type: NaCl, CsCl & NiAs, reasons for preference for a particular structure in above AB type of compounds.

iv) AB2 type: Fluorite, antifluorites, Rutile structures. Li_2O, Na_2O,$CdCl_2$, CdI_2 structures.

v) Ternary Compounds ABO_3 type: Perovskite, Barium titanate, lead titanate, $CaTiO_3$, Tolerance factor, charge neutrality & deviation structures. $FeTiO_3$.

Unit-II 15h

A) AB_2O_4 type- compounds: Normal & inverse,2-3 and 4-2 spinel ,packing of oxygen in tetrahedral & octahedral sites, sites occupancy number of site surrounding each oxygen, application of charge neutrality principles, site preferences in spinel, distorted spinel.Hausmannite(Jahn-Teller distortions),Factors causing distortion in spinel.

B) Lattice Defects: Per fect &Imperfect crystals, point defects**,** Interstitial, Schottky defect, Frenkel defect, line defect & other entities, thermodynamics of Schottky & Frankel defects. Dissociation, theory of dislocation, plane defects- Lineage boundary, grain boundary, stacking fault, 3D defects, Defects & their concentrations, ionic conductivity in solids, Non stoichiometric compounds. Electronic properties of Non-stoichiometric oxides.

Unit-III 15h

Glasses, Ceramics and composite:

Glasses, Ceramics Composites and Nano-materials: Glassy state, glass formers and Glass Modifiers. Glasses, Ceramics, Clay products, Refractories with reference to: preparation, Properties and applications. Microscopic composites, dispersion, strengtheried and particle reinforced, fibre reinforced Composites, microscopic composites, nanocrystaline phase, preparation procedure, special properties and applications.

Unit-IV 15 h

A) Liquid Crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematics & smectic mesophases; smectic-Nematic transition clearing temperature-homeotrpic, planer & schlieren textures twisted nematics, chiral nematics, molecular arrngement in smectic A & smectic C phases, optical properties of liquid crystals. Dielectric susceptibility & dielectric constants. Lyotropic phases & their description of ordering in liquid crystals.

PSCChP07: Practical-VII(Inorganic Chemistry Special)

9 h /week Marks: 80

Instrumental methods and Analytical Techniques:

A) Exercise based on experimental technique-

i) Colorimetry and Spectrophotometry: a)Simultaneous determination of manganese ($KMnO_4$) , and Chromium ($K_2Cr_2O_7$) and b) Cobalt and Nickel.

ii) Determination of composition and stability constant of complexes by Job's/continuous variation and mole ratio methods

1. Iron-phenanthroline complex: By Job's method of continuous variation

2. Zirconium-Alizarin Red-S complex: By mole ratio method

3. Copper-Ethylene diamine complex: By slope-ratio method.

iii) PH-metry: stepwise proton-ligand and Metal-ligand stability constant of complexes by Irving Rossotti method.

iv) Polarography: Composition and stability constant of complexes.

v) Flame photometric determination: Na, K and Ca.(Individual or together)

B) Separation and quaqntitative estimation of binary ant ternary mixture by the use of following separation techniques:

i) Paper and thin layer chromatography

ii) Ion exchange

iii) Solvent extraction

iv) Electrophoretic separation

List of Books

1. Day and Underwood: Quantitative Analysis
2. Vogel A.I: A textbook of quantitative Inorganic analysis, Longman.
3. Flaschka: EDTA Titration
4. Meites and Thomas: Advanced Analytical Chemistry.
5. Ewing,G.W.: Instrumental Methods of Chemical Analysis,McGraw-Hill
6. Drago,R.S: Physical Methods in Inorganic Chemistry
7. Christian G.D.: Analytical Chemistry
8. Khopkar S.M.: Basic Concept of Analytical Chemistry.
9. Kolltath and Ligane: Polarography
10. Braun: Instrumental methods of chemical Analysis
11. Willard, Merritt and Dean: Instrumental methods of Chemical Analysis,Van Nostrand
12. Strouts, Crifillan and Wison: Analytical Chemistry.
13. Skoog S.A.and West D.W.: Fundamental of Analytical Chemistry
14. Dilts R.V.: Analytical Chemistry
15. Jahagirdar D.V.- Experiments in Chemistry
16. Chondhekar T.K.- Systematic Experiments in Physical Chemistry,Rajbog S.W.,Anjali Pubn.
17. Wlehov G.J.- Standard methods of Chemical analysis, 6th Ed.
18. Ramesh RandAnbu M,Chemical Methods for Environmenta Analyss:Water and Sedient, Macmillion
India.
19. Akhmetov, N.: General and Inorganic Chemistry.
20. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
21. Bertini, et al: Bioinorganic Chemistry (Viva)
22. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).
23. Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
24. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
25. Fenton, David E.: Biocoordination chemistry, Oxford
26. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
27. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).

ORGANIC CHEMISTRY SPECIALIZATION

PSCChT10: Paper X (Special I-Organic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

UnitI: Photochemistry 15 h

Interaction of radiation with matter, types of excitation, rate of excited molecules, quenching, Quantum efficiency, quantum yield, transfer of excitation energy, actinometry, singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions Paterno–Buchi reaction, Photoreduction, Photochemistry of enones, Hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones, Photochemistry of parabenzoquinones, photochemistry of Aromatic compounds with reference to isomerisation additon and substitution Photochemical isomerization of cis and trans alkenes, Photochemical cyclization of reaction, Photo-Fries rearrangement, Photo theory reaction of anilides Barton reaction, Hoffmann-Loefler-Freytag reaction, photochemistry of vision, Applications of photochemical methods in synthesis: Isocumene, Cedrene, Hirsutene

Unit II: Pericyclic Reactions 15 h

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene, allyl system, classification of pericyclic reaction. FMO approach, Woodward-Hoffman correlation diagram method and Peturbation of molecular orbital (PMO) approach of pericyclic reaction under thermal and photochemical conditions Electrocyclic reactions, conrotatary and disrotatary motion 4n and (4n+2) systems, with more emphasis on [2+2] and [4+2] Cycloaddition of ketones Secondary effects in [4+2] cycloaddition. Stereochemical effects and effect of substituents on rate of cycloaddition reaction, Diels-Alder reaction, 1,3-dipolarcycloaddition and chelotropic reaction. Sigmotropic rearrangement, suprafacial,and antarafacial shift involving carbon moieties, retension and inversion of configuration, [3,3] and [3,5] sigmotropic rearrangements, Claisen, Cope, Sommelet-Hauser rearrangements, Ene reaction.

Unit III 15 h

A] Oxidation

a) Oxidation of alkanes, aromatic hydrocarbons and alkenes, Dehydrogenation with S, Se, Fremy's salt, DDQ, chloranil and $PhI(OAc)_2$, Oxidation with SeO_2, Epoxidation of olefins, Synthetic application of epoxides, Sharpless asymmetric epoxidation, Dihydroxylation of olefins

using $KMnO_4$, OsO_4, Woodward and Prevost dihydroxylation, Oxidative cleavage of olefins, Ozonolysis

b) Oxidation of alcohols: Chromium reagents, pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), Collin and Jones reagent, Combination of DMSO with DCC, $(COCl)_2$, NCS and $(CH_3CO)_2O$ for oxidation of alcohols, Oxidation with MnO_2, Oppenauer oxidation

c) Oxidation of aldehydes and ketones, Conversion of ketones to α, β-unsaturated ketones and α-hydroxy ketones, Baeyer-Villiger oxidation , Chemistry and synthetic applications of $Pb(OAc)_4$, Dess-Martin periiodinane, IBX

B] Reduction

a) Catalytic heterogeneous and homogeneous hydrogenation, Hydrogenation of alkenes, alkynes and arenes, Selectivity of reduction, Mechanism and stereochemistry of reduction, Raney Ni-catalyst, Adam catalyst, Lindlar catalyst, Wilkinson catalyst.

b) Reduction by dissolving metals, Reduction of carbonyl compounds, conjugated systems, aromatic compounds and alkynes. Birch reduction, Hydrogenolysis

c) Reduction by hydride transfer reagents, Meerwein-Pondorff-Verley reduction, Reduction with $LiAlH_4$ and $NaBH_4$, stereochemical aspects of hydride addition, Derivatives of $LiAlH_4$ and $NaBH_4$, Selectivity issues, Diisobutylaluminium hydride (DIBAL-H), Sodium cyanoborohydride, Reduction with boranes and derivatives Reduction with Bu3SnH., Enzyme catalyzed reduction, Reduction of carbonyl group to methylene, Reduction with diimide and trialkylsilanes

Unit IV: Chemistry of P, S, Si, B, and Ti compounds 15 h

a) Phosphours and sulphur ylide: Preperation and their synthetic application along with stereochemistry b) Umpolung concept: Dipole inversion, generation of acyl anion, use of 1,3-dithiane, ethylmethylthiomethylsulphoxide, bis-phenylthiomethane, metallated enol ethers, alkylidene dithiane, ketone thioacetals, 2-propenethiobismethyl thioallyl anion, thiamine hydrochloride based generation of acyl anion c) Organoboranes- preparation and properties of organoborane reagents e.g. RBH_2, R_2BH, R_3B, 9-BBN, catechol borane. Thexyl borane, cyclohexyl borane, $ICPBH_2$, IPC_2BH, Hydrboration-mechanism, stereo and regeoselectivity, uses in synthesis of primary, secondary tertiary alcohols, aldehydes, ketones, alkenes, Synthesis

of EE, EZ, ZZ dienes and alkyenes. Mechanism of addition of IPC_2BH. Allyl boranes- synthesis, mechanism and uses d) Organo silicon compounds in organic synthesis, Me_3SiCl, Me_3SiH and Paterson synthesis e) Synthetic methodologies based on titanium compounds

List of books

1] Books as suggested in Semester I for organic chemistry

2] Organic Synthesis, The disconnection approach-S. Warren

3] Designing Organic Synthesis-S. Warren

4] Some Modern Methods of Organic Synthesis-W. Carruthers

5] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press

6] Protective Group in Organic Synthesis-T. W. Greene and PGM

7] The Chemistry of Organo Phosphorous-A. J. Kirbi and S.G. Warren

8] Organo Silicon Compound-C. Eabon

9] Organic Synthesis via Boranes-H. C. Brown

10] Organo Borane Chemistry-T. P. Onak

11] Organic Chemistry of Boron-W. Gerrard

12] Fundamentals of Photochemistry-K. K. Rohatgi-Mukharji, Wiley Eastern Limited

13] Photochemistry-Cundau and Gilbert

14] Aspects of Organic Photochemistry-W. M. Horspoot

15] Photochemistry-J. D. Calvert

16] Photochemistry-R. P. Wayne

PSCChT11: Paper XI Special II- (Organic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit I 15 h

A]Terpenoids 15 h

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol, α-terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-carotene, Vitamin A and H

B] Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll

Unit II 15 h

A] Alkaloids

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants

Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+)-coniine, Nicotine, Atropine, Quinine, Reserpine and Morphine

B] Prostaglandins: Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2α

Unit-III 15 h

A]Steroids Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone and Aldosterone. Biosynthesis of steroids

B] Plant Pigments

Occurrence, nomenclature and general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway

Unit IV: 15 h

A] Carbohydrate: Types of naturally occurring sugars, deoxy sugars, amino sugars, branched chain sugars, methyl ethers and acid derivatives of sugars, general methods of structure and ring size determination with reference to maltose, lactose, sucrose, starch and cellulose.

B] Amino acids, protein and peptides: Amino acids, structural characteristics, acid base property, stereochemistry of amino acids, optical resolution, Stecker synthesis, peptide and proteins structure of peptide and protein, primary, secondary, tertiary and quaternary structure. Reaction of polypeptide, structure determination of polypeptide, Solid phase peptide synthesis, end group analysis.

List of books

1] Chemistry of Alkloids-S. W. Pelletier

2] Chemistry of Steroids-L. F. Fisher and M. Fisher

3] The Molecules of Nature-J. B. Hendricsion

4] Biogenesis of Natural Compound - Benfield

5] Natural Product Chemistry and Biological Significance- J. Mann, R. S Devison, J. B. Hobbs, D. V. Banthripde and J. B. Horborne

6] Introduction to Flavonoids-B. A. Bohm, Harwood

7] Chemistry of Naturally Occurring Quinines-R. H. Thomson

8] The Systematic Identification of Flavonoids- Marby, Markham, and Thomos

9] Text Book of Organic Medicinal Chemistry-Wilson, Geswold

10] Medicinal Chemistry Vol I and II-Burger

11] Synthetic Organic Chemistry -Gurudeep Chatwal.
12] Organic Chemistry of Natural Products Vol I and II-O. P. Agrawal

13] Organic Chemistry of Natural Products -Gurudeep Chatwal

14] A Textbook of Pharmaceutical Chemistry-Jayshree Ghosh

15] Synthetic Dyes Series -Venkatraman

16] Chemistry Process Industries-Shreve and Brink

17] Principal of Modern Heterocyclic Chemistry-L. A. Paquelte

18] Heterocyclic Chemistry-J. Joule and G. Smith

19] Heterocyclic Chemistry-Morton

20] An Introduction to Chemistry of Heterocyclic Compound-J. B. Acheson

21] Introduction to Medicinal Chemistry-A. Gringuadge

22] Wilson and Gisvold Text Book of Organic Medicinal and Pharmaceutical Chemistry-Ed. Robert F Dorge

23] An Introduction to Drug Design-S. S. Pandey and J. R. Demmock

24] Polymer Science-V. Govarikar

25] Principle of Polymer Chemistry-P. J. Flory

26] An Outline of Polymer Chemistry-James Q. Allen

27] Organic Polymer Chemistry-K. J. Saunders

PSCChP07: Practical-VII (Organic Chemistry Special)

9 h /week Marks: 80

[A] Quantitative Analysis

Student is expected to carry out following estimations (minimum 6 estimations.)

1. Estimation of Vitamin “C” Iodometry.

2. Estimation of Phenol by KBrO3-KBr.

3. Estimation of Amine by Bromate/ Bromide solution.

4. Estimation of Formaldyde by Iodometry.

5. Estimation of Glucose by Benedict's solution.

6. Estimation of given carbonyl compound by hydrazone formation.

7. Estimation of Aldehyde by Oxidation method.

8. Determination of percentage of number of hydroxyl group in an organic compound by acetylation method.

[B] Isolation of Organic Compounds from Natural Source (Any six)

a) Isolation of caffeine from tea leaves.

b) Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)

c) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported.)

d) Isolation of nicotine dipicrate from tobacco

e) Isolation of cinchonine from cinchona bark

f) Isolation of piperine from black pepper

g) Isolation of lycopene from tomatoes

h) Isolation of β-carotene from carrots

i) Isolation of cysteine from hair

j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid

k) Isolation of eugenol from cloves

l) Isolation of (+) limonine from citrus rinds

[C] QUALITATIVE ANALYSIS

Separation of the components of a mixture of three organic compounds (three solids, two solids and one liquid, two liquids and one solid, all three liquids and identification of any two

components using chemical methods or physical techniques. Minimum 10-12 mixtures to be analyzed

PHYSICAL CHEMISTRY SPECIALIZATION

PSCChT10: Paper X (Special I-Physical Chemistry)

60h (4h/week) 15h/unit 80 Marks

UNIT I 15h

A] Statistical thermodynamics: Concepts of distribution, thermodynamic probability and most probable distribution, ensemble averaging, postulates of ensemble averaging, canonical grand canonical and micro canonical ensembles,corresponding distribution laws using lagranges method of undetermined *multipliers* , ortho and para hydrogen, principle of equipartition of energy, calculation of average energy

B] Partition function, Translational partition function, rotational partition function, vibrational partition function, electronic partition function, applications of partition functions.

UNIT II 15h

A] Electrode Interfaces: Quantum aspects of charge transfer at electrode-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces: Theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces, effect of light at semiconductor solution interface.

B] Electro catalysis: Comparison of electro catalytic activity, importance of oxygen reduction and hydrogen evolution reactions, and their mechanism, volcanoes.

C] Bio-electrochemistry: Threshold membrane phenomena, Nernst Plank equation, Hodges Huxley equations, core conductor models, electrocardiography.

UNIT III 15h

A] CHEMICAL KINETICS**:** Introduction, complex reactions: reversible, consecutive, concurrent, and branching reactions, free radical and chain reactions, steady state treatment, reaction between H2-Br2(thermal and photochemical),H2-Cl2, decomposition of ethane, acetaldehyde, N2O5, Rice Herzfeld mechanism

B] Fast Reactions: relaxation methods, stopped flow methods, flash photolysis, magnetic resonance method, jump method, relaxation time and numericals.

UNIT IV: 15h

A]Photophysical phenomenon: Introduction, prompt fluorescence, delayed fluorescence, and phosphorescence, fluorescence quenching: concentration quenching, quenching by excimer and exciplex emission, fluorescence resonance energy transfer between photoexcited donor and acceptor systems. Stern-Volmer relation, critical energy transfer distances, energy transfer efficiency, examples and analytical significance, bimolecular collisions, quenching and Stern-Volmer equation.

B] Photochemical reactions: photoreduction, photooxidation, photodimerization, photochemical substitution, photoisomerization, photosenitisation, chemiluminescence, photochemistry of environment: Green house effect.

List of books:

1. G.M.Panchenkov and V.P.Labadev, " Chemical Kinetics and catalysis", MIR Publishing
2. E.A. Moelwyn- Hughes, " Chemical Kinetics and Kinetics of Solutions", Academic
3. K.J.Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York
4. J.Raja Ram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan Indian Ltd., New Delhi (1993)
5. 1. J.G. Calvert and J.N. Pitts, Jr., *Photochemistry,* John Wiley and Sons, New York (1966).
6. 2. K. K. Rohtagi-Mukherjee, *Fundamentals of Photochemistry,* New Age International, New Delhi(1986).
7. R. P. Wayne, *Principles and Applications of Photochemistry*, Oxford University Press, Oxford(1988).
8. N. J. Turro, *Modern Molecular Photochemistry,* Univ. Science Books, Sansalito (1991).
9. J. F. L. Lakowicz, *Principles of Fluorescence Spectroscopy,* 2nd Edition (1999), PlenumPublishers, New York.

10. F.W.Sears, " Introdction to Thermodynamics, Kinetic Theory of Gases and statistical mechanics".Addison Wesley
11. M.C.Gupta, Statistical Mechanics
12. Andrew Maczek, *Statistical Thermodynamics,* Oxford University Press Inc., New York (1998).
13. Andrew Maczek, *Statistical Thermodynamics,* Oxford University Press Inc., New York (1998).
14. B.K. Agarwal and M. Eisner, *Statistical Mechanics*, Wiley Eastern, New Delhi (1988).
15. D.A. McQuarrie, *Statistical mechanics*, Harper and Row Publishers, New York (1976).
16. J.O.M.Bokris and A.K.N.Reddy, " Modern Elcrtrochemistry". Wiley
17. S. Glasstone, " Introduction to Electrochemistry" Affilisated East West.
18. D.R.Crow, " The Principle of electrochemistry", Chapman Hall

PSCChT11:Paper XI (Special II-Physical Chemistry)

60h (4h/week) 15h/unit 80 Marks

UNIT-I: 15h

A] Radioactive Decay Processes : Alpha decay- penetration of potential barriers, hindered alpha decay, alpha decay energies. Beta Decay- Fermi theory, energy, Curie plots, comparative half-lives, electron capture, selection rules, forbidden transitions, non-conservation of parity, neutrinos. Gamma decay- life-time of excited states.

B] Nuclear Energy : Basic principles of chain reacting systems, the 4-factor formula, Classification of reactors, Breeder reactor, Reactor associated problems, Reactor safety, Fuel cycle, Re-processing of spent fuel, Nuclear waste management

Unit II: 15h

A] Solid State Reactions: General principle, types of reactions: Additive, structure sensitive, decomposition and phase transition reactions, tarnish reactions, kinetics of solid state reactions, factors affecting the reactivity of solid state reactions. photographic process.

B] Nanoparticles and Nanostructural materials: Introduction,methods of preparation,physical properties,and chemical properties, sol-gel chemistry of metal alkoxide, application of nanoparticles. Nanoporous Materials: Introduction, Zeolites and molecular sieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation and applications.

UNIT-III: Electrochemistry of Solution 15h

A] Metal/Electrolyte interface : OHP and IHP, potential profile across double layer region, potential difference across electrified interface; Structure of the double layer **:** Helmholtz-Perrin, Gouy Chapman model, Stern, Graham Devanathan- Mottwatts, Tobin, Bockris, Devnathan Models

B] Over potentials, exchange current density, derivation of Butler Volmer equation under near equilibrium and non-equilibrium conditions, Tafel plot

C] Electrical double lever, theories of double layer, electro-capillary phenomena, electro-capillary curve. Electro-osmosis, electrophoreses. Streaming and Sedimentation potentials. Zeta potentials and its determination by electrophoresis, influence of ions on Zeta potential.

UNIT IV: Irreversible Thermodynamics 15h

Local equilibria,Thermodynamic criteria for non equilibrium states, generalized flux, forces, phenomenological laws, matter flow and current flow, entropy production and entropy flow for

different irreversible reactions(e.g. heat flow, chemical reaction and electrochemical reactions), saxen relations, reciprocity relations, coupled reactions- Onsager theorem of microscopic reversibility, irreversible thermodynamics of biological systems.

List of books:

1. C.N.Rao. Nuclear Chemistry
2. B. G. Harvey, *Introduction to Nuclear Physics and Chemistry,* Prentice Hall, Inc. (1969).
3. H.J. Arnikar, *Essentials of Nuclear Chemistry*, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi
4. L.V.Azaroff, " Introduction to solids", McGraw Hill
5. C.Kittel, "Introduction to solid state Physics",Wiley
6. J.O.M.Bokris and A.K.N.Reddy, " Modern Elcrtrochemistry". Wiley
7. S. Glasstone, " Introduction to Electrochemistry" Affilisated East West.
8. D.R.Crow, " The Principle of electrochemistry", Chapman Hall
9. I.Prigoggine, " An Introduction to Thermodynamics of Irreversible Processes," Interscience
10. G. Fridlander, J.W. Kennedy, E.S. Macias and J.M. Miller, Nuclear & Radiochemistry, 3rd Edition (1981) John-Wiley & Sons, New York

PSCChP07: Practical-VII **(Physical Chemistry Special)**

9 h /week Marks: 80

Solutions:

1.Study the variation of solubility of potassium hydrogen tartarate with ionic strength using a salt having a common ion and hence determine the mean ionic activity coefficients.

2.Determination of partial molar volume of solute and solvent(ethanol-water,methanol-water,KCl-water mixture)

3.Determination of temp. dependence of the solubility of a compound in two solvents having similar intermolecular interactions(benzoic acid in water and DMSO –water mixture) and calculation of the partial molar heat of solution.

Phase equilibrium:

4. To study the effect of addition of an electrolyte such as NaCl, KCl,Na_2SO_4,K_2SO_4 etc.on the solubility of an organic acid(benzoic acid or salicylic acid).

5. To determine the heat of crystallization of $CuSO_4$,5H2O

6. To determine the heat of reaction involving precipitation of a salt $BaSO_4$

7. To determine transition temperature of $CaCl_2$ by thermometric method and to determine transition temperature of $CaCl_2$, sodium bromide by solubility method

Kinetics:

8. To determine the activation energy of hydrolysis of an ester by acid.

9. Kinetics of reaction between sodium thiosulphate and KI. Determination of rate constant; study of influence of ionic strength

10. Kinetics of decomposition of H_2O_2 catalysed by iodide ion. Also determination of activation energy of reaction.

Electrochemistry:

11. Estimate the concentration of H_2SO_4, CH_3COOH, $CuSO_4.5H_2O$ in a given solution by carrying out conductometric titration against NaOH solution.

12 .Determine the eq. conductance of strong electrolyte(KCl, NaCl, HCl,KNO_3) at several concentration and hence verify Onsager's equation.

13. Carry out the following precipitation titration conductometrically-

a.50 ml.0.02N $AgNO_3$ with 1N HCl

b.50 ml.0.02N $AgNO_3$ with 1N KCl

c. 50 ml 0.004 N $MgSO_4$ with 0.1 N $Ba(OH)_2$

d. 50 ml 0.002 N $BaCl_2$ with 1 N Li_2SO_4

e. 50 ml.0.02 N $BaCl_2$ with 1N K_2SO_4

Potentiometry:

14.Determination of redox potential of the couples($Fe^{2+/}Fe^{3+,}Co^{3+/}Co^{2+,}Cr^{3+/}Cr^{2+,}MnO_4$-/$Mn^{2+(}$any two) and equilibrium constant.

15.Study of complex formation by potentiometry e.g.Ag^{+}-$S_2O_3^{2+,}$-,Fe^{3+-}SCN-,Ag+-NH_3(any two) and calculation of stability constant.

ANALYTICAL CHEMISTRY SPECIALIZATION

PSCChT10: Paper X (Special I-Analytical Chemistry)

60h (4h/week) 15h/unit 80 Marks

Unit-I: Radioanalytical Chemistry-I 15h

Radioactivity-Radiation-Units-Curie, Becquerel, Gray, Rad, Sievert, RBE, REM, Half life, mixed half life, branching decay, different types of radiations and their interactions with matter, radioactive equilibrium, Elementary principles of GM and proportional counters, Gamma Ray Spectrometer,

calibration using standard sources, resolution, numericals.

Unit-II: Optical methods of analysis-III 15h

***Atomic absorption spectroscopy*:** Principle. Atomic energy levels. Grotrian diagrams. Population of energy levels. Instrumentation. Sources: Hollow cathode lamp and electrodeless discharge lamp, factors affecting spectral width. Atomizers: Flame atomizers, graphite rod and graphite furnace. Cold vapour and hydride generation techniques. Factors affecting atomization efficiency, flame profile. Monochromators and detectors. Beam modulation. Detection limit and sensitivity. Interferences and their removal. Comparison of AAS and flame emission spectrometry. Applications of AAS.

Unit-III:Electrochemical methods of analysis-II 15h

***Stripping Voltammetry*:** Principle and technique in anodic and cathodic stripping voltammetry, applications to metal ion analysis, limitations.

Adsorptive stripping voltammetry: Principle, technique, applications to metal ions and organic analysis. Advantages over anodic stripping voltammetry. Catalytic effects in voltammetry.

Working electrodes: Mercury electrodes, carbon electrodes, film electrodes.

***Cyclic voltammetry*:** Principle and technique. Randles-Sevcik equation. Interpretation of voltammogram- reversible, irreversible and quasi-reversible systems. Applications of cyclic voltammetry in study of reaction mechanism and adsorption processes.

Electrochemical sensors *(Chemically modified electrodes):* Biosensors, catalytic sensors and gas sensors. Comparison of voltammetry with AAS and ICP-AES.

Unit-IV: Miscellaneous techniques-I 15h

Photoacoustic spectroscopy: Theory. Instrumentation. Advantages over absorption spectroscopy. Chemical and surface applications of PAS.

***Electrochromatography*:** Principles of electrophoresis. Instrumentation. Zone electrophoresis. Curtain electrophoresis. Applications of electrochromatography. Reverse osmosis. Electrodialysis. Capillary electrophoresis. Applications of capillary electrophoresis. Micellar electrokinetic capillary chromatography.

Electrogravimery: Theory of electrolysis. Electrode reactions. Decomposition potential. Overvoltage. Characteristics of deposits and completion of deposition. Instrumentation. Application in separation of metals.

PSCChT11:Paper XI (Special II-Analytical Chemistry)

60h (4h/week) 15h/unit 80 Marks

Unit-I: Organoanalytical Chemistry 15h

Elemental analysis: Outline of macro, semi-micro, micro and ultra-micro analysis, semi-micro determination of carbon, hydrogen, halogen, sulphur, nitrogen, phosphorous, arsenic, boron and metals in organic compounds.

Functional group analysis: Semi-micro determination of the following functional groups in organic compounds- hydroxyl, amino, nitro, nitroso, azo, N-acetyl, O-acetyl, methyl, aldehydes, ketones, thio, disulphide, sulphonamide, unsaturation and active hydrogen.

KF reagent: Karl Fischer reagent and its use in analysis of water in organic compounds.

Unit-II: Analysis of ores and cement 15h

Ores: Composition and analysis of the followings ores- Bauxite, Pyrolusite, Dolomite, Chromite.

Portland cement: Composition, raw material, manufacturing processes, characteristics, analysis.

Unit III: Water pollution and analysis

Sources of water pollution, composition of potable water, importance of water analysis, sampling and sample preservation, physico-chemical analysis of water. Mineral analysis (temperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphates, hardness), Demand analysis (DO, BOD, COD, TOC), nutrients (nitrogen-total, nitrate, nitrite, phosphate) and heavy metals (As, Cd, Cr, Hg and Pb). A brief idea of coagulation and flocculation.

Unit-IV: Air pollution and analysis 15h

Air pollution and analysis-classification of air pollutants, sources of air pollution and methods of control, sampling of aerosols and gaseous pollutants and their effects, SO2, NO2, CO, CO2, particulates-SPM, RSPM, High Volume Sampler, Fabric Filters, Cyclones (direct and Reverse), ESP, ozone layer, Green house effect, Heat Islands, Acid Rain.

List of books:

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
4. Radiochemistry: A. N. Nesmeyanov (Mir Publications)

5. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)

6. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)

7. Vogel's Text Book of Quantitative Inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)

8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)

9. Atomic Absorption Spectroscopy: Robinson (Marcol Dekker)

10. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)

11. Analysis of Water: Rodier

12. Laboratory manual of water analysis: Moghe and Ramteke (NEERI)

13. Electroanalytical chemistry: Joseph Wang

14. Electroanalytical stripping methods: Brainina and Neyman (Wiley-Interscience)

15. Trace analysis: S. Lahiri (Narosa Publishing House)

16. Electroanalytical Chemistry: Bard (Marcel-Dekker)

17. Chemistry in Engineering and Technology- Vol I and II: J.C. Kuriacose and J. Rajaram (Tata-McGraw Hill)

PSCChP07: Practical-VII (Analytical Chemistry Special)
9 h /week Marks: 80

pH-metry

1. Determination of percent Na_2CO_3 in soda ash by pH-metric titration.

2. Determination of isoelectric point of amino acid.

Conductometry

1. Displacement titration of CH_3COONa with HCl.

2. Precipitation titration of $MgSO_4$ and $BaCl_2$.

Potentiometry

1. Estimation of Cl-, Br- and I- in a mixture.

2. Determination of percent purity of phenol by potentiometric titration with NaOH.

Coulometry

1. Estimation of nickel and cobalt by coulometric analysis at controlled potential.

2. Analysis of antimony (III) with I3- .

Polarography

1. Determination of E1/2 of Cd^{2+} and Zn^{2+} at DME.

2. Estimation of Cd^{2+} and Zn^{2+} in respective solutions by calibration curve and standard addition methods.

3. Determination of composition /stability constant of complex.

Cyclic voltammetry

Study of cyclic voltammograms of $K_3[Fe(CN)_6]$.

Electrogravimetry

Estimation of nickel and copper individually as well as in mixture.

Polarimetry

1. Inversion of cane sugar in the presence of HCl.

2. Determination of percentage of two optically active substances (d-glucose and d-tartaric acid) in a mixture.

Colorimetry/spectrophotometry

1. Simultaneous determination of chromium and manganese in given mixture.

2. Simultaneous determination of two dyes in a mixture.

3. Estimation of Mn in steel.

4. Estimation of Cu/Ni in alloys.

5. Estimation of iron in water sample using 1,10-phenanthroline.

6. Estimation of Fe(III) in given solution by photometric titration with EDTA (salicylic acid method).

Flame photometry

Estimation of Li, Na, K, Ca in rock/ soil / water samples.

Turbidimetry and nephelometry

1. To determine molecular weight of polymer.

2. Estimation of sulphate in water sample by turbidimetry.

3. Estimation of phosphate by nephelometry.

Radioanalytical techniques

1. *GM-counter*: Plateau, nuclear statistics, half thickness of aluminium absorbers, dead time.

2. *Gamma ray spectrometer*: Calibration using standard sources, determination of half life (Mn-56, I-128, In-116)

3. Experiments based on radiation chemistry: G-value, radiolysis of organic solvents.

Demonstrations

UV-spectrophotometry

PSCChT12: Paper XII (Elective- Applied Analytical Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Analysis of Pesticides and Fertilizers 15h

***Pesticides*:** General introduction, analysis of pesticides in general with reference to DDT, Dieldrin, Malathion, Parathion, BHC by different analytical methods such as titrimetric, colorimetric, chromatography and electroanalytical methods.

***Fertilizers*:** Sampling and sample preparation, determination of water, total nitrogen, urea, total phosphates, potassium, acid or base forming quality.

Unit-II: Forensic chemistry 15h

Introduction. Classification of poisons on the basis of physical states, mode of action and chemical properties with examples of each type. Methods of administration. Action of poisons in body. Factors affecting poisoning. Study of some common poisons used for suicide. Signs and symptoms of As, Pb, Hg and cyanide poisoning. Poisonous effects of kerosene and cooking gas.

Unit-III:Analysis of petroleum and petroleum products 15h

Introduction, determination of flash and fire point, Pensky Marten's apparatus, cloud and pour point, aniline point, drop point, viscosity and viscosity index, Redwood and Saybolt viscometer, API specific gravity, water and sulphur in petroleum products, carbon residue, corrosion stability, decomposition stability, emulsification, neutralization and saponification number.

Unit-IV: Analysis of alloys 15h

Definition of alloy. Iron-carbon phase diagram. Types of steel: hypoeutectic, hypereutectic steels, mild steel, and stainless steel. Uses of steel. Composition and uses of brass, bronze and soldering alloy. Analysis of iron, nickel, chromium and manganese in steel. Analysis of copper in brass, zinc in bronze and lead in soldering alloy. Industrial applications of alloys.

PSCChP08: Practical VIII–Elective (Applied Analytical Chemistry)

9 h per week (Marks-80)

1. Analysis of ores: Ca and Mg in Dolomite, Al in Bauxite, Mn in Pyrolusite.

2. Analysis of cement: Silica, alumina, ferric oxide, calcium and magnesium oxide, sodium and potassium oxide.

3. Alloy analysis: Mn in steel-colorimetry, Cu in brass-colorimetry, Ni in alloy- back titration/

extraction- spectrophotometry.

4. Analysis of oils: Carbon residue, Acid value, Saponification value, Iodine value, Viscosity, Flash point, Cloud point, Aniline point.

5. Analysis of soils: pH, alkalinity, conductivity, nitrogen, phosphorous and potassium.

6. Ambient air analysis: SPM, RSPM, SOx and NOx in ambient air.

7. Analysis of drugs: Fe in capsule, ascorbic acid in vitamin-C tablet, sulpha drug by diazotization, Mg in milk of magnesia tablet.

8. Bleaching powder: Available chlorine, break point chlorination.

9. Polymer analysis: Molecular weight, Saponification value, Iodine value.

10. Cosmetics analysis: Talcum powder, tooth paste, shampoo.

11. Food: Moisture content by Karl-Fischer titrator, phosphoric acid in cola beverages by pH titration.

List of books

1. ISI Handbook of Food Analysis: Vol.I to X (Bureau of India Standards Publication, New Delhi)

2. Food Analysis: A. G. Woodman (McGraw-Hill)

3. Milk and Milk Products: Eckless, Comb and Nacy (Tata McGraw-Hill)

4. Hand Book of Analysis and Quality Control for Fruit and Vegetable Products: Ranganna (Tata McGraw-Hill)

5. Insecticides- Action and Metabolism: O. Brian (Academic Press)

6. Chemistry of Insecticides and Fungicides: Sree Ramalu, Oxford, IBH,Pub.

7. Analytical Methods for pesticides and plant growth regulators and food additives-(Vol.I to X)Ed. G. Zweing (Academic press)

8. Practical Pharmacognosy: T. N. Vassudevan

9. Aids of analysis of food and drugs: Wicholls

10. Indian Pharmacopoeia-1985

11. British Pharmacopoeia-1990

12. Handbook of Drugs and cosmetics aids: Mehrotra

13. Lynch's medical laboratory technology: S. S. Raphel

14. Basic Food Chemistry: F. Lee (AVI publishing company)

15. Industrial chemistry: B. K. Sharma

16. Parikh's text book of medical jurisprudence, forensic medicine and toxicology, 6th Edn.: C.K.Parikh (CBS publishers and distributors)

17. Clarke's analysis of drugs and poisons: Anthony C Moffat, M David Osselton, Brian Widdop (Pharmaceutical press)

18. A Practical Course in polymer chemistry: S. J. Punea (Pergamon press).

19. The Text book on Petrochemical by Dr. B. K. Bhaskar Rao (Khanna Publishers).

20. Analytical chemistry: A. Gupta (Pragati Prakashan)

21. Applied Chemistry: Vermani and Narula (New Age International)

PSCChT12: Paper XII (Elective- Nuclear Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Radioactive decay 15h

Various modes of decay, natural radioactivity, successive radioactive decay and growth kinetics, radioactive equilibrium, half life, half life of mixed radioisotopes, decay schemes, its determination by experimental methods, statistical nature of nuclear radiation, treatment of nuclear data and calculation of standard deviation, probability

Unit-II: Nuclear structure 15h

mass-energy relationship, nuclear binding energy, semi-empirical mass formula, nuclear stability rules, nuclear properties, mass size, spin and parity, nature of nuclear forces, liquid drop model, shell model, its evidence and advantages, comparison of the two models, calculations based on above.

Energetics of nuclear reaction, cross reaction, comparison with chemical reactions, various types of nuclear reactions, photonuclear, spallation and thermonuclear reaction

Unit-III: Interaction of radiations with matter, detectors 15h

Interaction with matter and detection of gamma rays with matter by photoelectric, Compton and pai production, interaction of beta particles, neutrons and heavy charged particles, various methods of detecting nuclear radiations, gas filled counters, ionization chamber, proportional and GM counters, scintillation detector and solid state detector

Unit-IV: Nuclear fission and Fusion 15h

Probability, mass and charge distribution, release of energy and neutrons, spontaneous fission, nuclear reactors and their uses for power production, brief idea about thermal and fast breeder reactors, reprocessing of nuclear fuel, PUREX process, heavy water- manufacturing and use in reactors. accelerators, nuclear fusion.

Production of isotopes by nuclear reactions, production of new elements, radioactive waste management and disposal

PSCChP08: Practical VIII–Elective (Nuclear Chemistry)

9 h per week (Marks-80)

1. Working of GM counter, plateau, statistics, geometry effects, dead time, energy of beta particle, back scattering

2. Working of gas flow proportional counter, plateau, statistics, geometry effects, dead time, energy of beta particle

3. Working with scintillation counter, gamma ray spectra, energy calibration and resolution, half life determination of single and composite nuclei.

4. Radiochemical separation of 234Th from natural uranium salt and its half life determination

5. Experiment on Neutron Activation Analysis by non-destructive method

6. Dose measurement by Fricke and other chemical dosimeters

7. Radiolysis of potassium nitrate, methyl iodide, carbon tetrachloride-iodine systems

8. Szilard-Chalmers reactions with inorganic and organic systems, potassium permanganate and methyl iodide

9. Some trace experiments like partition coefficient, solubility product, isotopic exchange, isotope dilution analysis, radiochromatography, ion exchange.

List of books:

1. H. J. Arnikar - Essentials of Nuclear Chemistry (Willey Eastern Ltd)

2. G. Friendlander, J. W. Kennedy,E. S. Macias and J. M. Miller-Nuclear and Radiochemistry (Wiley Intersciences, New York)

3. G. R. Choppin and J. Rydberg- Nuclear Chemistry-Principles and Applications(Pergamon press, London)

4. B. G. Harvey-Introduction to Nuclear Physics and Chemistry(Prentice Hall of India)

A. N. Nesmeyanov - Radiochemistry- (Mir Publications)

5. M. N. Sastry-Introduction to Nuclear Science, Affiliated East-West Press, New Delhi

6. G. Hughes- Radiation Chemistry- Oxford University Press, London

I. V. Verschinskii and A. K. Pikeav-Introduction to Radiation Chemistry, Israel Publication, Jerusalem- Robinson (Marcol Dekker)

7. Farhat Aziz and M. A. J. Radgers-Radiation Chemistry-Principles and Applications, VCH Publishers FRC.

8. M. Hassinsky-Nuclear Chemistry and its application, Addison Wesley

PSCChT12: Paper XII (Elective- Environmental Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit -I: Concept and scope of Environmental Chemistry 15 h

Biosphere, Lithosphere, Hydrosphere and Atmosphere, Ecological principles- aspects of ecology, classification, types of ecosystems. Biogeochemical cycles- carbon, nitrogen, phosphorous, oxygen, hydrogen, sulphur, iron, sodium, potassium, magnesium, cobalt, mercury, lead, zinc and cadmium.

Thermal pollution—sources, harmful effects and prevention of thermal pollution.

Noise pollution --- sources, effects and control of noise pollution.

Unit-II: Water 15 h

Origin, physico-chemical properties of water, sources of water, hydrological cycle, criteria of water quality, Water management- water shed management, rain water harvesting, waterpollution- sources, consequences and harmful effects of water pollution, strategies for water pollution control.

Unit-III: Air 15 h

Major regions of the atmosphere, composition of the atmosphere, temperature inversion and air pollution episodes, photochemistry of the atmosphere, depletion of the stratospheric ozone, green house effect, green house gases, remedial measures for reversion of green house effect, acid rain, photochemical smog, particulate matter.

Unit-IV: 15 h

Soil

Chemical and mineralogical composition of soil, classification of soil, types of soil- saline and alkaline, physical properties – texture, bulk density, permeability, chemical properties—Ion exchange capacity, soil pH and micro and macro nutrient availability. Soil management—Management of saline and alkaline soil, soil indicator plants,

Radioactive Pollution

Introduction to radiation chemistry, sources of radioactive pollution, effects of radioactivepollution, nuclear disasters in the two decades, protection from radiation, control of radiation.

PSCChP08: Practical VIII–Elective (Environmental Chemistry)

9 h per week (Marks-80)

1. Sampling of water- tap water, well water, over head storage tank water pond water and lake water.

2. Physico-chemical and organoleptic characteristics of the above water samples.

3. Statistical evaluation of the data obtained for optimization of results.

4. Determination of Total solids, Total dissolved solids and total suspended solids and its significance.

5. Determination and comparison of chlorine content in tap water, storage tank and swimming pool.

6. Determination of acidity and alkalinity in water samples.

7. Determination of total, permanent and temporary hardness of water sample.

8. Determination of DO, COD and BOD of water sample.

9. Analysis of chemicals used in water and waste water treatment-Alum, bleaching powder, activated carbon.

10. Analysis of nutrients – Nitrogen (total, ammonia,nitrite and nitrate), Phosphate total

11. Analysis of iron and manganese in a water sample by visual titrimetry.

12. Analysis of copper and nickel in a water sample by spectrophotometry

13. Analysis of different types of soil- pH, conductivity, alkalinity

14. Determination of N,P,K of soil

15. Determination of macro and micro nutrients in soil.

List of books

1. Water analysis : J. Rodier

2. A Text book of Inorganic Analysis : A.I.Vogel

3. Colorimetric Determination of metals : E.B.Sandell

4. Environmental Chemistry : Moore J W and Moore E A. Academic Press, New York, 1976.

5. Environment and Man Vol VII: The Chemical Environment Edited by J Lenihar and W Fleecher Vlackie Publication, 1977.

6. The Chemistry of Environment: R A Horne, Wiley Interscience Publication 1978.

7. Fundamentals of Air Pollution: A C Stern

8. Instrumental Methods of Analysis: Willard,Merrit and Dean

9. Analytical Chemistry: Meites and Thomas

10. Standard Methods for Examination of water and waste water: A E Greenberg, A D Eaton, APHA,

AWWA,WEF

11. Chemistry for Environmental Engineering and Science: C N Sawyer, P L McCarty and G F Parkin

12. Laboratory Manual for the Examination of Water, waste water and soil: H H Rupa and H Krist, V C H Pub.

13. Manual on Water and Waste water analysis: D S Ramteke and C A Moghe, NEERI

14. Environmental Chemistry: B K Sharma and H Kaur

15. Environmental Chemistry: A K De

16. Environmental Pollution- Management and control for sustainable Development: R K Khatoliya

17. Environmental Chemistry: A K Bhagi and G R Chatwal

PSCChT12: Paper XII (Elective- Polymer Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I:Introduction to polymers 15h

Nomenclature and classification of polymers. Types of polymers- linear, branched, crosslinked, ladder, thermoplastic, thermosetting, fibres, elastomers, natural polymers, addition and condensation polymers.

Stereoregular polymers- atactic, syndiotactic and isotactic.

Unit-II:Molar mass and its determination 15h

Molecular mass and molar distribution. Number average, mass average, viscosity, average molecular mass and relation between them. Molecular mass distribution. Determination of molecular mass- Osmometry (membrane and vapour phase), light scattering, gel permeation chromatography, sedimentation and ultracentrifuge, viscosity method and end-group analysis.

Unit III: Physical characteristics of polyemers 15h

Morphology and order in crystalline polymers. Configuration of polymer chains, crystal structure of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. The glass transition temperature (Tg), relationship between Tg and TT, Effect of molecular weight,

dilments, chemical structure, chain topology, branching and cross linking. Methods of determination of glass transition and crystallinity of polymers.

Unit IV: Commercial polymers 15h

A) Organic polymers: Commercial polymers, synthesis and and application of polyethylene,

polyvinyl chlorides, polyaimdes, polyesters, phenolic resins and eposy resins.

B) Functional polymers: Fire retarding polymers and conducting polymers.

PSCChP08: Practical VIII–Elective (Polymer Chemistry)

9 h per week (Marks-80)

1. Synthesis of polymers:

a) Synthesis of Thiokol rubber (condensation)

b) Urea-formaldehyde (condensation)

c) Glyptal resin: glycerine phthalic acid (crosslinked Polymer Chemistry)

d) Polyacryonitril (bulk polymerization)

e) Polyacryonitril (emulsion polymerization)

f) Polymethylomethacrylate (emulsion of suspension Polymer Chemistry)

g) Nylon-66 (interfacial polycondensation)

h) Coordination polymers

i) Conducting polymer (electro- or peroxodisulphate oxidation)

2. Characterization of polymers:

a) End-group analysis

b) Viscosity and molecular mass

c) Density of polymer by flotation methods

d) IR spectra.

3. Purification and fractionation of polymer, polystyrene, Nylon 66, PMMA.

4. Magnetic and electrical properties of polymers, magnetic susceptibility and electrical conductivity of coordination and conducting polymers.

5. Thermal analysis and degradation of polymers

TGA: Isothermal and non-isothermal

DTA: Glass transition temperature and melting point

6. Crystallinity of polymers by density measurement.

7. Swelling and solubility parameters of polymers.

8. Synthesis of Graft-Polymers and its characterization by density and IR spectra.

9. Dielectric behavior of polymers.

10. Kinetics of polymerization:

a) Polycondensation

b) Peroxide initiation polymerization.

List of books:

1. Textbook of polymer science: F.W. Billmayer Jr. Wiley.

2. Polymer science: V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.

3. Fractional monomers and polymers: K Takemoto, Y. Inaki, and R.M. Ottam Brite.

4. Contemporaty polymer chemistry: H.R. Alcock and F. W. Lambe, Prentice Hall.

5. Principles of polymer Chemistry: Flory, Cornell Univ. press.

6. Introduction to polymer chemistry: R. B. Seymour, McGraw Hill.

7. Principles of polymerization: Odian.

8. A first course in polymer chemistry: A. Strepikheyew, V. Derevistkay and G. Slonimasky, Mir Publishers, Moscow.

9. Laboratory preparation of macro chemistry: EMM effery, McGraw Hill Co.

10. A practical course in polymer chemistry: S.J. Punea , Pergamon Press.

PSCChT12: Paper XII (Elective- Medicinal Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

UNIT-I: 15 h

A] Biological response to drug, significance of drug metabolism in medicinal chemistry ,Prodrugs, computer aided drugs, molecular modelling and drug design, Clinical studies, medical formulations ,Stereochemistry and drug development

B]Cardiovascular Drugs: Introduction, cardiovascular diseases, Synthesis of nitrate,verapami, methyldopa, atenolol.

UNIT-II: 15 h

A] Antineoplastic Agent: Introduction, classification,cancer chemotherapy, cancer causing chemicals, role of alkylating agents and antimetabolites in treatment of cancer, hormone and natural products. Synthesis of melphalan , thiotepa, lomustine

B] Antidiabetic Agents- Type-I and Type-II diabetes, Insulin, thiazolidinediones, Synthesis of ciglitazone.

UNIT-III: 15h

A] Local Anti-infective drug: Introduction and general mode of action. Synthesis of sulphonamides, ciprofloxacin, norfloxacin, dapsone ,amino salicylic acid, isoniazid, ethionamide, ethambutal, econozole, griseofulvin.

B] Diuretics: Introduction, mode of action, loop diuretics. Synthesis of Bumetanide, Frusemide, Ethacrynic acid, clorexolone Quinethazone.

C] Analgesics and Antipyretics: Introduction, mode of action, evaluation of analgetic agents.

Synthesis of: Aspirin, salsalate, phenacetin, phenylbutazone, Indomethacin, Analgin.

UNIT-IV: 15 h

A] Psychoactive drugs: Introduction, CNS depressants, Introduction and mode of action of Barbiturates, Benzodiazepenes, hydantoins, butyrophenones, buspirone, CNS Stimulants, Synthesis of Phenobarbital, thiopental sodium ,diazepam, lorazepam, bromazepam, ethosuximide **B]Coagulant and Anticoagulants:** Introduction, factors affecting coagulant and anti-coagulant. Mechanism of Blood coagulation and Anticoagulation. Structure of Vitamin K1, Vitamin K2 and heparin. Synthesis of Coumarins and indanediones.

PSCChP08: Practical VIII–Elective (Medicinal Chemistry)

9 h per week Marks-80)

1. Volumetric estimation of Ibuprofen.

2. Estimation of aspirin by volumetric and instrumental methods.

3. Analysis of ascorbic acid in biological/tablet sample.

4. Determination of paracetamol by colorimetry.

5. Analysis of ampicillin trihydrate.

6. Determination of vitamin B12 in commercial sample by spectrophotometry.

7. Determination of phenobarbitone in given cough syrup.

8. Determination of tetracycline in given capsule.

9. Determination of iron, calcium and phosphorus from milk or drug sample.

10. Determination of glucose by glucometer.

11. To perform I.P. monograph of tablet.

12. Estimation of uric acid in serum and urine.

13. Estimation of chloride in serum and Urine.

14. Estimation of liver glycogen.

15. Determination of blood cholesterol.

16. Determination of creatinine and creatine in blood/Urine.

17. Separation and determination of sulpha drugs in tablets or ointments.

Preparation of Drugs: Synthesis, purification and identification of (8-10) of the following drugs.

1. Benzocaine from p-nitrobenzoic acid.

2. Dapsone from diphenyl sulphone.

3. Paracetamol from p-nitro phenol.

4. Uracil from sulphanil amide.

5. Diphenyl hydantion from benzoin.

6. Aluminium asprin from salicylic acid.

7. 4,6-diphenyl-thiazine from chalcone.

8. 6/8 nitro coumarin from resorcinol.

9. Copper aspirin from salicylic acid.

10. N-acetyl parabanic acid.

11. Nerolin from 2-naphthol

12. Phenothiazine from diphenylamine

13. Umbelliferon from resorcinol

14. Benzylidene from benzaldehyde and aniline

15. 1-phenyl-1,2-pentadine-3-one from benzaldehyde

16. 1,5 diphenyl-1,3-pentadiene-2-one from benzaldehyde

17. 1,3-diphenyl-prop-2-ene-1-one

18. 3-methy pyrazol-5-one from ethylacetoacetate

19. 6-methyl uracil

20. Sulphanilamide from acetanilide

List of books:

1. Text book of organic medicinal chemistry-Wilson,Geswold

2. Medicinal chemistry Vil I and II-Burger

3. A textbook of pharmaceitical chemistry-Jayshree Ghosh

4. Introduction to medicinal chemistry-A Gringuadge

5. Wilson andGisvold text book of organic medicinal and pharmaceutical chemistry-Ed.Robert F Dorge

6. An introduction to drug design-SS Pandey,and JR Demmock

7. Goodman and Gilmans pharmacological basis of therapeutics- Stragies for organic drug sythesis and design-D Lednicer

8. Textbook of Medicinal Chemistry- A. Kar

9. Medicinal Chemistry – D Sriram and P.Yogeeswari

PSCChP09: Seminar-III

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 20 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

Syllabus prescribed for M.Sc. Chemistry Semester IV

PSCChT13: Paper XIII (Spectroscopy)

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: 15 h

A] Ultraviolet and visible spectroscopy: Natural line width, line broadening, transition probability, Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels. General nature of bandspectra. Beer- Lambert Law, limitations, Frank-Condon principle, various electronic transitions, effect ofsolvent and conjugation on electronic transitions, Fiesher Wooodward rules for dienes, aldehydes andketones. Structure differentiation of organic molecules by UV Spectroscopy

B] Photoelectron spectroscopy: Basic principles, photoelectric effect, ionization process, Koopman theorem,PES and XPES, PES of simple molecules, ESCA, chemical information from ESCA, Auger electron spectroscopy.

Unit II: Nuclear magnetic Resonance Spectroscopy 15 h

Magnetic properties of nuclei, resonance condition, NMR instrumentation, chemical shift, spin spininteraction, shielding mechanism, factors affecting chemical shift, PMR spectra for different types of organicmolecules, effect of deuteration, complex spin spin interaction (1st order spectra), stereochemistry, variationsof coupling constant with dihedral angle, electronegativity, Karplus equation etc., classification of molecules

as AX, AX_2, AMX, A_2B_2, Shift reagents. NMR studies of 13C, chemical shift in aliphatic, olefinic, alkyne,aromatic, heteroatomic and carbonyl compounds, 19F, 31P. Structure determination of organic molecules byNMR spectroscopy,

Unit III: 15 h

A] Application of NMR spectroscopy: FT-NMR, advantages of FT-NMR, use of NMR in medical diagnosis, 2dimensional NMR spectroscopy-COSY, NOSEY, DEPT, INEPT, APT, INADEQUATE techniques, Nuclearoverhauser effect, nuclear quadrupole resonance spectroscopy: quadrupole nuclei, quadrupole moment,electric field gradient, coupling constant, splitting, applications.

B] Problems based on structure determination of organic molecules by using combined spectral techniques.

Unit IV: Diffraction techniques 15 h

X ray diffraction: Braggs condition, Miller indices, Laue method, Bragg method, Debye Scherrer method,identification of unit cells from systematic absences in diffraction pattern,, structure of simple lattices and xray intensity, structure factor and its relation to intensity and electron density, absolute configuration ofmolecules, Ramchandran diagram.

Electron diffraction: scattering intensity vs scattering angle, Wierl equation, measurement techniques,elucidation of structure of simple gas phase molecules, low energy electron diffraction and structure ofsurfaces.

Neutron diffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurementtechniques, elucidation of structure of magnetically ordered unit cell.

List of books

1] Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril, John Wally
2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely
3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
4] Organic Spectroscopy-William Kemp, ELBS with McMillan
5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
6] Organic Spectroscopy-RT Morrison and RN Boyd
7] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin
8] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming
9] Fundamentals of Molecular Spectroscopy-CN Banwell
10] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro
11] Photoelectron Spectroscopy-Baber and Betteridge
12] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten
13] NMR –Basic Principle and Application-H Guntur
14] Interpretation of NMR spectra-Roy H Bible
15] Interpretation of IR spectra-NB Coulthop
16] Electron Spin Resonance Theory and Applications-W gordy
17] Mass Spectrometry Organic Chemical Applications, JH Banyon
18] Spectroscopy- H. Kaur

INORGANIC CHEMISTRY SPECIALIZATION

PSCChT14: Paper XIV(Special I-Inorganic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit-I 15h

A) Nanoparticles& Nanostructural materials: Introduction, methods of preparation, physical properties, andchemical properties. Molecular Precursor routes to inorganic solids:- Introduction, sol-gel chemistry of metalalkoxide, hybrid organic-inorganic compounds. Nanoporous Materials: Introduction, Zeolites & molecularsieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation &applications.

B) Solid State Reaction: General principles, reaction rates, reaction mechanism, reaction of solids, factorsinfluencing reactivity, photographic process.

Unit-II 15h

A) Coordination Polymers:

Coordination polymers and their classification. Synthesis and applications of coordination polymers. Use ofpolymeric ligands in synthesis of coordination polymers. Organosilicon polymers. Synthesis and their uses.

B) Characterization of coordination polymers on the basis of:

i) Spectra (UV, Visible, IR and NMR)

ii) Magnetic and thermal (TGA,DTA and DSC) studies

Unit-III 15h

Catalysis: Basic principles, thermodynamic and kinetic aspects, industrial requirements, classification,theories of catalysis, homogeneous and heterogeneous catalysis. Introduction, types & characteristics ofsubstrate-catalyst interactions, kinetics and energetic aspects of catalysis, selectivity, stereochemistry, orbitalsymmetry and reactivity. Catalytic reactions of coordination and Organometallic compounds includingpolymerization activation of small molecules, addition to multiple bonds, hydrogenation Zeigler-Nattapolymerization of olefins, hydroformylations, oxidations, carbonylations and epoxidation

.**Unit-IV 15h**

A) Supramolecular chemistry:Molecular recognition: Molecular receptors for different types of moleculesincluding arlsonic substrate, design nad synthesis of co receptor molecules and

multiple recognition.Supramolecular reactivity and catalysis.Transport processes and carrier design. Some examples of selfassemblyin supramolecular chemistry.

B) Thin films and languir-Biodgett films: Preparation technique, evaporation/spultering, chemical processes,MOCVD, solgel etc. Languir-Biodgett(LB) film, growth techniques, photolithography properties andapplications of thin and LB films.

List of books:

1. Barsoum ,M.W.,Fundamentals of Ceramics,McGraw Hill ,New Delhi
2. Ashcroft ,N.W. and Mermin,N.D.,Solid Stae Physics,Saunders College
3. Callister W.D.,Material Science and Engineering, An Introduction,Wiley
4. Keer,H.H,Principals of Solid State,Wiley Eastern
5. Anderson J.C.,Lever K.D.,Alexander J.M and Rawlings,R.D.,ELBS
6. Gray G.W.Ed.Thermotropic Liquid Crystals,John Wiley
7. Kelkar and Hatz Handbook of Liquid Crystals,Chemie Verlag.
8. Kalbunde K.I.,Nanoscale Materials in Chemistry,John Wiley,NY.
9. Shull R.D.,McMichael R.D. and Swartzendrub L.J.,Studies of Magnetic Properties of Fine particles and their
relevance to Mataerials Science, Elsevier Pub. Amsterdam

PSCChT15: Paper XV (Special II-Inorganic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit-I 15 h

A) Basics of Photochemistry: Absorption, excitation, photochemical laws, quantum yield, electronicallyexcited states-life times-measurements of the times. Flash photolysis, stopped flow techniques, Energydissipation by radiative and no-radiative processes, absorption spectra Frank-photochemical stages-primary & secondary processes.

B) Properties of excited states: Photochemical kinetics,Calculation of rates of radiative processes.

C) Excited States of Metal Complexes: Electronically excited states of metal complexes, charge transferspectra, charge transfer excitations, metods for obtaining charge transfer spectra.

Unit-II 15h

A) Ligand field Photochemistry: photosubstitution, photo oxidation & photoreduction. Liability andselectivity, zero vibrational levels of ground state and excited state, energy content of excited state, zero-zerospectroscopic energy, development of the equations for redox potentials of the excited states.

B) Redox reactions by Excited Metal Complexes: Energy transfer under conditions of weak interaction &strong interaction – exciplex formation, conditions of excited states to be useful as

redox reactants, excitedelectron transfer, metal complexes as attractive candidates (2,2-bipyridine & 1,10-Phenanthrolinecomplexes.), illustration of reducing and oxidizing character of ruthenium (II); role of spin-orbit coupling, lietime of these processes. Application of redox processes of electronically excited states for catalytic purposes,transformation of low energy reactants in to highenergy products, chemical energy in to light.

C) Metal Complex Sensitizers: Metal Complex Sensitizers, electron relay, metal colloid systems, andsemiconductor supported metal or oxide systems, water photolysis, nitrogen fixation & carbon dioxidereduction.

Unit-III 15h

Organotransition Metal Chemistry: Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability& decomposition pathways of alkyls & aryls of transition metals. Organocopper in Organic synthesis.

Compounds of Transition Metal –Carbon Multiple bonds: Alkylidenes, alkylidynes, low valent carbenes &carbynes–synthesis, nature of bond, structural characteristics, nucleophilic &electrophilic reactions onligands, role inorganic synthesis.

Unit-IV 15h

Transition Metal Pi Complexes-Carbon multiple bonds. Nature of bonding, structural characteristics &synthesis, properties of transition metal pi- Complexes with unsaturated organic molecules, alkenes alkynes,allyl, diene, dienyl, arene & trienyl complexes. Application of transition metal, organometallic intermediatesin oraganic synthesis relating to nucleophilic & electrophilic attack on ligands, role in organic synthesis.

List of books:

1. Elschenbroich Ch.and Salzer A.: Organometallics, VCH,Weinheim, NY.
2. Balzani Vand Cavassiti V.:Photochemistry of Coordination compounds,AP,London
3. Purcell K.F.and KotzJ.C., An Introduction to Inorganic Chemistry,Holt Sounder,Japan.
4. Rohtagi K.K.and Mukharjee,Fundamentals of Photochemistry,Wiley eastern
5. Calverts J.G.and Pits.J.N.,Photochemicals of Photochemistry,John Wiley
6. Wells,Introduction of Photochemistry
7. Paulson,Organometallic Chemistry,Arnold
8. Rochow,Organometallic Chemistry,Reinhold
9. Zeiss,Organometallic Chemistry,Reinhold
10. Gilbert A.and Baggott,J,Essential of Molecular Photochemistry,Blackwell Sci.Pub.
11. Turro N.J.and Benjamin W.A.,Molecular Photochemistry
12. CoxAand Camp,T.P.Introductory Photochemistry,McGraw-Hill
13. KundallR.P.and GilbertA,Photochemistry, Thomson Nelson Coxon J and Halton B.,Organic Photochemistry, Cambridge University Press.

PSCChP10 Practical-X (Inorganic Chemistry Special)
9 h /week Marks: 80

A) Preparation and characterization of following the following complexes/organometallic compoundincluding their structural elucidation by the available physical methods. (Element analysis, molecular weightdetermination, conductance and magnetic measurement and special studies) Selection can be made from thefollowing:

i) Cis and trans isomers of bis(glycinato) copper(II) monohydratye.

ii) N,N-bis (salicylaldehyde) ethylene diaminato nickel(II)

iii) Trinitrotriamine cobalt(III)

iv) Cis and trans disubstituted octahedral Cr (III) complexes $[CrF_2(en)_2]$.

v) Preparation of Grignard reagent

vi) Ferrocene and its acelytion

vii) Sodium amide

viii) Synthesis of trichlorodiphenylantimony(V) hydrate.

ix) Synthesis of metal acetylacetonate: magnetic moment, IR, NMR.

x) Magnetic moment of $Cu(acac)_2H_2O$

xi) Determination of Cr (III) complexes: $[Cr(H_2O)_6]NO_3.3H_2O$, $[Cr(H_2O)_4Cl_2].Cl.2H_2O$, $[Cr(en)_3]Cl_3$

xii) Preparation of N,N bis (salicylaldehyde) ethylenediamine,(salen), Cobalt and copper complexes.

B) Solid State:

1) Preparation of oxides and mixed oxides (Mn_2O_3, NiO, Cu_2O, Fe_3O_4, $ZnFe_2O_4$, $ZnMn_2O_4$, $CuMn_2O_4$ and
$NiFe_2O_4$)

2) Preparation of Silica and Alumina by sol-Gel technique.

3) To study the electrical conductivity of ferrites, Magnetites, doped oxides and pure samples and determineband gap.

C) Bioinorganic Chemistry

1) Extraction and absorption spectral study of chlorophylls from green leaves of students choice

2) Separation of Chlorophyll and their electronic spectral studies.

3) Complexation study of Cu(II) with biologically important amino acids

D) Inorganic reaction mechanism:

Kinetics and mechanism of following reactions:

1) Substitution reactions in octahedral complexes (Acid/Basehydrolysis)

2) Redox reactions in octahedral complexes.

3) Isomerization reaction of octahedral complexes.

E) Inorganic Photochemistry:

i) Synthesis of potassium ferrioxalate and determination of intensity of radiation

ii) photoxidation of oxalic acid by UO2

2+ sensitazation

iii) Photo decomposition of HI and determination of its quantum yield.

List of books:

1. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly, Prentice Hall.
2. Inorganic Experiments, J. Derck Woollins, VCH.
3. Practical Inorganic Chemistry, G. Marrand, B. W. Rockett, Van Nostrand.
4. A Text Book of Quantitative Inorganic Analysis, A. I.Vogel,Longoman.
5. EDTA Titrations. F. Laschka
6. Instrumental Methods of Analysis, Willard, Merit and Dean (CBS, Delhi).
7. Inorganic Synthesis, Jolly
8. Instrumental Methods of Chemical Analysis, Yelri Lalikov
9. Fundamental of Analytical Chemistry, Skoog D.A. andWest D.M Holt Rinehart andWinston Inc.
10. Experimental Inorganic Chemistry, W.G.Palmer, Cambridge.
11. Solid state Chemistry, N.B.Hanney
12. Introduction to Thermal Analysis, TechniquesandApplications,M.E.Brown, Springer
13. Preparation and Properties of solid state Materials, Wilcox, Vol.IandII, Dekker
14. The Structure and Properties of Materials Vol.IV, JohnWulff, Wiley Eastern.

ORGANIC CHEMISTRY SPECIALIZATION
PSCChT14: Paper XIV (Special II-Organic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit I:15 h

A] Carbanions in organic Chemistry Ionization of carbon hydrogen bond and prototopy, Base and acid catalysed halogenation of ketones, ketoenolequilibria, structure and rate in enolisation, concerted and carbanion mechanism for tautomerism,carbanion character in phenoxide and pyrrolyl anions, geometry of carbanions, kinetic and thermodynamiccontrol in the generation of enolates, LDA, hydrolysis of haloforms, use of malonic and acetoacetic esters,Aldol, Mannich, Cannizzaro, Darzens, Dieckmann, Claisen Baylis-Hillman reactions, Knoevenagel, benzoincondensation, Favorski reaction, alkylation of enolates and stereochemistry thereof, Conjugate additions.

B] Organometallic reagents -I

Synthesis and applications of organo Li and Mg reagents, nucleophilic addition to aldehyde, ketones, ester,epoxide, CO_2, CS_2, isocyanates, ketenes, imines, amides, lactones, Stereochemistry of Grignard addition tocarbonyl compounds, o-metallation of arenes using organolithium compounds.

Unit II: 15 h

A] Organometallic reagents-II

Organozinc reagents: Preparation and applications, Reformatsky reaction, Simon-Smith reaction. Organocopper reagents: Preparation and applications in C-C bond forming reaction, mixed oragnocuprates,Gilman's reagent. Organo Hg and Cd reagents in organic synthesis.

B] Transition metals in organic synthesis

Transition metal complexes in organic synthesis-Introduction-oxidation states of transition metals, 16-18 rule,dissociation, association, insertion, oxidative addition, reductive elimination of transition metalOrganopalladium in organic synthesis-Heck reaction, allylic activation, carbonylation, wacker oxidation,isomarization formation N-aryl and N-alkyl bond transmetalation, allyl deprotection in peptides, couplingreactions: Kumada Reaction, Stille coupling, Sonogashira and Suzuki coupling reactions and their importanceApplications of $Co_2(CO)_8$, $Ni(CO)_4$, $Fe(CO)_5$ in organic synthesis. Wilkinson, Noyori, Knowls catalyst of

Rutheniumand Rhodium – synthesis and uses its use in hydrogenation reactions-deallylation, C-C, C-O, C-N bond cleavages.Olefin metathesis by Istand IIndgeneration catalyst, reaction mechanism and application in the synthesis ofhomo and heterocyclic compounds

Unit III: 15 h

A] Advanced Stereochemistry:

Conformation of sugars, monosaccharides, disaccharides, mutorotation, Recapitulation of Stereochemicalconcepts- enantiomers, diastereomers, homotopic and heterotopic ligands, Chemo-, regio-, diastereo- andenantio-controlled approaches; Chirality transfer, Stereoselective addition of nucleophiles to carbonyl group:Re-Si face concepts, Cram's rule, Felkin Anh rule, Houk model, Cram's chelate model. Asymmetric synthesisuse of chiral auxiliaries, asymmetric hydrogenation, asymmetric epoxidation and asymmetric dihydroxylation,

B] Protection and Deprotection of functional groups: Protection and deprotection of functional groups like,hydroxyl, amino, carbonyl and carboxylic acids groups, Solid phase peptide synthesis.

Unit IV: Designing the synthesis based on retrosynthetic analysis 15 h

(A) Disconnection Approach: An introduction to synthons and synthetic equivalents, disconnection approach,functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-Xand two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, aminesynthesis

(B) One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, useof acetylenes and aliphatic nitro compounds in organic synthesis

(C)Two Group C-C Disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds, α,β-unsaturatedcarbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael additionand Robinson annelation, Methods of ring synthesis

List of books

1] Principle of Organic Synthesis R. O. C. Norman and J. M. Coxon

2] Modern Synthetic Reaction. H. O. House and W. A. Benjamin

3] Organic Synthesis: The Disconnection Approach-S. Warren

4] Designing Organic Synthesis-S. Warren

5] Some Modern Methods of Organic Synthesis-W. Carruthers

6] Advance Organic Reaction. Mechanism and Structure-Jerry March
7] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press
8] Organic Reaction and their Mechanism-P. S. Kalsi
9] Protective Groups in Organic Synthesis-T. W. Greene
10] The Chemistry of Organo Phosphorous-A. J. Kirbi and S. G. Warren
11] Organo Silicon Compound-C. Eabon
12] Organic Synthesis via Boranes-H. C. Brown
13] Organo Borane Chemistry-T. P. Onak
14] Organic Chemistry of Boron-W. Gerrard

PSCChT15: Paper XV (Special II-Organic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit I: Enzyme chemistry 15h

A] Enzymes: Introduction and historical perspective, chemical and biological catalysis, remarkable propertiesof enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction andpurification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of activesite by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Baker'syeast catalyzed reactions, Applications of enzymes in food and drug chemistry

B] Mechanism of Enzyme Action: Transition-state theory, orientation and steric effect, acid-base catalysis,covalent catalysis, strain or distortion. Example of some typical enzyme mechanisms for chymotrypsin,ribonuclease, lysozyme and carboxypeptidase A.

C] Co-Enzyme Chemistry: Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes.Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+,NADP+, FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofactors.

Unit II: Heterocycles 15h

A] Azoles: Structural and chemical properties; Synthesis of pyrazole, isothiazole and isoxazole; Synthesis ofimidazoles, thiazoles and oxazoles; Nucleophilic and electrophilic substitutions; Ring cleavages

B] Benzofused heterocycles: Synthesis of indole, benzofuran and benzo-thiophene, quinoline and isoquinoline Nucleophilic, electrophilic and radical substitutions; Addition reactions; Indole rings in biology.

C] Diazines: Structural and chemical properties; Synthesis of pyridazines, pyrimidines, pyrazines; Nucleophilicand electrophilic substitutions.

Unit III: 15h

A] Nucleic Acids: Primary, secondary and tertiary structure of DNA; DNA replication and heredity; Structureand function of mRNA, tRNA and rRNA. Purines and pyrimidine bases of nucleic acids and their preparation.

B] Lipids: Fatty acids, essential fatty acids, structures and functions of triglycerols, glycerophospho lipids,spingolipids, lipoproteins, composition and function, role in atherosclerosisProperties of lipid aggregates, micells, bilayers, liposomes and their biological functions, biologicalmembranes, fluid mosaic model of membrane structure, Lipid metabolism, β-Oxidation of fatty acids

C] Vitamins: Structure determination, synthesis and biosynthesis of vitamin A, E and H.

Unit IV: 15h

A] Dyes:

General Introduction, classification on the basis of structure and methos of application dying mechanism,methods of dying, such as direct dying, vat dying, dispersive dying, formation of dye in fibre, dying withreactive dyes, study of quinoline yellow, cyamine dye, ethyl red, methylene blue, Alizarin, cyamine-green,fluorescein, cosin, erythrosine, Rhodomines and Indigo.

B]Pharmaceutical chemistry:

History, medical terms in pharmaceutical chemistry, classification of drugs, antibacterial and antifungal drugs,specific clinical applications, Serendipity and drug development, Synthesis and applications of: Benzocaine,Methyl dopa, dilantin, ciprofloxacin, acyclovir, terfenadine, salbutamol

C] Polymer chemistry: Importance of polymers, Basic concepts: monomers, repeat units, degree ofpolymerization. Linear, branched and network polymers. Classification of polymers. Polymerization:condensation, addition, radical chain-ionic and co-ordination and co-

polymerization and their mechanisms,Polymerization in homogeneous and heterogeneous systems. Ziegler-Natta polymerization with mechanism,Stereo regulated polymers, syndiotactic, isotactic and atactic polymers

List of books

1] Textbook of Polymer Science, F. W. Billmeyer Jr, Wiley
2] Polymer Science, V. R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern
3] Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R. M. Ottanbrite
4] Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-
Verlag
5] Understanding Enzymes, Trevor Palmer, Prentice Hall
6] Enzyme Chemistry: Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall
7] Enzyme Structure and Mechanism, A. Fersht, W. H. Freeman
8] Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH
9] Wilson and Gisvold's Text Book of Organic Medical and Pharmaceutical Chemistry, Ed Robert F. Dorge
10] Burger's Medicinal Chemistry and Drug Discovery, Vol-1, Ed. M. E. Wolff, John Wiley
11] Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley
12] The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press

PSCChP10 Practical-X (Organic Chemistry Special)
9 h /week Marks: 80

[A] Quantitative Analysis based on classical and instrumental technique (any 9-10)
1] Estimation of nitrogen.
2] Estimation of halogen.
3] Estimation of sulphur.
Spectrophotometric/calorimetric and other instrumental methods of estimation
4] Estimation of streptomycin sulphate.
5] Estimation of vitamin B-12.
6] Estimation of amino acids.
7] Estimation of proteins.
8] Estimation of carbohydrates.
9] Estimation of Ascorbic acid.
10] Estimation of Aspirin.
11] Solvent extraction of oil from oil seeds and determination of saponification value, iodine value of the
same oil.
[B] Organic multi-step preparations (Two/Three steps): Minimum 10-12 preparations
[1] Aniline Diaminoazobenzene _ p-aminoazobenzene
[2] Benzoin →Benzyl →Dibenzyl
[3] Aniline → acetanilide → p-bromoacetanilide → p-bromoaniline
[4] Aniline → Acetanilide → p-nitroacetanilide → p-nitroaniline
[5] Benzaldehyde (thiamine hydrochloride) → benzoin → benzil → benzilic acid
[6] p-Nitrotoluene → p-nitrobenzoic acid → PABA → p-iodobenzoic acid
[7] p-Cresol → p-cresylacetate → 2-hydroxy-5-methyl acetophenone → 2-hydroxy chalcone

[8] Benzaldehyde → benzilidene acetophenone → 4,5-dihydro-1,3,5-triphenyl-1H-pyrazole
[9] Aniline → phenylthiocarbamide → 2-aminobenzthiazole (Microwave in step I)
[10] Chlorobenzene → 2,4- Dinitrochlorobenzene → 2,4- Dinitrophenylhydrazine.
[11] Acetophenone → acetophenone phenyl hydrazone → 2-phenylindole
[12] Benzion → benzoin benzoate → 2,4,5-triphenyl oxazole
[13] Benzophenone → benzpinacol → benzopinacolone (Photochemical preparation)
[14] Benzophenone → Benzophenone oxime →Benzanilide →Benzoic acid + aniline
15
[15] Aniline → aniline hydrogen sulphate → sulphanilic acid → Orange II
[16] Aniline → N-arylglycine → indoxyl → indigo
[17] Phthalimide →Anthranilic acid →Phenyl glycine-o-carboxylic acid →Indigo
[18] Phalic anhydride →Phthalimide→ Anthranilic acid →o-chlorobenzoic acid
[19] Phalic anhydride →Phthalimide →Anthranilic acid→Diphenic acid
[20] Ethyl acetoacetate →3-methyl-pyrazol-5-one →4,4-dibromo-3-methyl-pyrazol-5-one→ Butanoicacid
[21] Biosynthesis of ethanol from sucrose
[22] Enzyme catalyzed reactions
[C] SPECTRAL INTERPRETATION
Structure Elucidation of organic compounds on the basis of spectral data (UV, IR, 1H and 13CNMR and Mass)
(Minimum 12 compounds are to be analysed during regular practicals).

PHYSICAL CHEMISTRY SPECIALIZATION

PSCChT14:Special I Paper XIV (Special I-Physical Chemistry)
60h (4h/week) 15h/unit 80 Marks

UNIT-I SURFACE CHEMISTRY 15h

A] Macromolecules: Number and average molecular mass, molecular mass determination:Osmometry,Viscometry, sedimentation, diffusion and light scattering method.

B] Chemical adsorption, application of adsorption, factors affecting adsorption, Langmuir theory, BET theory,heat and entropy of adsorption. Surface film on liquids; Electro-kinetic phenomena. types of adsorptionisotherm. micelle formation, mass action model and phase separation model, shape and structure ofmicelles, CMC, factors affecting CMC effect of added electrolyte on the surface excess of ionic surfactants.

C] Modern techniques for investigating surfaces-Low energy electron diffraction(LEED), PES, Scanningtunneling and atomic force microscopy (STM and AFM)

UNIT II CORROSION AND CORROSION ANALYSIS 15h

A] Scope and economics of corrosion, causes (Change in Gibbs free energy) and types of corrosion,lectrochemical theories of corrosion, dry and wet corriosion, Different types of corrosion-Pit, Soil, chemical

and electrochemical, intergrannular, waterline, microbial corrosion, measurement of corrosion by differentmethods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design andmaterial selection.

B] Thermodynamics of corrosion, corrosion measurements (Weight loss, OCP measurements, polarizationmethods), passivity and its breakdown, corrosion prevention (electrochemical inhibitor and coatingmethods).

UNIT III: RADIATION CHEMISTRY 15h

Measurement of dose. Dosimetric terms and units (Roentgen, REM, Rad, Gray, Sievert), inter conversions,calculation of absorbed dose-various types of dosimeters, chemical dosimeters (Fricke and Ceric sulphate),experimental methods, TLD badges, Radiolysis-definition, process, Radiolysis of water and aqueous solutions,hydrated electron, Effect of radiation on biological substances, genetic effects, radiation effects on organiccompounds (Halides-carboxylic acids), polymers, nitrates and solid thermoluminescence.

UNIT IV: LIQUID STATE 15h

A] Theory of liquids:- Theory of liquids, partition function method or model approach, single cell models,communal energy and entropy, LTD model, significant structure model.

B] Supercooled and ionic liquids: Supercooled and ionic liquids, theories of transport properties, nonArrhenius behavior of transport properties, Cohen- Turnbull free volume model, configurational entropymodel, Macedo- litovitz model, glass transition in supercooled liquids.

List of Books

1. Y. Moroi, Micelles : Theoretical and Applied Aspects, Plenum Press, New York (1992).
2. E.M. Mc Cash, Surface Chemistry, Oxford University Press, Oxford (2001).
3. P.A. Eglestaff," An Introduction to Liquid State" Academic Press.
4. J.A.Pryde,"The Liquid State"
5. A.F.M.Barton, "The Dynamics of Liquid State", Longman.
6. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
7. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
8. G. Hughes- Radiation Chemistry- Oxford University Press, London

PSCChT15: Paper XV (Special II-Physical Chemistry)

60h (4h/week) 15h/unit 80 Marks

UNIT I: ELECTRICAL AND MAGNETIC PROPERTIES OF SOLIDS 15h

A] Metals, insulators and semiconductors, electronic structure of solids-band theory, fermi gas model,electrical conductivity, thermal conductivity, Lorenz number, periodic potential, band structure of metals,insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors,semiconductor p-n junctions, colors in solids.semiconductors, meissner effect, LTSC, HTSC.

B] Behaviour of substances in magnetic field, effect of temperature: Curie and Curie-weiss law, calculation ofmagnetic moments, magnetic materials, their structure and properties, Applications: structure/ propertyrelations, numericals.

UNIT II: ELECTRICAL PROPERTIES OF MOLECULES 15h

Dipole moments of molecules, basic ideas of electrostatic interactions, polarizability, orientation polarization,Debye equations, limitation of the Debye theory, Clausius-Mossotti equation. electrostatic of dielectricmedium, molecular basis of dielectric behavior, structural information from dipole moment measurements,use of individual bond dipole moments, application to disubstituted benzene derivatives, dipole moment andionic character of a molecule, determination of dipole moment from dielectric measurements in pure liquids
and in solutions. The energies due to dipole-dipole, dipole induced dipole and induced dipole-induced dipoleinteraction. Dispersion, dielectric loss and refractive index. Lennard-Jones potential.

Unit III: LIQUID CRYSTALS 15h

A] LIQUID CRYSTALS :Mesomorpic behavior, thermotropic liquid crystals, positional order, bond orientationalorder, nematic and sematic meso phases, sematic and nematic transitions and clearing temperature,homeotrpic, planer and schlieren textures twisted nematics, chiral nematics, molecular arrngement insmectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectricconstants. Lyotropic phases and their description of ordering in liquid crystals.

B] THIN FILMS: Langmuir- Blodgett (LB) Film, growth techniques, photolithography, properties andapplications of thin and LB films.

Unit IV: 15h

A] Liquid gas and liquid interfaces: Surface tension, methods of determination of surface tension, surfacetension across curved surfaces, vapor pressure of droplet (Kelvin equation) , surface spreading , spreadingcoefficient, cohesion and adhesion energy, contact angle, constant angle hystereis, wetting and detergency.

B] Solid - Solid interfaces : Surface energy of solids, adhesion and adsorption, sintering and sinteringmechanism, Tammann temperature and its importance, surface structure and surface composition.

List of books

1. Physical Chemistry - P.W. Atkin, ELBS fourth edition.
2. Physical Chemistry – R.A. Alberty, R.I. Bilby, Johy Wiley – 1995
3. Physical Chemistry – G.M. Barrow, Tata Mc – Graw Hill – 1988

PSCChP10 Practical-X (Physical Chemistry Special)
9 h /week Marks: 80
Adsorption:
1. To verify Freundlich adsorption isotherm.
2. To verify Langmuir adsorption isotherm.
3. To verify Gibbs adsorption isotherm and to find surface excess concentration of solute.
4. To determine CMC of the given surfactant by surface tension method.
5. Study of variation of surface tension of solution of n-propyl alcohol with concentration and hencedetermine the limiting cross section area of alcohol molecule.
Kinetics:
6. Clock reaction- activation energy of bromide-bromate reaction.
7. Temp dependence of persulfate-iodide reaction by iodine clock method and calculation of thermodynamicand Arrhenius activation parameters. Study of ionic strength effect on persulfate-iodide reaction.
8. Kinetics of B-Z reaction; Kinetics of modified B-Z reaction
9. Investigate the Autocatalytic reaction between potassium permanganate and oxalic acid.
10. Determination of PKa value of a weak acid by chemical kinetic method(formate-iodine reaction)
Potentiometry and Conductometry:
11. Transport number by potentiometry.
12. Hydrolysis constant by aniline-hydrochloride by potentiometry and conductometry
13. pKa of weak acids by potentiometry and conductometry.
14. Complexation between Hg2+and I- conductometrically.

ANALYTICAL CHEMISTRY SPECIALIZATION
PSCChT14: Paper XIV (Special I-Analytical Chemistry)

60h (4h/week) 15h/unit 80 Marks

Unit-I: Radioanalytical Chemistry-II 15h

Preparation of some commonly used radioisotopes, Use of radioactive isotopes in analytical and physicochemicalproblems, Industrial applications, Neutron sources, Neutron Activation Analysis, Isotope DilutionAnalysis, Radiometric titrations (Principle, Instrumentation, applications, merits and demerits),Radiochromatography, Carbon dating, Numericals based on above.

Unit-II: Optical methods of analysis-IV 15h

Inductively coupled plasma-atomic emission spectroscopy: Principle, atomization and excitation. Plasmasource and sample introduction. Instrumentation. Comparison of ICP-AES with AAS. Applications.X-ray fluorescence spectroscopy: Principle. Instrumentation: wavelength and energy dispersive devices.Sources and detectors. Comparison between wavelength and energy dispersive techniques. Samplepreparation for XRF. Matrix effects in XRF. Applications in qualitative and quantitative analysis.Particle induced X-ray emission (PIXE): Basic principle, Instrumentation and applications.Electron microscopy: Principle, instrumentation and applications of scanning electron microscopy (SEM) andtransmission electron microscopy (TEM)

Unit-III: Electrochemical methods of analysis-III 15h

Ion selective electrodes: Theory of membrane potential. Types of ion-selective electrodes. Construction ofsolid state electrodes, liquid membrane electrodes, glass membrane electrodes and enzyme electrodes,Selectivity coefficients, Glass electrodes with special reference to H^+, Na^+ and K^+ ions. Applications of ISE inanalysis of environmentally important anions like F^-, Cl^-, Br^-, I^-, NO_3^- and CN^-. Advantages of ISE.

Coulometry: Principle. Coulometry at constant potential and constant current. Instrumentation. Applicationsand advantages of coulometric titrations.

Electrochemical microscopy: Introduction to scanning probe microscopy (SPM), scanning tunnelingmicroscopy (STM), atomic force microscopy (AFM) and scanning electrochemical microscopy (SECM).

Unit-IV:Thermal methods of analysis 15h

Introduction to different thermal methods, Thermogravimetry (TG and DTG), Static thermogravimetry, quasistaticthermogravimetry and dynamic thermogravimetry, Instrumentation-Balances, X-Y recorder, Stanton-Redcroft TG-750,

Thermogram, Factors affecting thermogram, Applications of thermogravimetry, Differential Thermal Analysis (DTA)-Theories, DTA curves, Factors affecting DTA curve, Applications of DTA, simultaneous determination in thermal analysis,Differential Scanning Calorimetry (DSC)-Introduction, Instrumentation, DSC curves, factors affecting DSC curves,applications, Thermogravimetric titration-Theory, Instrumentation and applications.

PSCChT15: Paper XV (Special II-Analytical Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit-I: Pharmaceutical and clinical analysis 15h

Requirements of a quality control laboratory for pharmaceutical units, a general idea about following classesof drugs and their analysisa.

Antibiotics-Chloroamphenol, ampicilline, terramycine

b. Vitamins-Thymine hydrochloride (Vitamin-B1) Riboflavin (Vitamin-B2), Ascorbic acid (Vitamin-C)

c. Sulpha drugs- sulphaguanidine, sulphapyrazine, sulphanilamide

d. Narcotics and dangerous drugs- screening by GC and TLC and spectrophotometric measurements.Composition of blood, sample collection for blood and urine, clinical analysis, Immuno Assay-RIA, Setting upof RIA and applications, Fluorescence Immunoassay, Enzyme immunoassay, Blood gas analyzer, Traceelements in the body.

Unit-II: Soil analysis and coal analysis 15h

Soil analysis- Classification and composition, pH and conductivity, analysis of constitutents such as nitrogen,phosphorous, potassium and microconstitutents.

Coal analysis- Proximate analysis (moisture content, ash content, volatile matter, fixed carbon). Ultimateanalysis (carbon, hydrogen, sulphur, nitrogen, oxygen content). Combustion of carbonaceous fuel- Flue gas.Calorific value and its units.

Unit-III: Corrosion and corrosion analysis 15h

Definition, draw backs and theories of corrosion-dry and wet corrosion, Different types of corrosion-Pit, Soil,chemical and electrochemical, intergrannular, waterline, microbial corrosion, measurement of corrosion bydifferent methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, designand material selection.

Unit-IV: Automation in analytical chemistry 15h

Automation in the laboratory, Principle of automation, automated instruments, classification, continuousanalyzer, automatic instruments, semiautomatic instruments GeMSAEC Analyzer, Flow Injection Analysis(FIA), Dispersion coefficient, Factors affecting Peak Height, microprocessor based instruments, Numericalsbased on above.

Hyphenated techniques: Introduction to GC-MS, LC-MS, ICP-MS and MS-MS (Tandem) spectrometry.

PSCChP10 Practical-X (Analytical Chemistry Special)

9 h /week Marks: 80

A**. Organoanalytical chemistry**

1. Estimation of sulphur, nitrogen, phosphorous, chlorine in organic compound.
2. Estimation of phenol.
3. Estimation of aniline.

B. **Separation techniques**

Ion exchange

1. Separation and estimation of zinc and magnesium/cadmium in a mixture on anion exchanger.
2. Separation and estimation of chloride and iodide in a mixture on anion exchanger.
3. Determination of total cation concentration in water.

Solvent extraction

1. Estimation of Copper using Na-DDC.
2. Estimation of Iron using 8-hydroxyquinoline.
3. Estimation of Nickel using DMG.
4. Estimation of Cobalt using 8-hydroxyquinoline.
5. Estimation of Nickel by synergistic extraction with 1,10-phenanthroline and dithizone.

Paper chromatography

1. Separation and estimation of copper and nickel in a mixture.
2. Separation and estimation of cobalt and nickel in a mixture.

Thin layer chromatography

Separation and estimation of bromophenol blue, congo red and phenol red in a mixture.

C. Water analysis

Mineral analysis: Ttemperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphate,

hardness
Demand analysis: DO, COD
Heavy metals: Fe, Cd and Pb
D. Demonstrations
1. Gas chromatography
2. HPLC

List of books:

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Thermal analysis: Blazek (translated by J. F. Tyson, Van Nostrand)
4. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)
5. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
6. Vogel's Text Book of Quantitative inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
7. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
8. Atomic Absorption Spectroscopy: Robinson (Marcel Dekker)
9. Instrumental Methods of chemical Analysis: Braun (Tata McGraw-Hill)
10. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
11. Analysis of Water: Rodier
12. Ion selective electrods: Koryta (Cambridge University Press)
13. Instrumentation in analytical chemistry: Borman (American Chemical Society)
14. Industrial Chemistry: Arora and Singh (Anmol Publications)
15. Diffraction Methods: John Wormald (Clarendon Press)
16. Electroanalytical Chemistry: Bard (Dekker)
17. Analytical Chemistry by Open Learning (Wiley)
18. An Introduction to Electron Diffraction: Beeston (North Holand Publishing Co.)
19. Material Science and Engineering: V. Raghavan (Printice-Hall of India)
20. Practical Physical Chemistry: J. B. Yadav (Goel Publishing House)

PSCChT16 Paper XVI Elective (Applied Analytical Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Water treatment 15h

Hardness of water and types of hardness. Problems due to hardness. Removal of hardness by lime-sodaprocess, Zeolite process and synthetic ion-exchange resins. Principle, instrumentation and comparison ofthese three processes. Numericals based on hardness removal. Desalination of sea-water.

Unit-II: Polymer chemistry and Glass analysis 15h

Polymer chemistry: Definition, classification, co-polymers, conducting polymers, determination of molecularweight, acid value, saponification value, iodine value and hydroxyl groups of polymers., TGA and DTA studiesof polymers, LDC polymers. Rubbers, elastomers, silicones.

Glasses: Introduction. Physical and chemical properties. Composition of ordinary glass and special glasses.Determination of silicon, calcium, magnesium, aluminium, chloride, sulphur, barium, arsenic, antimony,chromium, cobalt, copper, iron, manganese, nickel, titanium in glasses.

Unit-III: Cosmetic technology and leather analysis 15h

Importance of quality control in cosmetic preparations, stability testing of various cosmetic products, Studyof rheological properties of semi-solid preparations, evaluation of active ingredients in finished products likeshampoos, hair dyes, toothpaste, talcum powder, lip sticks, sun screen preparations.Analysis of leather: Determination of moisture, acid, free sulphur, total ash, chromic oxide in leather, tensilestrength and stretch of leather.

Unit-IV: Explosives and propellants 15h

Classification of explosives, characteristics of TNB, TNT, RDX, dynamite, lead azide, ammonium nitrate,ammonium picrate. Pyrotechniques.Analysis of explosives and propellants: Heat of explosion, moisture determination by Karl-Fisher reagent,vacuum oven drying and non-aqueous titration. Stability by different methods. Total volatiles. Qualitativetests for explosives. Colorimetric methods for nitro-compounds. Mechanical tests for explosives.

PSCChT16 Paper XVI Elective(Nuclear Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Radiation Chemistry, Radiolysis 15h

Measurement of dose. Dosimetric terms and units (Roentgen, REM, Rad, Gray, Sievert), inter conversions,calculation of absorbed dose-various types of dosimeters, chemical dosimeters

(Fricke and Ceric sulphate),experimental methods, TLD badges, Radiolysis-definition, process, Radiolysis of water and aqueous solutions,hydrated electron,Effect of radiation on biological substances, genetic effects, radiation effects on organic compounds (Halidescarboxylicacids), polymers, nitrates and solid thermoluminescence

Unit-II: Hot Atom Chemistry and Radiochemistry 15h

Recoil energy and calculations, Szilard Chalmers effects, Kinetics, primary and secondary retention-effect ofvarious factors on retention and its uses, Mossbauer effect- principle, instrumentation and chemical lapplications

Unit-III: Radioanalytical techniques 15h

Neutron sources, Neutron activation analysis, principle, methodology and application for trace analysis,Isotope dilution analysis-principle and application, Isotopic exchange reaction, mechanism and application inuse of radioisotopes and tracers, radioactive dating based on carbon-14 and lead isotopes.

Unit-IV: Radiopharmaceuticals 15h

Radioimmunoassay (RIA), discovery, principle, set up of RIA, Principle of Immunoradiometric assay (IRMA),principle and set up, Radiopharmaceuticlas, classification of products, preparations, quality control aspects,99Mo-99mTc generator, Cylotron based products, PRT studies, Therapeutic applications , Radiotherapy

PSCChT16 Paper XVI (Elective- Environmental Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Water Pollution 15h

Pollutants- Types of pollutants, sources of water pollution, sampling, preservation and storage of watersample, physico –chemical, organoleptic and chemical analysis of water, electro-analytical, optical (UC-visiblespectrophotometry, AAS, flame photometry, XRF, ICPAES),

chromatographic (GC and HPLC) and neutronactivation methods of analysis of Co, Ni, Cu, Fe, Mn, Zn, Cd, Pb, Hg, As, Cl^- ,F^-, $SO^{4--,}PO^4$-, NO_3^2- Historicaldevelopment of detergents, chemistry of soaps and detergents.

Unit-II: Air Pollution 15h

Natural versus polluted air, air quality standards, air sampling, analysis and control of Particulates, Chemistryand analysis of SOx, NOx, CO, ozone, hydrocarbons, CFCs. Chemistry of gaseous, liquid and solid fuelsgasolineand additives, antiknock agents. Air pollution control—control of automobile emission and controlmeasures in thermal power stations.

Unit-III: Soil Pollution 15h

Types and sources of soil pollution, classification of soil pollutants, impact of soil pollution on air quality,Specifications for disposal of sewage and effluent on land for irrigation and ground water recharge.Methodology of waste water disposal on land in India. Impact of usage of land for solid waste disposal bothmunicipal solid waste and industrial solid wastes (fly ash from thermal power station, lime sludge from paperand pulp industry), cause of soil erosion, effects of soil erosion, conservation of soil, control of soil pollution

Unit-IV: Solid waste pollution 15h

Sources, types and consequences, classification of wastes- domestic, industrial, municipal, hospital, nuclearand agricultural and their methods of disposal. Transfer and transport, Recycle, reuse, recovery, conversionof solid wastes -energy / manure. Analysis and monitoring of pesticides.Impact of toxic chemicals on enzymes, Biochemical effects of As, Cd, Pb and Hg, their metabolism, toxicityand treatment.

PSCChT16 Paper XVI (Elective- Polymer Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: Polymerization 15h

Types of polymerization, addition-chain, free radical, ionic polymerization, step polymerization, electropolymerization, ring-opening polymerization.

Unit II: Techniques of polymerization ` 15h

Techniques of polymerization-suspension, emulsion and bulk polymerization, coordination, polymerizationmechanism of Ziegler Natta polymerization, stereospecific polymerization, interfacial polycondensation,mechanism of polymerization.

Unit III: Characterization of polymers ` 15h

Electronic, IR and NMR spectral methods for characterization of polymers (Block and Graft)

Thermal methods-TGA, DTA, DSC, thermomechanical and X-ray diffraction study, Block and Graft copolymers,random, block, graft co-polymers, methods of copolymerization.

Unit IV: Specific polymers ` 15h

A) Biomedical polymers: Contact lens, dental polymers, artificial heart, kidney and skin.

B) Inorganic polymers: Synthesis and application of silicon, phosphorous and sulphur containing polymers.

C) Coordination polymers: Synthesis and applications of coordination polymers.

PSCChT16 PaperXVI (Elective- Medicinal Chemistry)
60 h (4 h per week): 15 h per unit 80 Marks
UNIT-I: 15 h

A] Drug rules and drug acts, Overview of Intellectual property right, Indian and International framework forpatent protection.

B] Chromatographic separation techniques for drugs: TLC, Paper chromatography, GC, HPLC, LCMS.Dignostic agents: Radio Pharmaceuticals, Radiology and CT.

UNIT-II: 15 h

A]Statastical method: For sampling and interpretation of results, Statastic in quality control, T-Test, F-Test,Validation of analytical methods as defind proceding USP Radioimmunoanalysis, Investigational drugs.

B]Anti-Viral agents: Inroduction, viral diseases, viral replication, and transformation of cells, investigation ofantiviral agents,. Chemotherapy for HIV. Synhesis of: Idoexuidine,acyclovir ,amantadine and cytarabin.

C]Anti-malarial agents: Introduction, malarial parasite, and its life cycle, development of antimalarials,chemotherapy of malaria. Synthesis of: Chloroquin, primaquin, proguanil, and Quinacrine

UNIT-III: 15 h

A) Histamines and Antihistamic agents: Introduction, histamine H1-receptor antagonists. Inhibitors ofhistamine release. Synthesis of: alkyl amines, phenothiazines, piperzines derivatives.

B) Antibiotics: Introduction, β-lactam antibiotics, classification, SAR and chemical degradation of penicillin,cephalosporins-classification , tetracycline antibiotics-SAR,miscellaneous antibiotics. Synthesis of ampicillin,cephradine, methacycline,chloramphenicol

UNIT-IV: 15 h

A) Anthelminitics and antiamoebic drugs: Introduction to Helminthiasis, Anthelminitics, drugs used incestode infection, drugs used in trematode infection, origin of antiamoebic drug, drugs used in nematodeinfection. Synthesis of: Clioquinol, Iodoquinol, Haloquinol, Dichlorphen, Niclosamide.

B) Anti-inflammatory drugs: Introduction, etiology of inflammatory diseases. The inflammatory response,biochemical response. Synthesis of: Phenyl butazone and its derivatives, pyrazolone derivatives, pyrole andindole acetic acid derivatives.

PSCChP11 Practical-XI Project

9 h/week 80 Marks

Project is a part of practical examination. Project should be carried out by the student under the supervision of Guide/Teacher. The examination shall be conducted by External and Internal Examiners. Students are supposed to present their work either on LCD Projector / OHP or blackboard.

The division of marks will be as follows:

External examiner: 40 marks

Internal examiner (Guide/ Teacher): 40 marks

(With Internal Assessment of 20 Marks)
Note: One external examiner shall be appointed for evaluation of group of 6 students.

PSCChP12 Seminar-

2 h /week Marks: 25
Seminar of 30 minutes duration will be a part of internal assessment for 25 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

GONDWANA UNIVERSITY
GADCHIROLI

SYLLABUS
For
M. Sc.
BOTANY
SEMESTER III & IV

Under
Choice Based Credit System
(CBCS)
(With effect from: 2017-18)

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Botany.

Semester III

Core	Theory/ Practical	Teaching Scheme			Credit	Examination Scheme					
		Hrs/week				Duration in hrs.	Max. Marks		Total	Min. Marks	
		Theory	Practical	Total			External	Internal		Theory/ Seminar	Practical
PSCBOTT09	Paper - IX	4	-	4	4	3	80	20	100	40	
PSCBOTT10	Paper - X	4	-	4	4	3	80	20	100	40	
PSDBOTT11	Paper - XI	4	-	4	4	3	80	20	100	40	
PSSBOTT12	Paper - XII	4	-	4	4	3	80	20	100	40	
Pract-V PSCBOTP05	Practical - V	-	8	8	4	6	80	20	100		40
Pract-VI PSDBOTP06	Practical - VI	-	8	8	4	6	80	20	100		40
Seminar - III	Seminar - III	2	-	2	1			25	25	10	
TOTAL		**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

Semester IV

Core	Theory/ Practical	Teaching Scheme			Credit	Examination Scheme					
		Hrs/week				Duration in hrs.	Max. Marks		Total	Min. Marks	
		Theory	Practical	Total			External	Internal		Theory/ Seminar	Practical
PSCBOTT13	Paper - XIII	4	-	4	4	3	80	20	100	40	
PSCBOTT14	Paper - XIV	4	-	4	4	3	80	20	100	40	
PSDBOTT15	Paper - XV	4	-	4	4	3	80	20	100	40	
PSSBOTT16	Paper - XVI	4	-	4	4	3	80	20	100	40	
Pract-VII PSCDBOTP07	Practical - VII	-	8	8	4	6	80	20	100		40
Pract-VIII PSPBOTP08	Practical - VIII	-	8	8	4	6	80	20	100		40
Seminar - IV	Seminar - IV	2	-	2	1			25	25	10	
TOTAL		**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

Project Work/Dissertation Scheme / Guidelines for the Students, Supervisors and Examiners

Every student is required to carry out a project work in semester IV. The project can be of following types. A) Experimental Project Work; OR B) Field Based Project Work; OR C) Review writing based Project Work.

Experimental Project Work and Field Based Project Work:

Student can carry out Experimental / Field Based Project Work on a related research topic of the subject /course. It must be an original work and must indicate some degree of experimental work / Field work. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV. The project report shall comprise of Introduction, Material and Methods, Results, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College.

Review writing based Project Work.

Student can carry out review writing Based Project Work on a related topic of the subject / course. It must be a review of topic based on research publications. Student shall refer peer reviewed original research publications and based on findings, write a summary of the same. The pattern of review writing shall be based on reputed reviews published in a standard, peer reviewed journals. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV. The project report shall comprise of Abstract, Introduction, detailed review, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College.

*The supervisors for the Project Work shall be from the following.
A person shall be an approved faculty member in the relevant subject.
OR
Scientists of National Laboratories / Regional Research Laboratories/ Experts from R&D in Industry who are approved by competent authority in such facilities by the Union Government / the State Government / Gondwana University / Other Universities recognized by UGC.

The Project Work will carry total 100 marks and will be evaluated by both external and internal examiner in the respective Department / Center / Affiliated College.

The examiners will evaluate the Project Work/Dissertation taking into account the coverage of subject matter, arrangement and presentation, references, etc.

For written Project work	**40**	**Marks – Evaluated jointly by External & Internal examiner**
Oral Presentation	20	Marks – Evaluated jointly by External & Internal examiner
For Viva-Voce	20	Marks – Evaluated by External examiner
Internal Assessment	20	Marks – Evaluated by Internal examiner

Total	100	

Seminar

Guidelines for Students, Supervisors and Examiners

In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.

The students should submit the seminar report typed and properly bound in two copies to the head of the department. The said shall be evaluated by the concerned supervisor / head of the department. The marks of the seminar shall be forwarded to the university within due period through head of the Department. The record of the seminar should be preserved till the declaration of the final result.

Internal Assessment:

1. The internal assessment marks shall be awarded by the concerned teacher.
2. The internal assessment marks shall be sent to the University after the Assessment in the prescribed format.
3. For the purpose of internal assessment the University Department / College shall conduct any three assignments described below. Best two scores of a student in these tests shall be considered to obtain the internal assessment score of that student.
4. If the student does not appear for the Practical Exam he shall be declared failed in Practical Examination irrespective of marks obtained in Internal Practical Assessment. However the Internal Practical Assessment marks will be carried forward for his next supplementary Practical Exam.
5. General guidelines for Internal Assessment are:
   a) The internal assessment marks assigned to each theory paper as mentioned in Appendix 1 shall be awarded on the basis of assignments like class test, attendance, home assignments, study tour, industrial visits, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice / activity.
   b) There shall be three assignments (as described above) per course.
   c) There shall be no separate / extra allotment of work load to the teacher concerned. He/ She shall conduct the Internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.
   d) The concerned teacher / department / college shall have to keep the record of all the above activities until six months after the declaration of the results of that semester.
   e) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method he / she proposes to adopt and the scheme of marking for internal assessment. (Prescribed in syllabus of respective Subjects).
   f) Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD / Principal.

Practical Examination

1. Each practical carries 100 marks. The scheme of marking shall be as per given in the syllabi of respective subjects.
2. Practical performance shall be jointly evaluated by the External and Internal Examiner. In case of discrepancy, the External Examiner's decision shall be final.
3. Duration of practical examination will be as per given in the syllabi of respective subjects.
4. The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department. If the student fails to submit his / her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he / she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.

5. The certificate template shall be as follows:

C E R T I F I C A T E

Name of the college / institution _

Name of the Department: _

This is to certify that this Practical Record contains the bonafide record of the Practical work of Shri / Shrimati / Kumari _ of M. Sc. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ Semester _ _ _ _ _ _ _ _ _ during the academic year _ _ _ _ _ _ _ _. The candidate has satisfactorily completed the experiments prescribed by Gondwana University Gadchiroli for the subject _ _ _ _ _ _ _ _

Dated _ _ _ / _ _ _ / _ _ _ _ _

Signature of the teacher who taught the examinee Head of the Department

1. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

2. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Practical Schedule:
Semester III
PRACTICAL V

Course code: PSCBOTP05 **Credit - 04**

Time : 6 Hours Full marks : **80**

Q. 1 To perform the given Ecological exercise - [A]	15
Q. 2 Soil analysis/Ecological adaptation - [B]	10
Q. 3 One experiment from paper X - [C]	15
Q. 4 One experiment from paper X - [D]	10
Q. 5 Spotting: [E] (Paper IX), [F] (Paper IX), [G] (Paper X), [H] (Paper X)	20
Q. 6 Viva-voce	05
Q. 7 Practical Record	05

Semester III
PRACTICAL VI

Course code: PSDBOTP06 **Credit - 04**

Time : 6 Hours Full marks : **80**

Q. 1 Experiment from Major Exercise	15
Q. 2 Experiment from Minor Exercise	10
Q. 3 Experiment from Major Exercise	15
Q. 4 Experiment from Minor Exercise	10
Q. 5 Spotting: E (Major Exercise), F (Minor Exercise), G (Major Exercise), H (Minor Exercise)	20
Q. 6 Viva-voce	05

M. Sc. Botany Syllabus

Semester III

Course code- PSCBOTT09

PAPER –IX: Plant Ecology

UNIT - I:

Vegetation organization: Concepts of community and continuum, analysis of communities (analytical ad synthetic characters): interspecific associations, concept of ecological niche.

Vegetation development: Temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristic and initial floristic composition; facilitation, tolerance and inhibition models); changes in ecosystem properties during succession, Autecology.

UNIT - II:

Ecosystem organization: Structure and functions; primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological effeciencies); litter fall and decomposition (mechanism, substrate quality and climatic factors); global biogeochemical cycles of C, N, P, and S; mineral cycles (pathways, processes, budgets) in terrestrial and aquatic ecosystems.

UNIT - III:

Air, Water and Soil pollution: Kinds; sources; quality parameters; effects on plant and ecosystems.

Climate change: Greenhouse gases (CO_2, CH_4, N_2O, CFCs; sources, trends and role); ozone layer and ozone hole; consequences of climate change (Global warming, sea level rise, UV radiation).

UNIT - IV:

Ecosystem stability: Concept (resistance and resilence); Ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; environmental impact assessment; ecosystem restoration.

Ecological management: Concepts; sustainable development; sustainability indicators.

Practicals:

1. A trip to the grass land/ forest/ water body to get acquainted with their plant species.
2. Distribution pattern of different plant species determined by Quadrat/ Transat/ Point centered Quadrat methods.
3. Qualitative parameters of distribution of plant species, Frequency, Density, Basal cover, dominance, Abundance and IVI.
4. Analysis of soils of two different areas i.e. Cropland and forest/ grassland for certain nutrients, CO_3, NO_3, Base deficiency.
5. Analysis of water quality for physical properties like colour, BOD, COD, O_2, CO_2 contents etc.
6. Study of adaptations in plants of Hydrophytic, Xerophytic and Halophytic zones.

Suggested Readings:

1. Ambasht R.S. 1968. Freshwater ecosystem- Manual of Ecology 123-137 (See Misra KC et al 1968)
2. Ambasht R.S. 1966 Conservation Ecology, Abs Proc School on Plant Ecol (Full paper in press Oxford and IBH Calcutta).
3. Ambasht R.S. 1995 A text book of plant ecology Student and co. Varanasi-5
4. Anderson JM Ecology for environmental sciences: biosphere ecosystems and man
5. Billings WB 1964 Plants and the ecosystem Macmillan & co, London.
6. Clements FE 1916 Plant succession, An analysis of the development of vegetation. Carnegie Institute of Washington.
7. Cragg JB 1968 The theory and practice of conservation, IUCN Publ, New Series No. 12, 25-35.
8. Dash MC 1993 Fundamentals of Ecology WB Saunders and co. Philadelphia USA.
9. Deangelis DL Energy flow, nutrient cycling and ecosystem resilience. Ecology 56, 238-43.
10. Dwivedi Rama Shankar 1968. The decomposer system manual of ecology See Misra KC et al 1970)
11. Frankel OH, Soule ME, 1981, Conservation and Evolution, Cambridge Univ Press.
12. Grace J 1983, Plant atmosphere relationships. Champman & Hall.
13. Greig Smith P 1983, Quantitative plant ecology, Univ California Press, California.
14. Hutchings MJ (ed) 1988, Plant population biology, Blackwell.
15. Hutchinson GE 1978, An introduction to population ecology. Yale Univ. Press.
16. Kochhar PL 1986 Plant Ecology Ratan prakashan, Mandi, Agra.
17. Krebs GJ 1972 Ecology Harper and Row Publ, New York.
18. Kumar HD 1994 Modern concepts of ecology. Vikas publishing house pvt ltd, New Delhi.
19. May RM (ed) 1981 Theoretical Ecology, Blackwell.
20. Odum EP 1963 Ecology Holt Reinhart and Winston Inc.
21. Odum EP 1983 Basic Ecology, Saunders Publ Philadelphia.
22. Reynolds CS 1984 The ecology of phytoplankton, Cambridge Univ Press
23. Silverton JW 1982 Introduction to plant population ecology, Longman.
24. Southwick CH 1983 (ed) Global Ecology Sinauer.
25. Whittaker RH 1975 Communities and Ecosystems (2nd ed) MacMillan, New York.

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Semester III

Course code- PSCBOTT10

PAPER –X: Cell and Molecular Biology- II

UNIT - I:

Ribosomes: Structure and function

Transcription & Translation: Transcription in prokaryotic and eukaryotic cells, plant promoters, transcription factors, types of RNA and their function, splicing, mRNA transport, rRNA biosynthesis; translation in prokaryotic and eukaryotic cells, structural levels of proteins, post-translational modification; structure and role of tRNA.

UNIT - II:

Gene structure and expression: Fine structure of gene, Cis-trans test; fine structure analysis in eukaryotes; introns and their significance, RNA splicing; regulation of gene expression in pro- and eukaryotes.

Protein sorting: Machinery involved, vesicles, coat proteins; protein targeting to plastids, mitochondria, peroxisomes, nucleus, vacuoles; modification during transport.

UNIT - III:

Genome organization in prokaryotes and eukaryotic organelles: Phage genome, genetic recombination in phage and mapping phage genes; mapping of bacterial genes through transformation, conjugation and transduction; genetics of mitochondria and chloroplast.

Genetic recombination and genetic mapping: Recombination, independent assortment and crossing over; molecular mechanism of recombination, role of RecA and RecBCD enzymes; site-specific recombination; chromosome mapping, linkage group, genetic markers, construction of molecular maps, correlation of genetic and physical maps; Somatic cell genetics - an alternative approach to gene mapping.

UNIT - IV:

Cell cycle and apoptosis: Control mechanisms, role of cyclins and cyclin dependent kinases; retinoblastoma and E2F proteins; cytokinesis and cell plate formation; programmed cell death in plants; regulation in plant growth and development.

Signal transduction: Overview, receptors and G- proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascades, diversity in protein kinases and phosphatases.

Techniques in cell biology: Electrophoresis, immunotechniques, FISH, GISH, confocal microscopy

Practicals:

1. Isolation of nuclei and identification of histones by SDS-PAGE.
2. Isolation of chloroplast and demonstration of two subunits of RUBISCO by SDS PAGE
3. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis, visualization by ethidium bromide staining.
4. To study in vitro transcription.
5. To study in vitro translation.
6. To study conjugation in bacterial cells.
7. To detect the presence of specific antigen by ELISA
8. Isolation of RNA and quantification by spectrophotometric method.

References: Online journals available on UGC V-SAT programme

Suggested readings:

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999. Molecular Biology of Cell, Garland Publishing, Inc., New York.
2. Buchanan, B.B., Gruissem, W. and Jones, R. L. 2000 Biochemistry and Molecular Biology of Plants. American Soc. Of Plant Physiologists, Maryland, USA.
3. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology 8th Ed. B. I. Waverly Pvt. Ltd., New Delhi.
4. Karp, G. 1999 Cells and Molecular Biology; Concepts and Experiments. John Wiley & Sons, Inc., USA.
5. Khush, G.s. 1973 Cytogenetics of Aneuploids, Academic Press, New York, London
6. Kleinsmith, L.J. and Kish, V.M. 1995 Principles of Cell and Molecular Biology (2nd Edi.) Harper Collins Coll. Publisher, New York, USA.
7. Lewin, B. 2000 Gene VII Oxford Univ. press, New York.
8. Lodish, H., Berk, A. Zipursky, S. L. Matsudaira, P., Baltimore, D. and Darnell, J. 2000 Molecular Cell Biology Edi. W.H. Freeman and Co., New York, USA.
9. Malacinski, G. M. and Freifelder, D. 1998 Essentials of Molecular Biology (3rd Edi.) Jones and Bartiet Pub. Inc., London.
10. Russel, P. J. 1998 Genetics (5th Edi.) The Banjamin/ Cummings Publishing Com. Inc., USA
11. Sunstad, D. P. and Simmons, M. J. 2000 Principles of Genetics (2nd Edi.) John Wiley & Sons Inc., USA.
12. Tamarin, R. H. 2001 Principles of Genetics 7th Edi. The McGraw−Hill Companies.
13. Wolf, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.
14. Gerhard, Krauss, Wieley, VCH Third revised edition, Biochenmistry of Signal Transduction and Regulation.

M. Sc. Botany Syllabus

Semester III

Course code- PSDBOTT11 (DSE-I)

PAPER –XI: Reproductive Biology of Angiosperm-I

UNIT - I:

General: Need for reproductive system as experimental material, Interdisciplinary approaches: genetic and molecular perspective,

Anther: Structure, anther wall;: endothecium, middle layer, tapetum-Structure, types-structure-function relationship, role of tapetum, microsporogenesis- sporogenous cells cytoplasmic reorganization during sporogenesis (Ultrastructural changes), molecular biology of meiosis, DNA and RNA synthesis, Protein synthesis, meiosis specific genes. Pollen tetrad development, pollen wall proteins, adaptive significance of pollen wall.

UNIT - II:

Male gametophyte development: formation of vegetative and generative cells, differential behavior of sperms, gene expression during pollen development.

Pollen: Physiological and biochemical aspects, pollen storage, viability causes for loss of viability. pollen abortion and male sterility, structural, developmental and functional aspects of male sterility environmental factors, role of mitochondrial genome in male sterility, gametocides.

UNIT - III:

Pistill: Carpel determination, ovule and its structural details.

Megasporogenesis: Meiosis, functional megaspores, organization of female gametophyte structure of the embryo sac, egg, synergid-ultrastructure, role central cell, antipodal cell, haustoria, cytoskeleton of the embryo sac, enzymatic isolation of embryo sac, types of embryo sac, nutrition of embryo sac.

UNIT - IV:

Pollination-pollination mechanism, biotic and abiotic pollination, floral attractants and rewards,

Pollen-pistil interaction; The stigma-Types and structure, stigmatic exudates, style-transmitting tissue, canal cell, post pollination events (stigma receptivity, pollen adhesion, pollen hydration, pollen germination and pollen tube growth, biochemistry of pollen germination, RNA and protein metabolism during pollen tube, calcium gradient in the pollen tube (Chemotropism) pollen allelopathy.

Incompatibility: General concept, self incompatibility (Intraspecific type) heteromorphic, homomorphic types, mechanism of self compatibility, importance of self compatibility, methods of overcoming self incompatibility, Parasexual hybridization.

Practicals :
Major exercises:

1. Short term exercises on pollen production, viability and their percentage of germination. Rate of growth of germ tube to be studied in a given period.
2. Cytology of pollen inhibition in self and interspecific incompatibility, application of some techniques to overcome incompatibility.
3. Techniques, Familiarity with phase contrast, polarizing, fluroscence and electron microscopy, whole mounts, dissection and macerations, permanent double stained microtome sections, photo microscopy.
4. Interpretation of electron micrographs (SEM, TEM) of pollen.
5. Preparation of permanent slides using micro-technique: Embedding and block making.
6. Preparation of permanent slides using micro-technique: Section cutting and processing for staining.
7. Study of pollen morphology (polarity, symmetry, shape, size, aperture) using acetolysis method.

Minor exercises:

8. Study from the permanent preparations.
    a. Development and structures of anther pollen.
    b. Structure and types of ovule.
    c. Megasporogenesis,
    d. Embryo sac and its types.
    e. Development of endosperm, types.
    f. Structure and development of embryo- types
    g. Pericarp and seed coat structure from sections and macerations.
    h. Sketching of ovular structure, embryo sac, anther wall, embryo with the help of camera lucida.
9. Preparation of dissected whole mounts of endothecium, tapetum, endosperm and embryo, squash preparations of tapetum, microspore mother cells, dyads, tetrads pollinia and massulae.
10. Study of mitosis and meiosis and identification of various stages.
11. Experiments on intra- ovarian pollination.

Suggested Readings:

1. Asker S. 1979, Progress in apomixis research. Hereditas 91, 231-240.
2. Barnier, G. 1986, The flowering process as an example of plastic development. Soc. Expt.. Biol. 40: 257-286.
3. Barth, F.G. 1991, insects and flowers, Princeton Univ. Press. Princeton.
4. Battaglia, E. 1963. Apomixis In recent advances in the embryology of angiosperms (ed P. Maheshwari), pp- 264, Intt. Soc. Plant Morphologists, Univ. Delhi.
5. Bhandari N. N. 1984, The microsporangium in embryology of angiosperms (ed B.M. Johri) Springer- Verlag, Berlin, pp. 53-121.
6. Bhandari N.N., M. Bhargava and P. Chitralekha 1986, Cellularization of free nuclear endosperm of *Pappaver somniferum* L. Phytomorphology, 36, 357-366.
7. Bhojwani S.S. and M.K. Rajdan 1983, Plant tissue culture, Theory and Practice Elsevier, Amsterdam.
8. Boesewinkel F.D. and Boman F. 1984, The seed structure in embryology of angiosperms (ed B.M.Johri), Springer- Verlag, Berlin, pp. 567-610.
9. Bouman F. 1984 The ovule in embryology of angiosperms (ed B.M.Johri), Springer- Verlag, Berlin, pp. 123-157.
10. Cartson P.S., Smith N.H., Dearing R.D. (1972) Parasexual interspecific plant hybridization. Proc. Nat. Acad. Sci. USA, 69, 2292-2294.
11. Cartson P.S. (1973) The use of protoplasts of genetic research. Proc. Nat. Acad. Sci. USA, 70, 598-602.
12. Chitralekha P. and N.N. Bhandari 1991, Post fertilization development of antipodal cells in *Ranunculus scferatus*. Phytomorphology 41, 200-212.
13. Ciampolini F.M., Nepi and E. Pacini 1993, tapetum development in *Cucurbita pepo* (Cucurbitaceae) Pt. Syst. Evol. (Suppl) 7-13-22.
14. Cocking E.C. 1960, A method for the isolation of plant protoplasts and vacuoles. Nature (London) 187-927-929.
15. Cocking E.C. 1970, Virus uptake, cell wall regeneration and virus multiplication in isolated plant protoplasts. Int. Rev. Cytol 28-89-124

M. Sc. Botany Syllabus

Semester III

Course code- PSDBOTT11 (DSE-I)

PAPER –XI: Molecular Biology and Plant Biotechnology-I

UNIT- I:

DNA replication: DNA **r**eplication in prokaryotic organism – Initiation, elongation, and termination, DNA replication in eukaryotes – origin, replication form, replication proteins, Comparative account of DNA replication in prokaryotes and eukaryotes, DNA replication proteins

DNA damage and repair: Types of DNA damage, factors for DNA damage,

Repair system: Single base change, direct repair, mismatch repair, SOS response.

UNIT- II:

Isolation of gene and nucleotide sequence: DNA manipulation enzymes; General methods of gene isolation.

Molecular probing: Recombinant DNA libraries (gDNA and cDNA, oligonucleotide probes); nucleic acid hybridization (southern, northern, dot-blot and slot-blot); antibodies as probe for proteins (immunoblotting or western blotting, immunoprecipitation, southwestern screening).

UNIT- III:

Splicing of foreign DNA into cloning vector: Vectors for prokaryotes; ligation.

Introduction of foreign DNA into host cell: Transformation; transfection; transgenesis

Isolation of genes or protein products from clones: Expression vectors- Characteristics; vectors producing fusion proteins

Polymerase chain reaction: Types of PCR's and their applications in molecular biology

UNIT- IV:

Sequence alignment and phylogenetic trees: Dot plots, sequence similarity, pairwise and multiple alignment, significance of alignment, phylogeny and phylogenetic trees and evolution.

Genomics: Definition; genome analysis (genetic polymorphisms, genetic mutations); microarray technology and applications (gene expression and diseases).

Proteomics: Protein stability and folding; application of hydrophobicity; DALI (Distance-matrix alignment); Protein structure- evolution, classification, prediction and modeling, prediction of function. DNA microarrays, mass spectrometry, network and graphs, protein complexes and aggregates, protein interaction networks, regulatory networks.

Practicals:

Major Exercises -

1. Detection of DNA damage by mutagens.
2. Bacterial transformation and selection of transformed cells.
3. To detect molecular polymorphism of different species.
4. To demonstrate the presence of particular polypeptide by Western blotting.
5. To design PCR primers for isolation of given gene and to clone it in the given vector.
6. Amplification and sequencing of nr DNA by PCR

Minor Exercises-

7. To find the sequences of a given protein in SWISS-Prot, Uni-Prot.
8. To work out the sequence from given autoradiogram and to identify it from Gene Bank by BLAST method.
9. To generate Pairwise and multiple sequence alignment of a given organisms.
10. To generate phylogenetic tree using given sequences.
11. To predict a protein from given sequence by using online tools from NCBI.

Suggested Readings:

1. Alberts, Bruce; Johnson Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter,

2. Peter, C. 2002 Molecular Biology of the Cell, Garland Science, New York and London.

3. Baxevanis, A. D. and Ouellate, B. F. F. 2009 Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.

4. Baxevanis, A. D., Davison, D. B.; Page, R. D. M.; Petsko, G. A.; Stein, L. D. and Stormo, G. D. 2008 Current Protocols in Bioinformatics

5. Bergman, N.H 2007 Comparative Genomics Humana Press Inc., Part of Springer Science+ Business Media

6. Brown, T. A. 1999. Genomes, John Wiley & Sons(Asia) Pvt. Ltd., Singapore
7. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology 8th Ed. B. I. Waverly Pvt. Ltd., New Delhi.

8. Glover, D.M. and. Hames, D.B 1995 DNA Cloning : A practical approach, R.L. Press, Oxford.

9. Hackett, P. B. Fuchs, J. A. and Messing, J. W. 1988. An Introduction to Recombinant DNA Techniques. Basic Experiments in Gene Manipulation. The Benjamin/cummings Publishing Co., Inc. Menlo Park, California.

10. Jolles, O. and Jornvall, H. (eds) 2000. Proteomics in Functional Genomics. Birkhauser Verlag,

Basel, Switzerland.

11. Karp, G. 1999 Cells and Molecular Biology; Concepts and Experiments. John Wiley & Sons, Inc., USA.
12. Lehninger' Principles of biochemistry-Nelson, Cox, 4th Edn., W.H.Freeman and Co.,2005.
13. Lewin, B. 2000 Gene VII Oxford Univ. press, New York.
14. Lewin, B. 2010 Gene X Oxford Univ. press, New York.
15. Lodish, H., Berk, A. Zipursky, S. L. Matsudaira, P., Baltimore, D. and Darnell, J. 2000 Molecular Cell Biology Edi. W.H. Freeman and Co., New York, USA
16. Mount W. 2004 Bioinformatics and sequence genome analysis 2nd Edi. CBS Pub. New Delhi
17. Old and Primrose , 1994, Principles of gene manipulation. Blackwell Scientific Publ.
18. Raymond Schuler and Zielinski, E. 2005, Methods in plants Molecular biology - Acad. Press.
19. Russel, P. J. 1998 Genetics (5th Edi.) The Banjamin/ Cummings Publishing Com. Inc., USA
20. Sambrook and Russel. 2001. Molecular cloning Vol. 1-3 CSH press.
21. Shaw, C.H. 2006, Plant Molecular Biology: A practical approach. Panima Pub. Corp.
22. Stryer, Berg, Biochemistry- 6th Edition, W. H. Freeman and Co.,2007.
23. Voet, D.; Voet, J.; Biochemistry – 3rd Edn. John Wiley and sonsInc., 2004.
24. Wilson Keith and Walker John 2005 Principles and techniques of biochemistry and molecular biology, 6th Ed. Cambridge University Press, New York.
25. Wolf, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA

Suggested Readings(for laboratory exrcises)

1. Baxevanis, A. D. and Ouellate, B. F. F. 2009 Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
2. Baxevanis, A. D., Davison, D. B.; Page, R. D. M.; Petsko, G. A.; Stein, L. D. and Stormo, G. D. 2008 Current Protocols in Bioinformatics.
3. McEntyre, J.; Ostell, J., editors Bethesda (MD) The NCBI Handbook: National Library of
4. Medicine (US), NCBI; 2002-2005
5. Sambrook and Russel. 2001. Molecular cloning Vol. 1-3 CSH press.
6. Tools & updated literature available at www.ncbi.com

References: Online journals available on UGC V-SAT programme.

M. Sc. Botany Syllabus

Semester III

Course code- PSDBOTT11 (DSE-I)

PAPER –XI: Paleobotany-I

UNIT – I:

Introduction to the science of Petrology- The earth zones, chemical composition of earth crust. The classification of rocks i.e.Endogenetic and Exogenetic (igneous, metamorphic and sedimentary) and their brief account.Glaciations, volcanic eruption and earthquake.

UNIT–II

Geological column and time scale.Physiography of India.Fossilisation, modes of preservation, preparation and age determination and techniques.Systematics, reconstruction and nomenclature. Life in Precambrian, greening of earth –speculation.

UNIT–III:

Study of Rhyniopsida (primitive vascular plants) Cooksonia, Steganotheca, Uskiella, Renalia, Horniophyton, Aglophyton, Zosterophylopsida (ancestors of microphyllous plants) Zosterophyllum, Sawadonia, Asteroxylon. Prelycopods and Lycopsida-Hebaceous Lycopods of Devonian – Baragwanthia, Protolepidodendron and Miadesmia, Arborescent Lycopods of Carboniferous-study of Lepidodendrales members.

UNIT –IV:

Shpenopsida-Its origin and evolutionary consideration .Study of Hyeniales and Sphenophyllales. Horsetails and their relatives-Calamitales members.Filicopsida-Study of primitive ferns and their relatives- Cladoxylales, Stauropteridales, Zygopteridales.Filicales-classification and study of its members, Coenopteridales-Ankyropteris. Marratiales - Psaronius.

Suggested Laboratory and Field Exercises

Major Exercises:

1. Different techniques to study fossils. (Ground sectioning, peel technique) Study different types of fossils.
2. Study of plant fossils as per syllabus based on specimens and slides.
3. Arborescent Lycopods of Carboniferous-study of Lepidodendrales members.
4. Study of Sphenophyllales, Calamitales members.
5. Studyofprimitive ferns and their relatives Cladoxylales, Stauropteridales, Zygopteridales. Filicales- Coenopteridales-Ankyropteris, Marratiales - Psaronius

Minor Exercises:

6. Study of Rhyniopsida (primitive vascular plants).
7. Stratigraphy Maps of the India and World.
8. Geological Maps of India.
9. Geological column and time scale.

10. Study of different rocks.
11. Preparation of practical record.

Suggested Readings

1. AgasheS.N.(1995)-Palaeobotany , Plants of the past ,their evolution, palaeoenvirinment and application in exploration of fossil fuels.Oxford&IBH publishing company-New Delhi.
2. Andrews H.N.(1961)-Studies in Palaeobotany, Willey and Sons –New York.
3. Arnold,C.A.(1947)-An Introduction to Palaeobotany ,MC-GrawHills.,New York.
4. Beck, C. B. and Wight, D. C.(1988)-Progymnosperm, In origin and evolution of Gymnosperms,Columbia Uni. Press-New York.
5. Beck, C.B.(1976)-Current status of the Progymnospermosida, Review of Palaeobotany and Palynology.
6. Darrah, W.C.(1960)-Principles of Paleobotany.
7. Erdtman,G(1957)-Pollen and Spore morphology and plant taxonomy.(An introduction to palynology) Hafner Publishing Comp-New York.
8. Chandra,S.andSurange, K.R.(1979)-Revision of the Indian species of Glossopteris, Monograph,BirbalSahni Institute of Palaeobotany.
9. Hoffmeister,W.S.(1960)-Palynology has an important role in oil exploration.World oil-150:1001-140.
10. Meyen, S.V.(1987) – Fundamentals of Palaeobotany Chapman and Hill,London,New York.
11. Parihar ,N.S.(1995) –Essentials of Palaeobotany,Central Book –Allahabad.
12. Sahni, B.(1964)- Revisions of Indian fossils plants, -III(Monocotyledons) –BSIP-Lucknow.
13. Stewart, W.N.&Rothwell,G.V. (1993)-Palaeobotany and Evolution of Plants,Cambridge Univ., Press-Cambridge.
14. Venkatchala, B.S&Maheshwari,H.K.(1991)-Palaeobotanical Researches in India.Jour.Ind.Bot.Society-70;1-12.
15. Wadia, D.N (1953)-Geology of India,Mac,Millan-Co.London.
16. Prasad, K.N. (1999). - An introduction to palaeobotany, APH Pub.
17. Cleal, J. Christopher. &B.A.Thomas (2009) Introduction to Plant Fossils, Cambridge Univ., Press-Cambridge.
18. Willis, K. J. & McElwain, J. C. (2014). The Evolution Of Plants (second edition) OXFORD University Press.
19. Stewart, W.N. and Rothwell G.W. (1993), Palaeobotany and the Evolution of Plants, Cambridge University Press.
20. Arnold, C.A. (1947): Introduction to Palaeobotany, Mc-Graw Hill Book Co. Inc., New York and London.
21. Agashe, S.N. (1995), Palaeobotany, Oxford & IBH, New Delhi.
22. Siddiqui, K.A. (2002) Elements of Palaeobotany, Kitab Mahal, Allahabad.
23. Thomas, B.A. & Spicer R.A. (1987): The Evolution and Palaeobiology of land plants. Discordies Press, Fortland, USA.
24. Spicer, R.A. & Thomas, B.A. (1986) Systematic and taxonomic approaches in Palaeobotany. Systematic Association Special Volume.

M. S c. Botany Syllabus

Semester III

Course code- PSSBOTT12 (SEC-I)

PAPER –XII: Biofertilizers-I

UNIT I

Historical account of Biofertilizer, types of Biofertilizer, Microbial inoculent from bacteria, algae, fungi and other groups ,their isolation ,identification . Mass inoculation of microbial inoculants,effect of inoculent on crop yield. Marketing and work done on biofertilizer in India

UNIT II

Bacterial inoculants :- Rhizobial culture packing and quality control , method of inoculation , effect of Rhizobial inoculent on crop yield . Azatobactor inoculants on , Azospirullum inoculants and mass cultivation ; Phosphate solubilizing microorganism , Phosphate biofertilizer

UNIT III

Aigal inoculants:- Algalization, biological nitrogen fixation , nonsymbiotic and symbiotic microganism, Diazotrops; genetics and ecology of Diazotrops, spical features of nitrogen fixation in Cyano bacteria, Frankia-induced nodulation. Factors affecting growth, Azolla as bio fertilizers, Azolla assotiation of Anabanena, mass cultivation of Azolla, preactical application in rice field.

Unit IV

Fungal inoculants:- Mycorrhiaza fungi as bio fertilizers; Methods of Inoculation, Mechanism of symbiosis, Growth and yield – Colonization of VAM-Isolation and proudcution of VAM. Benifites from mycorr hizas to plants as biofertilizer.

Practicals:

Based on theory syllabus.

Suggested reading:-

1. The complete techonology book on biofertizers and organic farming –NIIR, New Delhi.
2. Somani L.L, P.Shilpkar and D.Shilpkar (2011) Biofertizers commercial production technology and quality control. Agrotech publisher Acedemy Udaipur.
3. The complete technology book on Vermiculture and Vermicompost NIIR- New Delhi.

M. Sc. Botany Syllabus

Semester III

Course code- PSSBOTT12 (SEC-I)

PAPER –XII: Nursery and Gardening **-I**

Unit-I:

Garden Planning- Formal and informal gardens, originality in planning, view from the house, variety and surprise, overcrowding (density of planting), colour scheme, spacing, fragrance, spacing for vegetables and fruits, water supply and garden accessories, choice of plants, arches and pergolas, wall aspect, hill features, situation, landscaping an d garden features.

Unit-II:

Garden Operation- Procurement of material. Preparation of soil. Drainage. Digging and trenching. Soil enrichment. Organic manures. Inorganic manures.

Unit-III:

Garden Style- Informal garden, Romantic Garden, Wildlife garden, Container garden, Roof garden, Planned garden, Small garden, Japanese garden, Exotic garden, Kitchen garden, Vegetable garden, Herb garden, Fruit garden.

Unit-IV:

Lawns and hedges, Flowers, herbaceous border and annuals, Roses, Chrysanthemums and Carnations, Bulbous plants, Climbers, Trees and shrubs, Orchids, Ferns and Palms, Cacti and other succulents.

Practicals:

Based on theory syllabus.

Suggested Readings:

1. Trivedi, P. P. (1987) Home Gardening. ICAR New Delhi.
2. Deena Beverley and Barty Phillips (2002) Encyclopedia of Gardening, Parragon Book, UK.

M. Sc. Botany Syllabus

Semester III

Course code- PSSBOTT12 (SEC-I)

PAPER –XII: PLANT DIVERSITY AND HUMAN WELFARE-I

Unit-I:

Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa.

Unit-II:

Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.

Unit-III:

Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss

Unit-IV:

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

Practicals:

Based on theory syllabus.

Suggested Readings

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity – Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

M. Sc. Botany Syllabus

Semester III

Course code- PSSBOTT12 (SEC-I)

PAPER –XII: FLORICULTURE-I

Unit-I:

Introduction: History of gardening; Importance and scope of floriculture and landscape gardening.

Unit-II:

Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

Unit-III:

Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.

Unit-IV:

Diseases and Pests of Ornamental Plants.

Practicals:

Based on theory syllabus.

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

M. Sc. Botany Syllabus

Semester III

Course code- PSSBOTT12 (SEC-I)

PAPER –XII: BASIC BOTANY-I

UNIT I

Diversity of cryptogams:- classification, general description, economic impotance of cryptogams with examples- viruses, micoplasma, bacteria, fungi, lichens, bryophytes and plant pathology.

UNIT II

Diversity of phenorogamas:- classification, general description, economic impotance with examples of pteridophytes, gymnosperms, monocotyledonous and dicotyledonous.

UNIT III

Morphology of angiosprerms:- discreption of monocotyledonous and dicotyledonous plants in technical terminology for the identification of plants in your region, habite and habitate, types of roots, leaves inflorescence, flowers, fruits, seeds identification of some important local plants from families of angiosperms.

UNIT IV

Anatomy of angiosperms:- Histological accounts of cell and tissue, tissue system in monocotyledonous and dicotyledonous plants. Anatomy of root, stem, leaf, primary structure and normal secondary growth in stem and root, Anamolous secondary growth in stem and root, Healing of wounds and fall of leaves.

Practicals:

Based on theory syllabus.

Suggested Readings:-

1) S.Sundara Rajan College Botany Vol I to IV Himalaya publishing house.
2) Saxena And Sarsbhai A textbook of botany Vol. I to III Kitabghar Gwalior.
3) Gangulee And Kar College botany Vol.I and II.
4) K.S.Bilgrami, L.M.Shrivastava, J.L.Shremali Fundamentals of botany Vol. I and II Vikas Publishing House PVT.LTD. Sahibabad UP.
5) A.C.Dutta Botany for degree students.
6) S.N.Pande And P.S.Trivedi Text book of botany Vol I and II. Vani educationa

Semester IV

PRACTICAL VII

Course code: PSCDBOTP07 **Credit - 04**

Time: 6 Hours Full marks: **80**

Q. 1 One Major exercise from paper XIII – [A]	10
Q. 2 One Minor exercise from paper XIII- [B]	05
Q. 3 One Major exercise from paper XIV – [C]	10
Q. 4 One Minor exercise from paper XIV- [D]	05
Q.3 One Major exercise from paper XV [E]	15
Q. 4 One Minor exercise from paper XV [F]	10
Q. 5 Spotting: [G] (Plant Biotechnology), [H] (Angiosperms) [I] (Core Elective-I)	15
Q. 7 Viva-voce	05
Q. 8 Practical Record and tour report	05

Semester IV

PRACTICAL VIII

Course code: PSPBOTP08 **Credit - 04**

PROJECT Full marks: **80**

M. Sc. Botany Syllabus

Semester IV

Course code- PSCBOTT13

PAPER –XIII: Plant Biotechnology

UNIT- I:

Recombinant DNA technology: Gene cloning and principles and technique; vectors- types and their properties; construction of DNA libraries; splicing of insert into the vector; screening of DNA libraries and introduction of the recombinant DNA into the host cells.

Genetic engineering of plants: Aims, strategies for development of transgenics (with suitable examples); Agrobacterium- the natural genetic engineer; T-DNA and transposon mediated gene tagging.

UNIT- II:

Microbial genetic manipulation: Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

Genomics and proteomics: Molecular markers for introgression of useful traits; high throughput sequencing; functional genomics; Protein profiling and its significance**.**

DNA synthesis; DNA sequencing; polymerase chain reaction; DNA fingerprinting

UNIT- III:

Plant tissue culture: Basic concepts; Principles and scope; tissue culture media; callus induction and cell suspension; aspects of morphogenesis; haploid and triploid production; production of somatic embryos; applications of plant tissue culture; protoplast isolation and culture; production of cybrids

Transgenic production: Methods to introduce gene in plants; selection of transformed plants/explants; salient achievements in crop bioteachnology.

UNIT- IV:

Bioinformatics: Introduction, History, Definition and applications of bioinformatics.

Database: Types and classification of databases – Primary Databases (Nucleic acid sequence, protein sequence, protein structure), Secondary databases (Genomic, cDNA, Organellar, gene expression), special databases (Human, *Escherichia coli*, *Saccharomyces cerevesaie* and *Arabidopsis thaliana*), Literature database (PubMed, OMIM), Information Retrieval system (Entrez). Other databases: GeneBank, KEGG, Taxonomy databases

Data analysis, prediction and submission tools and their uses: ORF finder**,** Blasts, FASTA, RASMOL, Prediction of pro- and eukaryotic genes and promoters (Genscan); protein structure (SWISS-Prot, pfam, PDB, PIR); **sequin**, webin, AutoDep tools.

Practicals:

Major Exercise:

1. Growth characteristics of *E.coli* using plating and turbidimetric methods.
2. Isolation of plasmid from *E.coli* and its quantification.
3. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.
4. Cloning of a DNA fragment in a plasmid vector, transformation of the given bacterial population and selection of recombinants.
5. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histochemically.
6. To isolate protoplast and determine its viability.

Minor Exercise:

7. Preparation of media for plant tissue culture.
8. To surface sterilize the given seeds/explant for tissue cultural manipulation.
9. To fuse the protoplast for production somatic hybrid.
10. Demonstration of DNA sequencing by Sanger's dideoxy method.
11. To search literature of different organisms and genes from NCBI.
12. Use of various tools to retrieve information available from NCBI
13. To retrieve gene and protein sequences of various organisms from NCBI.
14. To locate gene(s) on chromosomes for a given disease/disorder.

Suggested Readings (for laboratory exrcises)

1. Baxevanis, A. D., Davison, D. B.; Page, R. D. M.; Petsko, G. A.; Stein, L. D. and Stormo, G. D. 2008 Current Protocols in Bioinformatics, John-Wiley and Sons Publications, New York.
2. Baxevanis, A. D. and Ouellate, B. F. F. 2009 Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
3. Gelvin, S. B. and Schilperoort, R. A (eds) 1994. Plant Molecular Biology Manual, 2nd edition. Kluwer Academic Publishers, Dordrecht, The Netherlands,
4. Glover, D. M. and Hames, B. D.(Eds) 1995. DNA Cloning 1: A Practical Approach: Core Techniques, 2nd edition PAS, IRL Press at Oxford University Press, Oxford.
5. Hackett, P. B. Fuchs, J. A. and Messing, J. W. 1988. An Introduction to Recombinant DNA Techniques. Basic Experiments in Gene Manipulation. The Benjamin/cummings Publishing Co., Inc. Menlo Park, California.

6. Maniatis et al. Molecular cloning Vol. I, II and III. Cold-Spring Harbor Lab Press.
7. Shaw, C. H. (Ed.) 1988, Plant Molecular Biology : A Practical Approach. IRl Press, Oxford.

References: Online journals available on UGC V-SAT programme.

Suggested Readings:

1. Baxevanis, A. D., Davison, D. B.; Page, R. D. M.; Petsko, G. A.; Stein, L. D. and Stormo, G. D. 2008 Current Protocols in Bioinformatics, John-Wiley and Sons Publications, New York.
2. Baxevanis, A. D. and Ouellate, B. F. F. 2009 Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
3. Brown, T. A. 1999. Genomes, John Wiley & Sons(Asia) Pvt. Ltd., Singapore.
4. Callow, J. A., Ford-Lloyed, B. V. and Newbury, H. J. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use, CAB International, Oxon UK.
5. Chrispeeels, M. J. and Sadava, D. E. 1994, Plants, Genes and Agriculture. Jones & Barlett Publishers, Boston, USA.
6. Glazer, A. N. and Nikaido, H. 1995. Microbial Biotechnology. W. H. Freeman & Company, New York, USA.
7. Gustafson, R. J. 2000. Genomes. Kluwer Academic Plenum Publishers, New York, USA.
8. Henry, R. J. 1997. Practical Applications of Plant Molecular Biology. Chapman & Hall, London, UK.
9. Jain, S. M., Sopory, S. K. and Veilleux, R.E. 1996. *In vitro* Haploid Production in Higher Plants, Vols. 1-5, Fundamental Aspects and Methods. Kluwer Academic Publishers, Dordrecht, The Netherlands.
10. Jolles, O. and Jornvall, H. (eds) 2000. Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
11. Kartha, K. K. 1985. Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida USA.
12. Kingsman, S. M. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, Blackwell Scientific Publications, Oxford, 1998.
13. Mount W. 2004 Bioinformatics and sequence genome analysis 2nd Edi. CBS Pub. New Delhi.
14. Old, R. W. and Primrose, S. B. 1989. Principles of Genome Analysis. Blackwell Scientific Publications. Oxford, UK.
15. Primrose, S. B.1995. Principles of Genome Analysis. Blackwell Scientific Ltd., Oxford, UK.
16. Raghavan, V. 1997. Molecular Biology of Flowering Plants. Cambridge University Press, New York, USA.
17. Watson, J. , Tooze and Kurtz Recombinant DNA: A short course

M. Sc. Botany Syllabus

Semester IV

Course code- PSCBOTT14

PAPER –XIV: Angiosperms - II

UNIT- I:

General account, distinguished characters, floral variation and evolution, affinities of :- Magnolidae, Hamamelidae, Dilleniidae, Rosidae, Asteridae, circumscription as per Cronquist,1968

UNIT- II:

General account, distinguished characters, floral variation and evolution, affinities of :- Alismatidae, commelinidae, Aracidae, Lilidae; Interesting features and systematic position of Cucurbitaceae, Cactaceae, Asteraceae, Amentiferae, Lemnaceae, Palmae, Orchidaceae.

UNIT- III:

Probable ancestors of angiosperms, primitive living angiosperms, speciation and extinction, IUCN categories of threat, distribution and global pattern of biodiversity.

UNIT- IV:

Biological diversity concept and levels, role of biodiversity in ecosystem functions and stability, Endemism, hotspots and hottest hotspots, invasions and introductions, local plant diversities and its socioeconomic importance.

Practicals:

Major Exercises:

1. Description of a specimen from representative, locally available families.
2. Description of a species based on various specimens to study intra specific variation: collective exercise.
3. Field trips within and around the campus; compilation of field notes and preparation herbarium sheets of such plants, wild or cultivated as are abundant.
4. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.

Minor Exercises:

5. Description of various species of a genus, location of key characters and preparation keys at generic level.
6. Location of key characters and use of keys at family level.
7. Training in using floras herbaria for identification of specimens described in the class.
8. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.

Suggested Readings:

1. Devis, P.H. and Heywood, V. H. 1973. Principles of angiosperms taxonomy. Robert E. Kreiger Pub. Co. Newyork.
2. Grant, V. 1971. Plant Speciation, Columbia University press, London.
3. Grant W. F. 1984**.** Plant Biosystematics. Academic press, London.
4. Harisson, H.J. 1971. New concept in flowering plant Taxonomy. Hickman educational books Ltd. London.
5. Hislop-Harisson, J. 1967. Plant Taxonomy. English Language Book Sco. And Edward Arnold Pub. Ltd, UK.
6. Heywood, V. H. and Moore, D. M. 1984. Current concepts in Plant Taxonomy. Academic Press, London.
7. Joncs, A. D. and Wibins, A. D. 1971. Variation and adaptation in Plant species Hickman and Co. New York.
8. Jones, S. B., Jr.and Luchsinger, A. E. 1986. Plant Systematics (gd edition). McGraw- Hill Book Co., New York.
9. Nordentam, B., El Gazaly, G. and kassas, M. 2000. Plant systematic for 2ft century. Portlant press. Ltd, London.
10. Radford, A. E. 1986. Fundamentals of plant systematic. Harper and Raw publication, USA.
11. Solbrig, O.T. 1970. Principles and methods of plant Sytematics. The Macmillan Co. Publication Co. Inc., USA.
12. Woodland, D. W. 1991. Contemporary Plant Syatematics, Pentice Hall, New Jersery.
13. Takhtajan, A. L. 1997. Diversity and classification of Flowering Plants. Columbia University Press, New York.
14. Stebbins, G. L. 1974. Flowering Plants-evolution Above species Level. Edvard Arnold Ltd, London.
15. Joncs, A. D. and Wibins, A. D. 1971. Variation and adaptation in Plant species Hickman and Co.
16. Jones, S. B., Jr.and Luchsinger, A. E. 1986. Plant Systematics (gd edition). McGraw Hill Book Co., New Delhi.

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Semester IV

Course code- PSDBOTT15 (DSE-II)

PAPER –XV: Reproductive Biology of Angiosperms II

UNIT- I:

Fertilization: Cellular nature of sperm, the sperm cytoskeleton, the male germ unit, isolation and characterization of sperm, growth of the pollen tube through the style, passage of sperm into the embryo sac, fussion of nuclei, double fertilization, triple fussion, unusual features. In-vitro approaches to the study of fertilization-Intra-ovarian pollination, test tube fertilization, in-vitro fertilization, placental pollination, Gynogenesis.

Endosperm: types of endosperms, ruminate endosperm, cytological status. endosperm haustoria, chemical composition of endosperm, food reserve in endosperm, role of endosperm in embryo development, endosperm mutants.

UNIT- II:

Embryogenesis: Zygote and its ultra-structure, milieu of the developing embryo, symmetry and polarity, rest period in zygote embryonic formulae, embryonomic law. **Suspensor-**Ultra structure of suspensor cells, cytology of suspensor cell, physiology and biochemistry of suspensor; Nutrition of embryo- nutrient supply of the zygote, embryo-endosperm relation.

Polyembryony: Defination, causes, classification, induction of polyembryony, practical importance of polyembryony.

UNIT- III:

Apomixis: Defination, causes, classification, - Diplospory, Apospory, pseudogamy, autogamous development of endosperm, causes of apomixes, significance.

Parthenocarpy: Defination, causes, practical importance

Mellitopalynology : Pollen analysis of honey, Role of apiary in crop production.

Biotechnology: Concept and scope of biotechnology; Cell structure, cellular totipotency

a) **Anther and pollen culture,**
b) **Ovule and nucellus culture**
c) **Endosperm culture and its practical applications**
d) **Embryo culture:** Techniques, nutritional aspects of embryo culture morphological and physiological considerations, culture of mature embryo and proembryo.
e) **Somatic embryogenesis**: historical background, embryogenesis from callus, direct embryogenesis- recurrent embryogenesis; cytology of somatic embryogenesis, nutritional factors, hormonal factors.

UNIT- IV:

a) **Protoplast culture and somatic hybridization-** isolation of protoplast, culture methods, fussion of protoplast, selection of fussion products, consequences of fussion, production of Cybrids and hybrids.
b) **Biotransformation and production of useful compounds** through cell culture, factor affecting yield, biotransformation, bioreactors, perspective.

Practicals :

Major Exercises:

1) Organogenesis using appropriate explants.
2) Responses of calli to stress condition viz. temp, (low, high), moisture, salinity.
3) Induction of androgenesis through anther culture.
4) Isolation of protoplasts, fusion and its culture.
5) Induction of somatic embryogenesis
6) Physiology of embryo development, using electrophoretic and histochemical methods embryo culture.

Minor Exercises:

7) Viability of seed through germination, biochemical and excised embryo methods.
8) Preparation of plant tissue culture medium (MS).
9) Demonstration of sterilization methods employed in Plant Tissue Culture techniques.
10) Induction of secondary metabolite synthesis in suspension culture.
11) Endosperm culture.
12) Ovule and Nucellus culture.
13) Viability test for isolated protoplasts.

Suggested Readings:

1. Asker S. 1979, Progress in apomixis research. Hereditas 91, 231-240.
2. Barnier, G. 1986, The flowering process as an example of plastic development. Soc. Expt.. Biol. 40: 257-286.
3. Barth, F.G. 1991, insects and flowers, Princeton Univ. Press. Princeton.
4. Battaglia, E. 1963. Apomixis In recent advances in the embryology of angiosperms (ed P. Maheshwari), pp- 264, Intt. Soc. Plant Morphologists, Univ. Delhi.
5. Bhandari N. N. 1984, The microsporangium in embryology of angiosperms (ed B.M. Johri) Springer- Verlag, Berlin, pp. 53-121.
6. Bhandari N.N., M. Bhargava and P. Chitralekha 1986, Cellularization of free nuclear endosperm of *Pappaver somniferum* L. Phytomorphology, 36, 357-366.
7. Bhojwani S.S. and M.K. Rajdan 1983, Plant tissue culture, Theory and Practice Elsevier, Amsterdam.
8. Boesewinkel F.D. and Boman F. 1984, The seed structure in embryology of angiosperms (ed B.M.Johri), Springer- Verlag, Berlin, pp. 567-610.
9. Bouman F. 1984 The ovule in embryology of angiosperms (ed B.M.Johri), Springer- Verlag, Berlin, pp. 123-157.
10. Cartson P.S., Smith N.H., Dearing R.D. (1972) Parasexual interspecific plant hybridization. Proc. Nat. Acad. Sci. USA, 69, 2292-2294.
11. Cartson P.S. (1973) The use of protoplasts of genetic research. Proc. Nat. Acad. Sci. USA, 70, 598-602.
12. Chitralekha P. and N.N. Bhandari 1991, Post fertilization development of antipodal cells in

Ranunculus scferatus. Phytomorphology 41, 200-212.
13. Ciampolini F.M., Nepi and E. Pacini 1993, tapetum development in *Cucurbita pepo* (Cucurbitaceae) Pt. Syst. Evol. (Suppl) 7-13-22.
14. Cocking E.C. 1960, A method for the isolation of plant protoplasts and vacuoles. Nature (London) 187-927-929.
15. Cocking E.C. 1970, Virus uptake, cell wall regeneration and virus multiplication in isolated plant protoplasts. Int. Rev. Cytol 28-89-124.

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Semester IV

Course code- PSDBOTT15 (DSE-II)

PAPER –XV: Molecular Biology and Plant Biotechnology-II

UNIT- I:

Transgenics : Cloning vectors for higher plants; Methods for gene transfer, *Agrobacterium tumefaciens* mediated- Basis of tumor formation, features of Ti and Ri plasmids, mechanisms of DNA transfer, role of virulence genes, use of Ti and Ri genetic markers, use of reporter genes and introns; Direct DNA transfer; particle bombardment; electroporation; microinjection; macroinjection; liposomes; electrophoretic; pollen tube method; pollen transformation; PEG method; transformation of monocots; transgene stability and gene silencing; chloroplast transformation.

UNIT- II:

Applications of transformation: Herbicide resistance; insect resistance; Bt genes, disease resistance; Nutritional quality; biopesticides and biofertilizers; hazards and safety regulations for transgenic plants.

Metabolic engineering through transgenic plants: Production of secondary metabolites; industrial enzymes; biodegradable plastics (PHB and any other); edible vaccines; antibody production and other important drugs.

UNIT- III:

Plant tissue culture: History, Culture types: Callus culture, organ culture, suspension culture for production of secondary metabolites, protoplast culture, fusion and somatic hybrids, Somatic embryogenesis, anther and pollen culture, haploid plants, somaclonal variations, organogenesis (direct and indirect).

Gene expression: Gene expression in Mitochondria, chloroplast, yeast

Regulation of gene expression: Regulation of gene expression in translation and post-translation level

UNIT- IV:

Nitrogen fixing genes: Organization, function and regulation of nitrogen fixing genes in *Klebsiella, hup* genes.

DNA fingerprinting and marker assisted breeding: RFLP maps; linkage analysis; RAPD markers; STS; SSR (microsatellites); ISSR; SCAR (sequence characterized amplified regions); SSCP (single strand conformational polymorphism); AFLP; QTL: map based cloning; molecular marker assisted selection

Cleaner Biotechnology: Pollution control through genetically modified organisms.

Practicals:

Major Exercises:

1. Agrobacterium *tumefaciens* mediating gene transfer in a suitable plant.
2. Induction of secondary metabolite synthesis in suspension culture.
3. Use of RAPD/RFLP/SSCP etc. markers to detect molecular polymorphism of different species.
4. Isolation and protein profiling in different plant species by SDS-PAGE.
5. Raising of suspension culture and plotting of growth curve.
6. Bacterial transformation and selection of transformed cells.
7. Study of expression of inducible genes at biochemical level.

Minor Exercises:

8. Elisa testing of Bt gene in cotton.
9. Isolation of secondary metabolites by gel filtration.
10. Purification of plant metabolite/ protein by column chromatography.
11. DNA ligation and analysis of ligated DNA on agarose gel (cloning and analysis using GUS gene.
12. Organogenesis and somatic embryogenesis using appropriate explants and preparation of artificial seeds.
13. Demonstration of anther culture.

Suggested Readings (for laboratory exrcises)

1. Gelvin, S. B. and Schilperoort, R. A (eds) 1994. Plant Molecular Biology Manual, 2nd edition. Kluwer Academic Publishers, Dordrecht, The Netherlands.
2. Glick, B. R. and Thompson, J. E. 1993, Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
3. Glover, D. M. and Hames, B. D.(Eds) 1995. DNA Cloning 1: A Practical Approach: Core Techniques, 2nd edition PAS, IRL Press at Oxford University Press, Oxford.
4. Hackett, P. B. Fuchs, J. A. and Messing, J. W. 1988. An Introduction to Recombinant DNA Techniques. Basic Experiments in Gene Manipulation. The Benjamin/cummings Publishing Co., Inc. Menlo Park, California.
5. Hall, R. D. (Ed.), 1999. Plant Cell Culture Protocols. Humana Press. Inc. New Jersey, USA.
6. Maniatis et al. Molecular cloning Vol. I, II and III. Cold-Spring Harbor Lab Press.
7. Sambrook and Russel. 2001. Molecular cloning Vol. 1-3 CSH press.
8. Shaw, C. H. (Ed.) 1988, Plant Molecular Biology : A Practical Approach. IRl Press, Oxford.
9. Smith, R. H. 2000. Plant Tissue Culture : Tecniques and Experiments. Academic Press, New York.

Suggested Readings:

1. Alberts, Bruce; Johnson Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter, Peter, C. 2002 Molecular Biology of the Cell, Garland Science, New York and London.
2. Bhojwani SS and Rajdhan MK 1996 Plant tissue culture: Theory and Practice. Elsevier Sci. Publ., New York.
3. Peter c2002 Molecular Biology of the Cell, New York and London: Garland Science.
4. Callow, J. A., Ford-Lloyed, B. V. and Newbury, H. J. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use, CAB International, Oxon UK.
5. Charlwood, B. Y. and Rhodes, M.V. 1999 Secondary products from plant tissue culture, Clarendon Press. Oxford.
6. Chrispeeels, M. J. and Sadava, D. E. 1994, Plants, Genes and Agriculture. Jones & Barlett Publishers, Boston, USA.
7. Collins HA and Edwards S 1998 Plant cell culture. BIOS Sci. Publ., Oxford UK.
8. Dicosmo F and Misawa, M. 1996 Plant Cell culture: Secondary metabolism towards industrial application, CRC press, Boca Raton, NewYork.
9. Glazer, A. N. and Nikaido, H. 1995. Microbial Biotechnology. W. H. Freeman & Company, New York, USA.
10. Gustafson, R. J. 2000. Genomes. Kluwer Academic Plenum Publishers, New York, USA.
11. Henry, R. J. 1997. Practical Applications of Plant Molecular Biology. Chapman & Hall, London, UK.
12. Jain SM, Sopory SK and Veilleux RE 1996 In vitro haploid production in higher plants. Vols. 1-5. Kluwer Acad. Publ., The Netherlands.
13. Kurz, W.G.W 1989 Primary and Secondary metabolism of plant and Cell cultures, Springer Verlag, Berlin.
14. Old, R. W. and Primrose, S. B. 1989. Principles of Genome Analysis. Blackwell Scientific Publications. Oxford, UK.
15. Primrose, S. B. 1995. Principles of Genome Analysis. Blackwell Scientific Ltd., Oxford, UK.
16. Raghavan, V. 1997. Molecular Biology of Flowering Plants. Cambridge University Press, New York, USA.
17. Shantharam, S. and Montgomery, J. F. 1999. Biotechnology, Biosafety, and Biodiversity. Oxford & IBH Publication Co., Pvt., Ltd., New Delhi.

References: Online journals available on UGC V-SAT programme.

M. Sc. Botany Syllabus

Semester IV

Course code- PSDBOTT15 (DSE-II)

PAPER –XV: Paleobotany-II

UNIT- I:

Gymnospermopsida-- Study of Aneurophytales and Archaeopteridales.Gymnosperm and early evolution (Archeosperma, Elkinsia, and Morentia) of seed habit stages in evolution. Study of Pteridosprmales-Lyginopteridaceae, Medullosaceae, Cycadeoidales-Cycadeoidaceae, Williamsoniaceae, Wielandiellaceae.and Fossil Cycads (Nilssonia, Baenia, Androstrobus).

UNIT- II:

Gymnosper- Caytoniales, Glossopteridales, Penntoxylales.fossil Cordaitales, Voltziales and phylogenenetic consideration of all the orders.

UNIT- III:

Study of Deccan Intertrappean flora of India. Formation of Deccan traps and Intertraps, age and its floristic composition in relation to Pteridophytes, Gymnosperms and Angiosperms.Palecimate and Paleogeography of Deccan Intertraps.

UNIT- IV:

Paleopalynology-Important features of spores and pollen morphology, their role in stratigraphy and in exploration of coal and oil.Palaeopalynological studies, microfossils and its application.Paleoecology and paleogeography.

Indian Gonwana-Its stratigraphy and classification (Two fold and three fold). Index fossil.

Suggested Laboratory and Field Exercises

Major Exercises:

1. Study of Deccan Intertrappean flora of India. Pteridophytes, Gymnosperms and Angiosperms-flowers and fruits.
2. Gymnosperm- Caytoniales, Glossopteridales, Penntoxylales.fossil Cordaitales.
3. Lyginopteridaceae, Medullosaceae, Cycadeoidales-Cycadeoidaceae, Williamsoniaceae, Wielandiellaceae and Fossil Cycads (Nilssonia, Baenia, Androstrobus).
4. Important features of spores and pollen morphology and technique to study them (Maceration)

Minor Exercises:

5. Study different types of fossils.
6. Study of plant fossils as per syllabus based on specimens and slides.
7. Study of wood anatomy of fossils.
8. Exploration and excursion to different fossiliferous localities.

9. Preparation of practical record/submission of collection and tour report of excursion.

Suggested Readings

1. Agashe S. N. (1995)-Palaeobotany, Plants of the past ,their evolution, palaeoenvirinment and application in exploration of fossil fuels. Oxford & IBH publishing company-New Delhi.
2. Andrews H.N.(1961)-Studies in Palaeobotany, Willey and Sons –New York.
3. Arnold,C.A.(1947)-An Introduction to Palaeobotany ,MC-GrawHills.,New York.
4. Beck, C. B. and Wight, D. C.(1988)-Progymnosperm, In origin and evolution of Gymnosperms,Columbia Uni. Press-New York.
5. Beck, C.B.(1976)-Current status of the Progymnospermosida, Review of Palaeobotany and Palynology.
6. Darrah, W.C.(1960)-Principles of Paleobotany.
7. Erdtman,G(1957)-Pollen and Spore morphology and plant taxonomy.(An introduction to palynology) Hafner Publishing Comp-New York.
8. Chandra,S.andSurange, K.R.(1979)-Revision of the Indian species of Glossopteris, Monograph,BirbalSahni Institute of Palaeobotany.
9. Hoffmeister,W.S.(1960)-Palynology has an important role in oil exploration.World oil-150:1001-140.
10. Meyen, S.V.(1987) – Fundamentals of Palaeobotany Chapman and Hill,London,New York.
11. Parihar ,N.S.(1995) –Essentials of Palaeobotany,Central Book –Allahabad.
12. Sahni, B.(1964)- Revisions of Indian fossils plants, -III(Monocotyledons) –BSIP-Lucknow.
13. Stewart, W.N.&Rothwell,G.V. (1993)-Palaeobotany and Evolution of Plants,Cambridge Univ., Press-Cambridge.
14. Venkatchala, B.S&Maheshwari,H.K.(1991)-Palaeobotanical Researches in India.Jour.Ind.Bot.Society-70;1-12.
15. Wadia, D.N (1953)-Geology of India,Mac,Millan-Co.London.
16. Prasad, K.N. (1999). - An introduction to palaeobotany, APH Pub.
17. Cleal, J. Christopher. &B.A.Thomas (2009) Introduction to Plant Fossils, Cambridge Univ., Press-Cambridge.
18. Willis, K. J. & McElwain, J. C. (2014). The Evolution Of Plants (second edition) OXFORD University Press.
19. Stewart, W.N. and Rothwell G.W. (1993), Palaeobotany and the Evolution of Plants, Cambridge University Press.
20. Arnold, C.A. (1947): Introduction to Palaeobotany, Mc-Graw Hill Book Co. Inc., New York and London.
21. Agashe, S.N. (1995), Palaeobotany, Oxford & IBH, New Delhi.
22. Siddiqui, K.A. (2002) Elements of Palaeobotany, Kitab Mahal, Allahabad.
23. Thomas, B.A. & Spicer R.A. (1987): The Evolution and Palaeobiology of land plants. Discordies Press, Fortland, USA.
24. Spicer, R.A. & Thomas, B.A. (1986) Systematic and taxonomic approaches in Palaeobotany. Systematic Association Special Volume.

M. Sc. Botany Syllabus

Semester IV

Course code- PSSBOTT16 (SEC-II)

PAPER –XVI: BIOFERTILIZERS-II

UNIT I

Application and evaluation techniques of crop response to biofertilizers, simplified Anaerobic digester for biofertilizers; modified Anaerobic fermenter bioferitilizer, Operation condition for anaerobic digestion of biofertilizer.

UNIT II

Soil fertility and Fertilizer:- Soil microbiology and biofertilizer; Biogas from liquid biodfertiliser derived from ecoiogically hazardus water hycianth; Muncipal sewage , agricultural and industrial waste. Recycling of biodegradable waste.

UNIT III

Vermiculture and Vermitechnology:-Introduction; Advantages of vermicomposting, earthworm, ecological typs of earthworm,Vermicomposting and their application in organic culture- compost making, Methods and field application

UNIT IV

Green manuaring and Organic fertilizer:- Organic farming and organic manuares, Methanogenesis- pest and disease management system in agriculture.

Practicals:

Based on theory syllabus.

Suggested reading:-

4. The complete techonology book on biofertizers and organic farming –NIIR, New Delhi.
5. Somani L.L, P.Shilpkar and D.Shilpkar (2011) Biofertizers commercial production technology and quality control. Agrotech publisher Acedemy Udaipur.
6. The complete technology book on Vermiculture and Vermicompost NIIR- New Delhi.

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Semester IV

Course code- PSSBOTT16 (SEC-II)

PAPER –XVI: Nursery and Gardening-II

Unit-I:

Plant Protection- Difference between a pest and a disease, preventive measures, control measures, cultural control, mechanical control, chemical control, common pests, bird and animal pests, rodent pests, insect pests and diseases.

Unit –II:

Plant propagation- Sexual and vegetative methods of propagation, short and long term storage of propagules (seeds, fruits, bulbs, rhizomes etc).

Unit-III:

Bonsai and Indoor plants- Tools and containers,Procuring plants for bonsai, characteristic elements of bonsai, Shaping-pruning-wiring technique, form and style, root pruning and potting-repotting, Maintenance of growth. Indoor plants and foliage and ornamental plants.

Unit-IV:

Poly-house, Pots and potculture- Design and construction of Poly-house, maintenance and applications of poly-house. Popularity of pot culture, pot arrangements, selection of pots, filling up of pots, watering, repotting, boxes and baskets of potting.

Practicals:

Based on theory syllabus.

Suggested Readings:

3. Trivedi, P. P. (1987) Home Gardening. ICAR New Delhi.
4. Deena Beverley and Barty Phillips (2002) Encyclopedia of Gardening, Parragon Book, UK.

M. Sc. Botany Syllabus

Semester IV

Course code- PSSBOTT16 (SEC-II)

PAPER –XVI: PLANT DIVERSITY AND HUMAN WELFARE-II

Unit-I:

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

Unit-II:

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

Unit-III:

Role of plants in relation to Human Welfare:

Importance of forestry their utilization and commercial aspects

Avenue trees, Ornamental plants of India.

Unit-IV:

Role of plants in relation to Human Welfare. Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.

Practicals:

Based on theory syllabus.

Suggested Readings

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity – Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

M. Sc. Botany Syllabus

Semester IV

Course code- PSSBOTT16 (SEC-II)

PAPER –XVI: FLORICULTURE-II

Unit-I:

Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India.

Unit-II:

Landscaping Places of Public Importance: Landscaping highways and Educational institutions.

Unit-III:

Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life;

Unit-IV:

Cultivation of Important cut flowers such as Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Lilium, Orchids.

Practicals:

Based on theory syllabus.

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

M. Sc. Botany Syllabus

Semester IV

Course code- PSSBOTT16 (SEC-II)

PAPER –XVI: BASIC BOTANY-II

UNIT I

Plant physiology:-

A) Water relation – Diffusion, Osmosis and Inbibition.
B) Absorption of water and minerals by root.
C) The loss of water from plants.
D) The movement of water in plants.
E) Metabolism of nitrogen, Photosynthesis, Respiration.
F) Synthesis of protein, fat and there trans location.
G) Plant growth, movement and reproduction.

UNIT II

Ecology and evolution:- Ecological groups of plants, ecological factors, the units of vegetation (communities), plant succession, ecological types of adaptation of plants, environmental pollution. Evolution of plant kingdom. The ideas of development of organic evolution (Darwinism and Lamarckism).

UNIT III

Economic botany:- General description of economically important plants, yielding food, fodder and forage, wood, oils, gums and resin, oil, drugs and narcotics, beverages, Spices and condiments.(any three examples from each type)

UNIT IV

Paleo botany:- Geological time scales, changes in organic life through ages, process of fossilization, types of fossls presarvations, economic importance of fossils.

Practicals:

Based on theory syllabus.

Suggested Readings:-

1. S.Sundara Rajan College Botany Vol I to IV Himalaya publishing house.
2. Saxena And Sarsbhai A textbook of botany Vol. I to III Kitabghar Gwalior.
3. Gangulee And Kar College botany Vol.I and II.
4. K.S.Bilgrami, L.M.Shrivastava, J.L.Shremali Fundamentals of botany Vol. I and II Vikas Publishing House PVT.LTD. Sahibabad UP.
5. A.C.Dutta Botany for degree students.
6. S.N.Pande And P.S.Trivedi Text book of botany Vol I and II. Vani educational book.

GONDWANA UNIVERSITY, GADCHIROLI

BOARD OF STUDIES IN ZOOLOGY

SUBMISSION OF

CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR POST GRADUATE (M. Sc.) PROGRAMME

FROM SESSION 2016 - 17

Gondwana University, Gadchiroli

Scheme and syllabus under choice based credit system.
Syllabus for M. Sc. Zoology (Semester with choice based credit system) w e f 2016-17 Academic session.

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Zoology

M. Sc. Zoology Semester I												
Code	*Theory / Practical*	Teaching scheme (Hours / Week)			*Credits*	Examination Scheme						
						Duration in	Max. Marks		*Total Marks*	Minimum Passing Marks		
		Th	*Pract*	*Total*			*ernal*	*terminal*		*Th*	*Prac*	
Core 1	Paper 1: Structure and Function of Invertebrates	4	-	4	4	3	80	20	100	40		
Core 2	Paper 2: General Physiology	4	-	4	4	3	80	20	100	40		
Core 3	Paper 3: Cell Biology and Genetics	4	-	4	4	3	80	20	100	40		
Core 4	Paper 4: Advanced Reproductive Biology	4	-	4	4	3	80	20	100	40		
Pract. Core 1 & 2	Practical 1: Based on theory Paper 1 & 2	-	8	8	4	3-8*	80	20	100		40	
Pract. Core 3 & 4	Practical 2: Based on theory Paper 3 & 4	-	8	8	4	3-8*	80	20	100		40	
Seminar 1	Seminar 1	2	-	2	1			25	25	10		
	TOTAL	**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**	

M. Sc. Zoology Semester II											
Code	*Theory / Practical*	Teaching scheme (Hours / Week)			*Credits*	Examination Scheme					
		Th	*Pract*	*Total*		*Duration in*	Max. Marks		*Total Marks*	Minimum Passing Marks	
							ernal	*terminal*		*Th*	*Pract*
Core 5	Paper 5: Structure and Function of Vertebrates	4	-	4	4	3	80	20	100	40	
Core 6	Paper 6: Comparative Endocrinology	4	-	4	4	3	80	20	100	40	
Core 7	Paper 7: Molecular Biology and Biotechnology	4	-	4	4	3	80	20	100	40	
Core 8	Paper 8: Advanced Developmental Biology	4	-	4	4	3	80	20	100	40	
Pract. Core 5 & 6	Practical 3: Based on theory Paper 5 & 6	-	8	8	4	3-8*	80	20	100		40
Pract. Core 7 & 8	Practical 4: Based on theory Paper 7 & 8	-	8	8	4	3-8*	80	20	100		40
Seminar 2	Seminar 2	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

M. Sc. Zoology Semester III											
Code	*Theory / Practical*	Teaching scheme (Hours / Week)			*Credits*	Examination Scheme					
		Th	*Pract*	*Total*		*Duration in*	Max. Marks		*Total Marks*	Minimum Passing Marks	
							Internal			*Th*	*Pract*
Core 9	Paper 9: Parasitology and Immunology	4	-	4	4	3	80	20	100	40	
Core 10	Paper 10: **Special Group- Paper I** • Entomology • Fish and Fisheries • Mammalian Reproductive Physiology (MRP) • Animal Physiology • Cell Biology • Fresh Water Zoology • Aquaculture • Environmental Biology • Sericulture	4	-	4	4	3	80	20	100	40	
Core Elective 1	**Paper 11: Special Group- Paper II** • Entomology • Fish and Fisheries • Mammalian Reproductive	4	-	4	4	3	80	20	100	40	

	Physiology (MRP) • Animal Physiology • Cell Biology • Fresh Water Zoology • Aquaculture • Environmental Biology • Sericulture										
Foundation Course 1	Paper 12: Foundation I – • Elementary Zoology • Basic Entomology • Fresh Water Fisheries • Human Physiology	4	-	4	4	3	80	20	100	40	
Pract. Core 9 & 10	Practical 5: Based on theory of 9	-	8	8	4	3-8*	80	20	100		40
Pract. Core Elective 1	Practical 6: Based on theory of 10 and 11	-	8	8	4	3-8*	80	20	100		40
Seminar 3	Seminar 3	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

M. Sc. Zoology Semester IV												
Code	*Theory / Practical*	Teaching scheme (Hours / Week)			*Credits*	Examination Scheme						
		Th	*Pract*	*Total*		*Duration in*	Max. Marks		*Total Marks*	Minimum Passing Marks		
								Intern		*Th*	*Pra*	
Core 11	Paper 13: Biotechnique, Biostatistics, Ethology, Toxicology and Bioinformatics	4	-	4	4	3	80	20	100	40		
Core 12	Paper 14: **Special Group- Paper III** • Entomology • Fish and Fisheries • Mammalian Reproductive Physiology (MRP) • Animal Physiology • Cell Biology • Fresh Water Zoology • Aquaculture • Environmental Biology • Sericulture	4	-	4	4	3	80	20	100	40		
Core Elective 2	Paper 15: **Special Group- Paper IV** • Entomology • Fish and	4	-	4	4	3	80	20	100	40		

	Fisheries • Mammalian Reproductive Physiology (MRP) • Animal Physiology • Cell Biology • Fresh Water Zoology • Aquaculture • Environmental Biology • Sericulture										
Foundation Course 2	Paper 16: Foundation II – • Applied Zoology • Applied and Industrial Entomology • Applied Fresh Water Fisheries • Applied Human Physiology	4	-	4	4	3	80	20	100	40	
Pract. Core 11, 12 & Elective 2	**Practical 7: Based on theory of 14 and 15**	-	8	8	4	3-8*	80	20	100		40
Project	Project	-	8	8	4	3-8*	80	20	100		40
Seminar 4	Seminar 4	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**480**	**145**	**625**	**170**	**80**

Gondwana University, Gadchiroli

Changes in practical curriculum as per UGC Notification No. F.14-6/2014 (CPP-II) Dated 1st August 2014

(w.e.f. academic session 2016-17) Important Instructions

I. Use of animals for dissection for practical purpose in the curriculum is banned by

UGC vide its notification No. F.14-6/2014 (CPP-II) dated 1st August 2014. It is now essential to use necessary alternatives to stop dissection and promote and orient students towards the knowledge component rather than skill development using ICT and available resources without disturbing natural habitat. To understand anatomy of any animal, virtual dissection of the animal should be conducted through various

computer simulations. These digital learning devices and available resources are to be used to demonstrate the dissection of the animals and other laboratory exercises and to evaluate the students at the time of examination and to ensures compliance of the aforesaid notification.

II. Those institutions which are already having Zoology museum / Permanent Slides / Skeleton and Loose Bones of any animals should use them till they last. No new specimens/ slides or any other laboratory material procured from animal source shall be purchased for conducting practicals mentioned here- in above. If needed, they

should purchase charts/ models/ photographs or digital sources as alternatives.

III. During regular practical and practical examination, for anatomical observations, demonstration and detailed explanation of the given system of Invertebrate/ Vertebrate animal, the student will expose/ explain the given system of the animal and

draw, label and comment on it.

IV. During regular practical and practical examination, for mounting of given material and permanent stained preparation, the student is expected to describe the process and/or identify, draw, label and describe the given material.

Semester- III

Paper- IX, Parasitology and Immunology

Unit I:

1.1 *Vibrio cholera and Clostridium titani*- Life cycle, mode of transmission, infection andtreatment

1.2 *Yersinia pestis*- Life cycle, mode of transmission, infection and treatment

1.3 Influenza and H1 N1 viruses- Life cycle, mode of transmission, infection and treatment.

1.4 Dengue and Hepatitis- Life cycle, mode of transmission, infection and treatment

Unit II:

2.1 *Trypanosoma and Entomoeba*- Life cycle, mode of transmission, infection and treatment

2.2 *Leishmania and* Malaria- Life cycle, mode of transmission, infection and treatment

2.3 *Wuchereria*and*Trichinella*- Life cycle, mode of transmission, infection and treatment

2.4 Toxins and antitoxins

Unit III:

3.1 Immune system- innate and adaptive immunity; Antigens and antibodies and its interaction

3.2 Cells and organs of immune system; T cells and B cells - maturation, activation and differentiation, T cell receptors

3.3 Major Histocompatibility Complex (MHC)- general organization and inheritance of the MHC, MHC molecules and genes

3.4 Complement system- classical, alternative and lectin pathways, regulation of complement system, biological consequences of complement activation

Unit IV:

4.1 Cytokine receptors- properties of cytokines, cytokine receptors, cytokine secretion by TH1 and TH2 subsets; Cell mediated cytotoxic responses- effector mechanisms, leukocyte activation and migration.

4.2 Hypersensitivity reactions- types, mechanisms of type I to IV hypersensitivity reactions; Autoimmunity- Organ specific autoimmune disease and treatment

4.3 Transplantation immunology- blood antigens, transplantation rejection, graft rejection, familial grafting, tissue typing, cross matching, immunosuppression.

4.4 Tumor immunology- Types and roles of tumor antigens, immune response to tumor; Imunotechniques- RIA and ELISA

Semester-III, Practical-V, Parasitology and Immunology (CREDIT - 4)

Section-A

1. Study of different types of parasitic protozoan's with the help of already available permanent slides/ ICT tools/ Models/ Charts/ Photographs etc.
2. Study of different types of parasitic helminthes with the help of already available specimens, permanent slides/ ICT tools/ models/ charts/ photographs etc.
3. Study of different types of insect vectors with the help of already available specimens, permanent slides/ ICT tools/ models/ charts/ photographs etc.
4. Identification and study of various ecto and endo parasites with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
5. Study of different types of insect vectors and their mouth parts with the help of already available specimens, permanent slides/ ICT tools/ models/ charts/ photographs etc.
6. Study of life cycles of various parasites with the help of already available specimens, permanent slides/ ICT tools/ models/ charts/ photographs etc.
7. Demonstration of Gram positive and Gram negative bacteria.
8. Demonstration of immunoelectrophoresis.

Section-B

9. Immunological diagnosis of pregnancy.
10. Preparation of tissue sections of thymus, spleen, and lymph nodes. (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry farms/ fish markets etc.)
11. Agar gel diffusion.
12. Identification and study of T and B cells with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
13. Demonstration of Mast cells. (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry farms/ fish markets etc.)
14. Demonstration of ouchterlony double diffusion (ODD).

Distribution of marks		**Marks**
1.	Identification and comments on spot (1 to 10)	20
2.	Demonstration of Gram +ve (Positive), Gram –ve (Negative) bacteria.	10
3.	Antigen-antibody reaction/Agar gel diffusion/diagnosis of pregnancy	10
4.	T and B cells identification/Mast cell demonstration	15
5.	Submission of photographs of vectors	10
6.	Practical record	10
7.	Viva-voce	05
	Total marks	80

- **Suggested Readings**

Parasitology

1. Brock Biology of Microorganisms (Ed. IX) M. T. Madigan J. M. Martinko and J.

Parker. Prentice Hall International Publication.
2. The Nematode Parasite in Vertebrate, W. Youle and Maplestone.
3. General Parasitology, V. A. Dogiel.
4. Helminthology, E. C. Fausy.
5. Platyhelminthes and Parasitisium, D.R.Birt.
6. Animal Parasite- O.W. Aisen
7. Parasitic Protozoa, J.P. Kreier and J.R. Baker. Allen and Unwin Press.
8. Medical and Veterinary Protozoalogy M. G. Kathering , A. James paul and V. Zaman. Churchill Livingstone.

Immunology

1. Immunology – R. C. Kuby et al.
2. Immunology - Tizzard.
3. Immunology -. Roitt, Brostoff and D. Male.
4. Microbiology- M. T. Pelzer. Jr. E. C. S. Chan and N. R. Krieg. Tata McGraw -Hill
5. Immunology - Abbas

Semester-III

Paper-X, Special Group-Entomology-I (CREDIT - 4)

Insect Morphology and Physiology

Unit-I

1.1 Integument: molecular structure, moulting and sclerotization.

1.2 Morphology of head, thorax and abdomen.

1.3 Appendages: antennae, legs and genitalia.

1.4 Wing structure and mechanism of flight.

Unit-II

2.1 Mouth parts: type, morphology and feeding mechanism.

2.2 Structure of alimentary canal and salivary glands, mechanism of digestion.

2.3 Respiratory system: tracheal, aquatic and plastron respiratory mechanism.

2.4 Circulatory system: organs, mechanism of circulation, haemolymph- cellular and chemical composition. Functions of haemocytes.

Unit-III

3.1 Excretory system: organs and physiology of excretion.

3.2 Nervous system: structure and anatomy of brain and ventral nerve cord.

3.3 Neuroendocrine system: structure and function, role in metamorphosis and reproduction.

3.4 Exocrine glands: Pheromones and allomones-chemistry and functions.

Unit-IV

4.1 Reproduction: male and female reproductive system, structure of testis and ovary, mechanism of spermatogenesis and vitellogenesis.

4.2 Specialized reproductive mechanism: viviparity, polyembryony, paedogenesis and parthenogenesis.

4.3 Early embryonic development up to germ band formation.

4.4 Metamorphosis: types of larvae and pupae.

Semester-III, (M. Sc. Part-II)
Paper-XI, Special Group-Entomology-II (CREDIT - 4)
Classification and Industrial Insects

Unit-I

1.1 Modern scheme of insect classification and general characters of various Orders.
1.2 General characters and classification of Thysanura and Collembola.
1.3 General characters and classification of Mallophaga and Siphunculata.
1.4 General characters and classification of Siphonaptera.

Unit-II

2.1 General characters and classification of Orthoptera.
2.2 General characters and classification of Hemiptera.
2.3 General characters and classification of Lepidoptera.
2.4 General characters and classification of Coleoptera.

Unit-III

3.1 Mulberry silkworm *Bombyxmori,* life cycle, silkgland and silk proteins.
3.2 Silkworm rearing, cocoon harvesting and seed production.
3.3 Bacterial and viral diseases in silkworm.
3.4 Lac insect-biology, lac cultivation and economic importance.

Unit-IV

4.1 Tasar sericulture- life cycle, host plant, rearing, cocoon formation and silk production.
4.2 Eri sericulture- life cycle, host plant rearing and silk production.
4.3 Honey bee- types, life cycle, colony formation and apiary products.
4.4 Bee keeping- movable frame hive, bee rearing management and diseases.

Semester-III, Practical-VI, Special Group-Entomology (CREDIT - 4)

1 Anatomical observations, demonstration and detailed explanation of the various organs and systems in insects such as cockroach, grasshopper, cricket, molecricket, red cotton bug, honey bee, beetle, house fly, butterfly/ moth and caterpillars with the help of ICT tools/ models/ charts/ photographs etc.

2 Histological study of alimentary canal, salivary glands, gastric caecae, malpighian tubules, testis, ovary, sex accessory glands, exocrine glands, endocrine glands, brain and other ganglia with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

3 Whole mount preparation of insect parts using insects from agricultural wastes or with the help of already available permanent slides/ ICT tools/ charts/ photographs/ models etc.

4 Insect study- Identification, classification and characters up to families belonging to orders- Odonata, Orthoptera, Dictyoptera, Hemiptera, Lepidoptera, Coleoptera, 27

Hymenoptera, Diptera etc. with the help of already available museum specimens, permanent slides/ ICT tools/ charts/ photographs/ models etc.

5 **Physiological Experiments:**

a. Estimation of total proteins/carbohydrates/lipids
b. Chromatographic separation of free amino acids
c. Separation of proteins by electrophoresis
d. Estimation of Na^+ and K^+ by flame photometer.
e. Estimation of DNA and RNA.

6 Visits to agricultural fields, national parks and forests for observations of insect population dynamics, behavior and diversity.

Note: Student should submit insect photographs of 10 locally available species at thetime of examination.

	Distribution of Marks	**Marks**
1.	Anatomical observations	10
2.	Physiological Experiment	10
3.	Identification of histological slides and insects (1-15)	30
4.	Mounting	05
5.	Class records and submission of insect photographs	10
6.	Submission of histological slides	05
7.	Viva-voce	10

	Total marks	80

Semester –III

Paper-X, Special Group-Fish and Fisheries -I (CREDIT - 4)

General studies

Unit-I

1.1 Origin and Evolution of fishes: Fossil record, classification, cyclostoms, ostracoderms, placoderms, Sharklike fisher, Bony fishes

1.2 Development of jaws and limbs in fishes.

1.3 Classification and general characters of Placoderms: Acanthodii, Coccostei, Pterychthyes, Stegoselachii, Palaeospondyli.

1.4 Affinities of Placoderms and fossil record.

Unit-II

2.1 Classification and general characters of Elasmobranch/Chondrichthyes: Sharks and Rays, Holocephali

2.2 Affinities of Elasmobranchs, specialized characters of Elasmobranchs.

2.3 Classification and general characters of Actinopterygii/Ray finned

fishes:Palaeonisciformes,Polypteriformes, Acipenseriformes, Amiiformes, Teleostea (Osteoglossomorpha, Elopomorpha, Clupeomorpha, Euteleostei)

2.4 Affinities of Actinopterygiians.

Unit-III

3.1 Dipnoi: General characters, classification, origin, fossil Dipnoians and distribution of Dipnoians.

3.2 Specialized characters of Dipnoi, Blood vascular system of Protopterus and affinities of Dipnoians.

3.3 Respiratory system: Structure of gills in fishes, gill histology

3.4 Blood supply and mode of respiration and gaseous exchange in teleosts.

Unit-IV

4.1 Accessary respiratory organs: Origin of air breathing organs; skin, buccopharynxopercular cavity, air bladder

4.2 Mechanism of air breathing, function of accessory respiratory organ.

4.3 Air bladder: Origin, Development, types of air bladder; physostomous, physoclists, structure of gas secreating complex

4.4 Blood supply to air bladder and functions of air bladder

Semester-III

Paper-XI, Special Group-Fish and Fisheries -II (CREDIT - 4)

Applied fisheries

Unit-I

1.1 Fresh water fisheries of India, Riverine and Reservoir fisheries.

1.2 Estuarine and Marine fisheries of India.

1.3 Breeding of Indian Major carps: i Natural breeding, ii Induced breeding, iii Methods of obtaining eggs, spawn, fry and fingerlings from natural resources.

1.4 Neuroendocrine control of carp reproduction.

Unit-II

2.1 Culture of exotic fishes – common carp, Composite culture.

2.2 Monoculture, Monosex culture.

2.3 Integrated Fish farming – Poultry, Duck, Fish rice culture.

2.4 Sewage fed fisheries

Unit-III

3.1 Catfish culture

3.2 Trout culture

3.3 Ornamental fish culture: i) Oviparous, ii) Live bearers.

3.4 Culture of sea weeds and Spirulina.

Unit-IV

4.1 Pearl culture

4.2 Oyster culture: i) Species- edible ii) Culture methods.

4.3 Prawn culture (Life cycle and breeding)

4.4 Frog culture

Semester-III, Practical-V, Special Group-Fish and Fisheries

1. Identification of local fishes upon species.
2. Anatomical observations, demonstration and detailed explanation of fish in general, reproduction and urino genital system, Endocrine glands with the help of ICT tools/ models/ charts/ photographs etc.
3. Study of cranial nerves in *Wallago* and *Labeo* with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
4. Identification of various stages of fry and fingerlings of major carps with the help of already available preserved material, permanent slides/ charts/ models / photographs/ ICT tools etc.
5. Permanent preparation of various scales using wastes from recognized fish markets..
6. Estimation of dissolve oxygen in water sample.
7. Estimation of CO2 in water sample.
8. Estimation of chloride sample in water.
9. Estimation of protein in blood of fish (Source of fish blood: Local recognized fish markets).
10. Estimation of sodium in blood of fish (Source of fish blood: Local recognized fish markets).
11. Estimation of potassium in blood of fish (Source of fish blood: Local recognized fish markets).

Distribution of Marks:		**Marks**
1.	Anatomical observations (Major)	10
2.	Physiology Experiment	20
3.	Mounting of Scale	10
4.	Identification of fishes	20
5.	Practical Record	10
6.	Viva voce	10
	Total marks	80

Semester –III

Paper-X, Special Group-Mammalian Reproductive Physiology (MRP)-I (CREDIT - 4)

Reproductive Process in Male

Unit-I

1.1 Development, descent and structure of the testis.

1.2 Spermatogenesis: Molecular changes, hormonal regulation, and

spermiogenesis.

1.3 Sertoli cells: Structure , functions, blood testis barrier.

1.4 Leydig cells: Structure , functions and interaction with peritubular and Sertoli cells.

Unit-II

2.1 Epididymis: Structure and function.

2.2 Structure of spermatozoa and anomalies.

2.3 Sperm capacitation: molecular and biochemical changes, decapacitation.

2.4 Vas deferens: Structure and function.

Unit-III

3.1 Seminal Vesicle: Structure, function and regulation.

3.2 Prostate gland: Structure, function and prostatic cancer.

3.3 Cowpers gland: Structure, function and anomalies.

3.4 Penis: Structure and mechanism of erection.

Unit-IV

4.1 Male reproductive behaviour: Mating system, neural and hormonal control.

4.2 Pheromones: types, structure and function.

4.3 Infertility: causes and remedy.

4.4 Andrologically relevant diseases in advanced age.

Semester-III

Paper-XI, Special Group-Mammalian Reproductive Physiology-II
(CREDIT- 4)

Reproductive Process in Female

Unit- I

1.1 Differentiation of the ovary and female genital tract.

1.2 The process of folliculogenesis and its hormonal control.

1.3 Recruitment, selection, dominance of follicle and signaling for ovulation.

1.4 Follicle wall: Theca, differentiation, steroid hormone synthesis (2-gonadotropin,2- cell concept).

Unit-II

2.1 Estrous cycle in mammals.

2.2 Menstrual cycle and Menopause.

2.3 Mechanism and hormonal control of ovulation .

2.4 Corpus luteum: histogenesis, function, maintenance and luteolysis.

Unit-III

3.1 Oviduct: structure, regional differentiation and function.

3.2 Uterus: Types, abnormalities.

3.3 Cervix-structure, functions.

3.4 Vagina-structure, function, detection of various stages of oestrous cycle by vaginal cytology, vaginal plug.

Unit-IV

4.1 Onset of puberty and delayed puberty.

4.2 Prostaglandins and their role in reproduction .

4.3 Anatomy and growth of mammary glands.

4.4 Lactogenesis and galactopoiesis.

Semester-III, Practical-VI, Special Group-Mammalian Reproductive Physiology (MRP)

1. Demonstration of surgical operation in rat/ mice Orchidectomy or Vasectomy or Epididymoctomy with the help of ICT tools
2. Anatomical observations, demonstration and detailed explanation of the male reproductive system of rat/ mice with the help of ICT tools/ models/ charts/ photographs etc.
3. Sperm count for the assessment of fertility (Source of semen: Government artificial insemination centre).
4. Study of spermatogenesis and identification of its various stages with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
5. Estimation of fructose/ sialic acid in reproductive tissue using animal wastes from recognized slaughter houses/ poultry farms etc.
6. Experimental studies (histological slides for identification) of the following with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
   a. Effects of castration and androgen replacement on sex accessory glands
   b. Effects of anti-androgen on testis and sex-accessory glands
   c. Effect of anti-cancer drugs on testis and sex-accessory glands, different duration and different regimen studies
   d. Effect of heavy metals on testis and sex accessory glands
7. Histology: Histological changes in male reproductive organs and sex accessories during active and inactive stage with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
8. Study of following endocrine glands with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
   a. Pituitary gland: anatomy, cell types and identification of cell types
   b. Thyroid gland: Histology of active and inactive glands, effects of antithyroid drugs
   c. Adrenal: Normal histology and effects of metapyrone and corticosteroids administration
9. Field Work: Visit to Artificial insemination centre.

Distribution of marks	**Marks**
1. Surgical operation	10
2. Anatomical observations	10

3.	Minor experimental analysis	10
4.	Biochemical estimation	20
5.	Identification and comments on spots (1-5)	10
6.	Practical record	10
7.	Viva-voce	10

	Total marks	80

Semester –III

Paper-X, Special Group-Animal Physiology-I (CREDIT - 4)

Physiology of Digestion and Excretion

Unit-I

1.1 Histology of salivary glands, Mechanism of salivary secretion, composition and functions of saliva.

1.2 Histology of stomach, mechanism of secretion of gastric juice, composition and functions of gastric juice.

1.3 Histology of pancreas, mechanism of pancreatic secretion, composition and functions of pancreatic juice.

1.4 Histology of liver, bile secretion, its composition and functions.

Unit-II

2.1 Histology of small and large intestine, intestinal glands, its secretion and control, intestinal bacteria.

2.2 Neural and endocrine regulation of gastro intestinal movements and secretions.

2.3 Gastrointestinal hormones - Synthesis, chemical structure and functions**.**

2.4 Digestion and absorption of proteins, carbohydrates and fats in the gastrointestinal tract.

Unit-III

3.1 Functional anatomy of kidney.

3.2 Mechanism of formation of urine.

3.3 Normal and abnormal constituents of urine.

3.4 Mechanism of concentration and dilution of urine – The Counter current system.

Unit-IV

4.1.1 Regulation of urine and body fluid concentration and volume, hormonal mechanism of Antidiuratic hormone, Aldosterone and Renin – Angiotensin system in renal physiology.

4.2 Regulation of water, electrolytes and acid base, renal clearance.

4.3 Physiology of nitrogen excretion

4.4 Renal failure.

Semester –III

Paper-XI, Special Group- Animal Physiology-II (CREDIT - 4)

Physiology of Circulation

Unit-I

1.1 Types of heart (Myogenic and Neurogenic).

1.2 Anatomy, histology and nerve innervation of the heart, heart valves.

1.3 Pace maker and specialized conducting fibers.

1.4 Blood pressure and factors affecting blood pressure.

Unit-II

2.1 Cardiac cycle, Electrocardiogram (ECG).

2.2 Cardiac output, heart sound.

2.3 Haemodynamics.

2.4 Cardiac Failure.

Unit-III

3.1 Cellular composition and functions of blood.

3.2 Blood groups and Blood transfusion.

3.3 Blood sugars – Causes and control of hypoglycemia and hyperglycemia

3.4 Blood lipids- Causes and control of hypolipidimia and hyperlipidimia

Unit-IV

4.1 Plasma proteins- Albumins, globulins.

4.2 Haemostasis, Cascade of biochemical reactions involved in coagulation of blood.

4.3 Transport of O_2& CO_2 by blood.

4.4 Lymph – composition, formation and functions.

Semester-III Practical-VI, Special Group- Animal Physiology

I. Physiology Experiments

1 Effect of pH, temperature and incubation on human salivary amylase activity.

2 Determination of:-

a) Clotting time, bleeding time.

b) Erythrocyte sedimentation rate and c) Haemoglobin concentration.

3 Determination of protein, glucose in Urine.

4 Study of structure of RBCs in vertebrates with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

5 Determination of protein, glucose in Urine from diabetic patient.

6 Total leukocyte count and differential leukocyte count.

7 Total erythrocyte count.

II. Quantitative Analysis

1 Estimation of blood Glucose (Source of blood: Local recognized pathology laboratory)

2 Estimation of blood proteins (Source of blood: Local recognized pathology laboratory)

3 Estimation of blood triglycerides (Source of blood: Local recognized pathology laboratory)

4 Estimation of blood cholesterol (Source of blood: Local recognized pathology laboratory)

5 Estimation of blood Sodium, potassium, Calcium (Source of blood: Local recognized pathology laboratory)

6 Estimation of blood alkaline & acid phosphates (Source of blood: Local recognized pathology laboratory).

7 Blood amino-acid separation by TLC / Paper chromatography (Source of blood: Local recognized pathology laboratory).

III. Qualitative Analysis

1 Normal & abnormal constituents of human urine.

2 Blood group detection by antisera.

3 Preparation and study of Urine crystals.

4 Estimation of serum urea (Source of blood: Local recognized pathology laboratory)

5 Preparation and study of haemin crystals.

IV. **Histological Study of** Stomach, Liver, Small intestine, Large intestine, Pancreas, Kidney,Thyroid, Pituitary, Blood smear, Heart, T.S. Vein, T.S. Artery with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

Distribution of Marks:		**Marks**
1.	Physiology Experiment	10
2.	Major quantitative analysis	20
3.	Minor quantitative analysis	10
4.	Qualitative analysis	10
5.	Identification and comment on spots(1-5)	10
6.	Practical Record	10
7.	Viva-voce	10
	Total marks	80

Semester-III

Paper-X, Special Group-Cell Biology -I **(CREDIT - 4)**

Unit-I

1.1 Light Microscopy: principles, working and applications of Phase contrast, Interference, Fluorescence and Confocal microscopy. Electron Microscopy- Principles, working, applications of Scanning & transmission electron microscopy.

1.2 Basic principles of sedimentation, types of centrifuges, Preparative centrifugation, analytical centrifugation and applications of ultracentrifugation in cell fractionation. Cell separation by flow cytometry.

1.3 Isolation and purification of DNA, RNA & proteins.

1.4 NMR, ESR & X-Ray crystallography.

Unit-II

2.1 Principle, working and application of UV/Visible absorption spectroscopy, UV/Visible fluroscence spectroscopy, Mass spectroscopy.

2.2 Principle, working and applications of paper and thin layer chromatography, affinity chromatography, gel filtration chromatography, ion-exchange chromatography and Gas-liquid chromatography.

2.3 Cell culture techniques- Monolayer and polylayer. Design and functioning of tissue culture laboratory.

2.4 Tissue engineering.

Unit-III

3.1 Physicochemical properties of Nucleic acids. Enzymology of recombinant DNA technology- DNA modifying enzymes, restriction endonucleases, DNA ligases.

3.2 Cloning vectors – Plasmid, Lambda & M13 virus based vectors, phagemids, cosmids, YAC and BAC vectors.

3.3 Gene probes – Designing and production of gene probes for recombinant DNA technology.

3.4 Gene library – Construction of C-DNA & genomic library.

Unit-IV

4.1 Gene transformation and transfection methods for recombinabt DNA. Genetic screening methods for gene constructs.

4.2 Applications of gene cloning – Sequencing cloned DNA, *invitro* mutagenesis, PCR based mutagenesis.

4.3 Applications of gene cloning – Expression of foreign genes, production of fusion proteins, phage display techniques.

4.4 Applications of gene cloning – Identifying and analyzing mRNA, analyzing gene *in situ*, analyzing promoter protein interactions, transgenics, detecting DNA polymorphism, DNA chip technology.

Semester –III

Paper-XI, Special Group-Cell Biology-II (CREDIT - 4)

Unit I

1.1 Chromosome structure and classification – Human karyotyping and criteria for ideogram preparation. Chromosome banding methods, it's applications in genetics.

1.2 Chromosomal mutations, molecular mechanism of mutation. Structural abnormalities of human chromosomes and related syndromes: Deletion, Robersonian translocation, Cri-du-chat syndrome, Prader-Willi syndrome.

1.3 Human metabolic disorders: Phenylketonuria, Lesch-Nyhan syndrome, Tay-Sachs disease, Alkaptonuria, Albinism, Glucose-6-phosphate dehydrogenase deficiency.

1.4 Molecular methods of chromosome studies and applications – *in situ* hybridization, FISH.

Unit-II

2.1 Genome organization – Physical and genetic mapping of genome. Organelle genome – organization and expression of mitochondrial and chloroplast genome.

2.2 Detailed account of genome models of lambda phage, *E. coli*.

2.3 Functional genomics – Human genome project.

2.4 Molecular cytogenetic techniques – DNA fingerprinting, automated karyotyping, chromosome painting, DNA sequencing, microarray.

Unit-III

3.1 Sex determination–Mechanism of sex determination in *Drosophila*human.and

3.2 Developmental genetics–Establishment of anterior-posterior polarity and role of maternal effect genes during development.

3.3 Cell specification and determination–Role of segmentation genes, gap genes, pair-rule genes and segment polarity genes during development. Homeobox concept in different phylogenic groups.

3.4 Cell differentiation and differential gene activity, totipotency and nuclear transfer experiment.

Unit-IV

4.1 Population genetics – Demes, gene pool, gene flow and genetic drift. Hardy-Weinberg equation and its significance in population genetics.

4.2 Genetic selection–Selection pressure, fitness and coefficient of selection, types and examples of genetic selection.

4.3 Speciation and isolating mechanisms.

4.4 Theories of organic evolution.

Semester-III, Practical-VI, Special Group- Cell Biology

1 Study of structure of prokaryotic cell using lactobacilli (curd)

2 Study of structure of eukaryotic cell and cell organelles: nucleus, mitochondria, golgi apparatus, smooth endoplasmic reticulum, rough endoplasmic reticulum, liposomes, microtubules, microfilaments, ribosomes, centrioles with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

3 Study of electrom micrographs of eukaryotic cell and cell organelles.

4 Study of different types of mammalian cells (tissues) with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

5 Isolation of DNA from any available material.

6 Demonstration of Mitochondria by vital staining using buccal epithelium.

7 Study of mitotic stages in onion root tips.

8 Estimation of Mitotic Index.

9 Study of meiotic stages from Tradescantia buds.

10 Study of polytene chromosome in Chironomous larva with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

11 Measurement of cell size using oculometer.

12 Study of human karyotype using photographs: normal male and female diseases conditions (classification of chromosomes according to size and position of centromere).

13 Identification and study of male and female drosophila, mutants in eye color and structure, body color, wings with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

14 Study of drosophila culture technique and life cycle of drosophila

15 Problems based on Hardy- Weinberg equation and its significance in population genetics.

16 Design and functioning of tissue culture lab

Distribution of Marks		**Marks**
1.	Isolation of DNA/ Demonstration of mitochondria	10
2.	Estimation of mitotic index/ Demonstration of meiotic stages	15
3.	Measurement of cell size by oculometer/ Problems based on Hardy-Weinberg equation	15
4.	Identification and comment on spots (1-10)	20
5.	Class record/ submissions	10
6.	Viva-voce	10
	Total marks	80

Semester –III

Paper-X, Special Group-Fresh water Zoology -I (CREDIT - 4)

Limnology

Unit-I

1.1 Dynamics of Aquatic Ecosystems (predators, consumers, decomposers, transformers, ecological pyramids & trophic levels), Energy flow models.

1.2 Lotic Habitat: Major river systems in India.

1.3 Lentic Habitat: Lakes and their origin

1.4 Bog lakes & succession of lakes, man-made lakes and reservoirs

Unit-II

2.1 Physical conditions of water: Movement of water, Viscosity, Density.

2.2 Buoyancy, Surface film and surface film animal.

2.3 Temperature and Light, Transparency and turbidity.

2.4 Influence of physical conditions on pH of surface and bottom water.

Unit-III

3.1 Chemical conditions of water: Dissolved oxygen & carbon dioxide

3.2 Phosphates, Nitrates & Silicates.

3.3 Hardness: Total Hardness, Mg - hardness & Ca – Hardness.

3.4 Nitrogen and Ammonia, Importance of Chemical Parameters.

Unit-IV

4.1 Primary and secondary productivity in aquatic ecosystems.

4.2 Classification of waterbodies based on productivity.

4.3 Methods of measurement of productivity.

4.4 Factors affecting primary productivity and significance of productivity studies

Semester-III

Paper-XI, Special Group-Fresh water Zoology-II (CREDIT - 4)

Fishery Biology

Unit-I

1.1 Schemes of classification of fishes by Berg (1940) and Romer (1971).

1.2 Biology of Indian major carps and culturable exotic carps.

1.3 Food and feeding habits of some common fresh water fishes.

1.4 Methods of gut content (food) analysis.

Unit-II

2.1 Structure and function of gills.

2.2 Electroreceptors in fishes and their functions.

2.3 Growth and age studies on fish

2.4 Length- weight relationship and condition factor.

Unit-III

3.1 Maturation, spawning periodicity and fecundity of fish.

3.2 Maturity stages of male & female fish, and atretic follicles.

3.3 Genetic engineering methods for fish stock improvement.

3.4 Fish diseases caused by pathogens and parasites.

Unit-IV

4.1 Aquarium-fish keeping and its maintenance.

4.2 Breeding of ornamental fishes - egg depositors and live bearers.

4.3 Exotic and larvivorous fishes and their importance

4.4 Threatened fresh water fishes and conservation measures.

Semester –III Practical-VI, Special Group- Fresh water Zoology
(CREDIT - 4) Section: A

1 Measurement of transparency of water body by Secchi disk method.

2 Analysis of pH & Turbidity of water.

3 Estimation of Dissolved Oxygen (DO) & free carbon dioxide from water.

4 Estimation of Alkalinity (Carbonates & Bicarbonates), Hardness (Total, Ca & Mg)

5 Estimation of Chlorides, Phosphates & Nitrates from water.

6 Biochemical oxygen demand (BOD) from given water sample.

7 Determination of primary productivity of a water body by light and dark bottle method.

Section: B

1 Identification of commercially important freshwater fishes and prawns using fishes available in local recognized fish markets or with the help of already available specimens/ ICT tools/ models/ charts/ photographs etc.

2 Morphometric study of fish available in local recognized fish markets or with the help of already available specimens/ ICT tools/ models/ charts/ photographs etc.

3 Study of spawning periodicity by provided data.

4 Determination of length - weight relationship of fish available in local recognized fish markets or with the help of already available specimens/ ICT tools/ models/ charts/ photographs etc.

5 Determination of condition factor by using given data.

6 Study of maturity stages of fish by using pictures.

7 Histological study of fish organs with the help of already available permanent slides/ ICT tools/ charts/ Models / Photographs etc.

8 Identification of common parasites of fish with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.

9 Permanent mounting of fish scales using wastes from local recognized fish markets.

10 Visit to a fresh water body for the study of aquatic ecosystem.

Distribution of marks		**Marks**
1.	Water analysis: Major expt.	15
2.	Water analysis: Minor expt.	10
3.	Determination of spawning periodicity / Length - weight relationship by provided data.	10
4.	Explanation of morphometry of fish / Determination of Condition factor by given data.	05
5.	Identification of spots (1 to10) by pictures	20
6.	Study of maturity stages of fish with the help of photos/ Study of Fish scales by using pictures.	05
7.	Practical record & submission photographs of fishes.	10
8.	Viva – voce	05
		……
		80
Internal Assessment		20

	Total marks	100

Semester-III

Paper-X, Special Group-Aquaculture-I (CREDIT - 4)

Fresh water Aquaculture

Unit-I

1.1 Aquaculture: Definition, importance and present status in India.

1.2 Physicochemical conditions of pond water.

1.3 Biological conditions – Aquatic vegetation, Association of macro vegetation.

1.4 Plankton: Seasonal distribution, Diurnal movement and its role in fisheries.

Unit-II

2.1 Pond soil, Chemical conditions.

2.2 Pond ecosystem: Trophic level, food chain and food web in pond.

2.3 Methods of productivity measurement.

2.4 Planning and construction of fresh water fish farm.

Unit-III

3.1 Biology of culturable indigenous carps.

3.2 Biology of culturable exotic carps.

3.3 Reproductive system and breeding behavior in Indian carps.

3.4 Fisheries of major river systems in India.

Unit-IV

4.1 Reverine collection of fish seed.

4.2 Fish breeding in wet and dry bundhs.

4.3 Induced breeding by hypophysation.

4.4 Hatching techniques and types of hatcheries.

Semester –III

Paper-XI, Special Group-Aquaculture-II (CREDIT - 4)

Aquaculture and Rural Development

Unit-I

1.1 Culture of zooplankton

1.2 Prawn culture & Methods of breeding

1.3 Culture of crabs

1.4 Pearl culture / Oyster culture

Unit-II

2.1 Development and advancement of aquaculture in India.

2.2 Larvivorous fishes in relation to public health.

2.3 Culture of Exotic and transplanted fishes

2.4 Breeding and care of fresh water aquarium fishes.

Unit-III

3.1 Definition of economics and application of economic principles to aquaculture.

3.2 Aquaculture and rural development in India.

3.3 Role of FFDA in development of aquaculture in India.

3.4 Fishery extension techniques.

Unit-IV

4.1 Socio-economic status of fishermen community.

4.2 Fisheries co-operatives and their role in fish production and marketing.

4.3 Organization and operational problems in fisheries co-operative societies.

4.4 Fishery legislation and their role in fishery development.

Semester-III, Practical-VI, Special Group- Aquaculture

1 Physicochemical analysis of pond water for determination of pH, Turbidity, DO, Free CO2, Ammonia, Alkalinity, Hardness, Nitrates and Phosphates.

2 Physicochemical analysis of pond soil to determine its texture, pH, particle size, available nitrogen, phosphorus and free CaCO3.

3 Qualitative and quantitative study of plankton and benthos.

4 Study of food chain in fresh water pond ecosystem

5 Estimation of primary productivity by light and dark bottle method.

6 Identification of local fish fauna using fishes available in the local recognized fish markets or with the help of ICT tools/ Charts/ Models / Photographs etc.

7 Identification and classification of Indian and exotic carps using fishes available in the local recognized fish markets/ ICT tools/ charts/ models/ photographs etc.

8 Estimation of fecundity.

9 Anatomical observations, demonstration and detailed explanation of pituitary gland of carp/ Catfish with the help of ICT tools/ models/ charts/ photographs etc.

10 Visit to a fish seed hatchery.

Distribution of marks		**Marks**
1.	Analysis of pond water	10
2.	Analysis of pond soil	10
3.	Quantitative analysis of plankton / detection of primary productivity.	10
4.	Estimation of Fecundity	05
5.	Identification of spots (1 to10)	20
6.	Anatomical observations / mounting	05
7.	Practical record & submission	10
8.	Viva – voce	10
	Total marks	80

Semester –III

Paper-X, Special Group-Environmental Biology-I (CREDIT - 4)

Ecosystems and Communities

Unit-I

1.1 Ecosystem: Structure and functions of marine and freshwater ecosystems, grassland, desert and forest ecosystems, abiotic and biotic components of ecosystems.

1.2 Energy flow: Y shaped and universal model.

1.3 Food chain, food web, ecological pyramid-types and diversity.

1.4 Planktons: nature, distribution, seasonal succession, beneficial and harmful effects, qualitative and quantitative estimation

Unit-II

2.1 Nekton, Benthos: nature, distribution and analysis, Periphyton- definition, collection, preservation and importance.

2.2 Eutrophication: Definition, types, effects and control measures.

2.3 Biogeochemical Cycles in Nature- Gaseous Cycles: Water, Carbon and Oxygen cycle.

2.4 Sedimentary Cycles in nature- Nitrogen, sulphur and Phosphorus cycles.

Unit-III

3.1 Productivity: concept, Primary and secondary productivity, measurement of productivity by light and dark bottle method, factors affecting primary and secondary productivity.

3.2 Biotic community: definition, concept and characteristics of community, community structure, stratification and periodicity, ecotone and edge effect.

3.3 Ecological niche, ecotype, ecophene and ecological indicators.

3.4 Ecological succession: definition, types and process of ecological succession, significance.

Unit –IV

4.1 Biosphere: Major biomes of the world with emphasis on Indian biomes.

4.2 Biometeorology: scope and factors

4.3 Water and soil as essential factors for the meteorological studies.

4.4 Radiant energy, temperature and light.

Semester –III

Paper-XI, Special Group- Environmental Biology-II (CREDIT - 4)

Adaptations, Population dynamics, and Animal Behaviour

Unit-I

1.1 Adaptations of animals with reference to physical conditions: temperature and light.

1.2 Chemical conditions: oxygen, carbon dioxide.

1.3 Physiological process: osmoregulation and thermoregulation.

1.4 Physiological process: Bioluminescence and Echolocation.

Unit-II

2.1 Influence of physical environment on organism: viscosity, surface tension, salinity, pressure, buoyancy and surface film animals.

2.2 Biological Rhythms: photoperiodism, biological clock, annual and lunar periodicity.

2.3 Mimicry and protective colouration: definition of mimicry, kinds of mimicry.

2.4 Batesion and mullerian mimicry and significance.

Unit-III

3.1 Population dynamics: population structure, pattern of population distribution, population growth and density relationship, population fluctuations and dispersal of population.

3.2 Dispersal: Barriers of dispersal, means of dispersal, migration.

3.3 Intersepecific relationship: mutualism, commensalism, parasitism, synergism, antagonism and competition.

3.4 Prey and Predator relationship

Unit-IV

4.1 Intraspecific relationship: aggregations and social organization.

4.2 Animal behavior: innate or inherent behavior, learned behavior, visin and behavior, sound and behavior.

4.3 Social behaviour: mating, family, and group behavior, advantages of social behavior

4.4 Genetic, hormonal and evolutionary aspects of behavior.

Semester –III, Practical-VI, Special Group-Environmental Biology

1 Sampling of water determination of pH, temperature and turbidity.

2 Plankton study and analysis of zooplankton.

3 Identification of crustaceans, insects, snails from fresh water/ lake/ pond with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.

4 Identification of common aquatic weeds, predatory fishes and harmful insects from the pond with the help of already available specimens, permanent slides/ ICT tools/ charts/ models / photographs etc.

5 Study of indication of pollution - estimation of BOD and COD.

6 Determination of primary productivity by light and dark bottle method.

7 Estimation of dissolved oxygen in water sample by wrinkler's method.

8 Estimation of carbon dioxide from given water sample.

9 Determination of relative humidity by hygrometer / psychrometer.

10 Determination of wind velocity by anemometer.

11 Physico-chemical analysis of water for determination of alkalinity, hardness, nitrites and phosphates.

12 Estimation of Sodium and potassium by flame photometry.

13 Identification of benthic and periphytonic organisms.

Distribution of Marks		**Marks**
1.	Major experiment	20
2.	Minor experiment	10
3.	Minor experiment	10
4.	Identification and comment on given spots (1-10)	20
5.	Class record	10
6.	Viva voce	10

	Total marks	80

Semester –III

Paper-X, Special Group-Sericulture-I (CREDIT - 4)

Moriculture

Unit-I

1.1 Sericulture: Definition, history, present status of sericulture industry in India, economic importance.

1.2 Silkworms: Systematic position, types of silkworm, their host plants and geographic distribution.

1.3 Problems and prospects of sericulture in India

1.4 Sericulture Extension: Principles and importance of extension education in sericulture, methods of sericulture extension.

Unit-II

2.1 Economics of Sericulture: Economics of mulberry cultivation, cocoon production, silkworm rearing, silk reeling and processing.

2.2 Sericulture Organizations: Central Silk Board, Directorate of Sericulture at state level, role of sericulture organization in extension of sericulture.

2.3 Marketing and Management of Sericulture: Marketing of cocoons and raw silk yarn, traditional and regulated markets.

2.4 Silk exports - challenges and growth.

Unit-III

3.1 Mulberry Plant: Taxonomy and morphology of mulberry plant, anatomy of leaf, root, stem and flowers, mulberry varieties.

3.2 Mulberry Cultivation: Selection and preparation of land, climate and soil conditions for mulberry cultivation, propagation of mulberry, manuring and irrigation, intercultivation and prunning.

3.3 Pests of Mulberry: Identification, classification, life cycle, nature of damage and control measures of pests of mulberry - bihar hairy catterpillar, jassids, mealy bugs, thrips, stem borers, gall midge.

3.4 Diseases of Mulberry: Factors, symptoms, disease cycle and control measures of diseases of mulberry - leaf spot, powdery mildew, red rust, root knot, common mulberry dwarf.

Unit-IV

4.1 Physiology: Mineral nutrition, photosynthesis, respiration, growth regulators, photoperiodism and transcription.

4.2 Genetics of Mulberry: Spontaneous and induced mutation, molecular basis of DNA damage and repair, biological diversity in mulberry. Germplasm conservation - methods, centres of collection and significance.

4.3 Cytogenetics of mulberry, genetic control of disease resistance in mulberry.

4.4 Breeding of Mulberry: Breeding of mulberry for drought resistance, application of tissue culture in mulberry breeding, hybridization and selection of mulberry for genetic improvement. Pure line clonal and mass selection - application, advantages and limitations. Evaluation of mulberry genotype - Primary, secondary and multilocational traits.

Semester –III

Paper-XI, Special Group- Sericulture-II (CREDIT - 4)

Mulberry and non mulberry silkworms

Unit-I

1.1 Mulberry Silkworm: Classification, geographical distribution and life cycle of *B.mori*

1.2 Moultinism and Voltinism: Univoltine, bivoltine and multivoltine races.

1.3 Morphology: Morphology of egg, larva, pupa, adult, mouth parts of larva, sexual dimorphism.

1.4 Anatomy: Silk gland, digestive, circulatory, respiratory, excretory, male and female reproductive system, neuroendocrine system and sense organs.

Unit-II

2.1 Physiology: Physiology of digestion, excretion, respiration; mechanism of circulation, silk synthesis and diapause.

2.2 Neuroendocrine system - neurosecretary cells, corpora allata, corpora cardiaca, ecydycial gland. Hormonal control of moulting and metamorphosis. Exocrine glands and pheromones.

2.3 Pests of Silkworm, *B. mori*: Identification, classification, life cycle and control measures of invertebrate pests (Uzi fly, dermestid beetle, ant, praying mantis, mites) and vertebrate pests (Lizzard, bird, squirrel, rat) of silkworm.

2.4 Diseases of Silkworm, *B. mori*: Etiology, structure, symptoms, pathogenesis and diagnosis of diseases - pebrine, grasserie, flacherie and muscardine.

Unit-III

3.1 Tasar Silkworm: Distribution, life cycle and food plants.

3.2 Anatomy of Tasar Silkworm: Silk gland, digestive, respiratory and reproductive system.

3.3 Rearing of tasar silkworm and reeling of cocoons.

3.4 Pests and diseases of tasar silkworm.

Unit-IV

4.1 Distribution, life cycle and food plants of muga silkworm.

4.2 Rearing of muga silkworm and reeling of cocoon.

4.3 Distribution, life cycle and food plants of eri silkworm.

4.4 Rearing of eri silkworm and reeling of cocoon.

Semester –III, Practical-VI, Special Group-Sericulture

1 Study of external morphology of the egg, larva, pupa and adult of different silkworm types, sexual dimorphism in larva, pupa and adults with the help of already available specimens, permanent slides/ ICT tools/ charts/ models / photographs etc.

2 Study of life history of different silkworm types with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.

3 Anatomical observations, demonstration and detailed explanation of the digestive system, silk gland, nervous system, circulatory system and mouth parts of larva; Reproductive system of larva and adults with the help of ICT tools/ models/ charts/ photographs etc.

4 Identification of the locally available varieties of mulberry.

5 Study of the locally available non-mulberry host plants.

6 Study of the anatomy of leaf, stem, root and petiole of different locally available varieties of mulberry.

7 Propagation of mulberry through cutting, grafting and layering.

8 Analysis of organic, inorganic contents and pH of the soil.

9 Identification and Study of economic importance of the local pests of mulberry silkworm with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.

10 Identification and Study of economic importance of the locally found pests and diseases of mulberry with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.

11 Identification of diseases of mulberry silkworm with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.

Distribution of marks		**Marks**
1.	Anatomical observations	10
2.	Identification and Comment on the spots (1-5)	10
3.	Temporary slide preparation (Mouth parts/plant structure	10
4.	Characteristics of mulberry leaves of different verities and their stomatal frequency.	10
5.	Analysis of soil (test report)	10
6.	Submission of Tour diary and herbarium	10
7.	Practical record	10
8.	Viva voce	10

Total marks 80

Semester –III

Paper-XII, Foundation I, Elementary Zoology

Unit I- Wonders of animal world

1.1 Introduction to animal classification upto classes

1.2 Bioluminescence in animals (Insects and Fish): Mechanism and its significance

1.3 Coral formation and types of coral reefs

1.4 Parental care in pisces, amphibia and mammals

Unit II- Biodiversity and its conservation

2.1 Introduction to biodiversity: Definition, scope and significance

2.2 Biodiversity hotspots in India, Western ghats

2.3 Threats to biodiversity, List of threatened animals

2.4 National parks and Sanctuaries of India: wildlife conservation and management

Unit III- Animal Biotechnology

3.1 Introduction to animal cell

3.2 Transgenic and cloned animals

3.3 DNA Fingerprinting: Technique and its application in forensic science (Crime Investigation)

3.4 Immunization, Immunodeficiency syndrome (AIDS)

Unit IV- General aspects

4.1 Evolution of man

4.2 Poisonous and non poisonous snakes, Snake venom and its importance

4.3 Vermiculture and its importance

4.4 Bird migration: Definition, types and factors inducing bird migration

Semester –III

Paper-XII, Foundation I, Basic Entomology

UNIT- I

1.1 Introduction to Insects- Its systematic position; Classification FromAnamalia to Insecta.

1.2 General anatomical description of Insect body: head, thorax and abdomen.

1.3 Insect eyes and antennae. Basic structure and function.

1.4 Insect metamorphosis- Complete and incomplete metamorphosis.

UNIT- II

2.1 Insect sound production

2.2 Insect light production

2.3 Reproduction behaviour of butterflies- Copulation and egg laying

2.4 Reproduction behaviour of dragonflies- Copulation and egg laying.

UNIT- III

3.1 Chemical communication in insects- Pheromones

3.2 Honey Bee Dance

3.3 Insect pollinators- Honey bee and butterflies

3.4 Predatory and edible insects.

UNIT- IV

4.1 Introduction of five species of Order- Lepidoptera (Butterflies) of central India.

4.2 Introduction of five species of Order- Odonata (Dragonflies) of central India.

4.3 Introduction of five species of Order- Coleoptera (Beetles) of central India.

4.4 Introduction of five species of Order- Hymenoptera (Bees, Wasps and Ants) of central India.

Semester –III

Paper-XII, Foundation I, Fresh Water Fisheries

Unit – I

1.1 Brief outline of reverine fisheries.

1.2 Lacustrine and reservoir fisheries.

1.3 Physico-chemical characteristics of fresh water.

1.4 Construction and layout of ideal fish farm.

Unit – II

2.1 History of fish culture in India.

2.2 Brief outline of commercially important species of fresh water fishes and prawns. Indian & exotic carps, Cat fishes, Snake headed fishes and *Macrobrachium* spp.

2.3 Present status, scope and importance of fisheries.

2.4 Fishery products and by-products.

Unit – III

3.1 Induced breeding.

3.2 Bundh breeding (Dry & Wet bundh).

3.3 Fish seed production by Chinese circular hatchery.

3.4 Transportation of brood fish and fish seed.

Unit - IV

4.1 Food & Feeding habits of commercially important fishes.

4.2 Nutritional requirements of fish.

4.3 Artificial feeds and their composition.

4.4 Crafts and gears used in fresh water fish capture.

Semester –III

Paper-XII, Foundation I, Human Physiology

Unit- I: Digestion

1.1 Digestive tract, digestive glands, its secretion and role in digestion

1.2 Gastrointestinal hormones

1.3 Digestive disorders- Diarrhea. constipation and peptic ulcer

1.4 Antioxidant nutrients, free radicals and physiology of ageing

Unit- II: Respiration

2.1 Respiratory system

2.2 Respiratory pigment- Haemoglobin

2.3 Transport of respiratory gases (O2 and CO2)

2.4 Respiratory disorders- Asthma and Bronchitis

Uint- III: Excretion

3.1 Human kidney (Structure)

3.2 Mechanism of urine formation

3.3 Adrenal gland and water electrolyte balance

3.4 Renal function test; Dialysis

Unit- IV: Endocrine glands

4.1 Pituitary gland and its hormones

4.2 Thyroid gland and its hormones

4.3 Adrenal gland and its hormones

4.4 Endocrine pancreas

Semester-IV

Paper-XIII, Biotechniques, Biostatistics, Ethology, Toxicology and Bioinformatics

Unit- I

1.1 Sterilization techniques, media for microbial culture, inoculation methods

1.2 Animal cell & tissue culture- primary culture, cell lines, cell quantification, growth kinetics of cells in culture, cryopreservation of cells

1.3 Basic principle of sedimentation and centrifugation; Radioactive isotopes.

1.4 Chromatographic separation- Thin layer and gas chromatography; Electrophoretic separation techniques

Unit- II

2.1 Central tendency and dispersion- mean, mode and median with examples; Dispersion and variance.

2.2 Probability and probability distribution -Basic theory and type of probability and probability distribution with example (binomial, poison and normal distribution).

2.3 Sampling – types, standard error (SE), standard deviation (SD), significance tests - t- test, z- test, Chi square test- assumption, importance and example

2.4 Neuronal control, genetic and environmental components in development of animal behavior; Animal ethics- Introduction, concept, organizations and their functions

Unit- III

3.1 Introduction and scope of toxicology

3.2 Environmental toxicology- Classification of environmental toxicants; Pesticides, Fertilizers, Heavy and trace metals, radioactive substances, food additives, automobile emission.

3.3 Translocation of toxicants- absorption, distribution, biotransformation and excretion of toxicants

3.4 Toxicity tests- Types (Acute and Chronic), calculation of LC50 and LD 50; Antidotal thereapy- Antidotes, type of antidotes and antidotal procedure.

Unit- IV

4.1 Introduction and scope of bioinformatics - history, scope of bioinformatics in research, business and employment opportunities; Bioinformatics in India.

4.2 Sequence alignment- Pair wise sequence alignment and multiple sequence alignment.

4.3 Biological databases– Basic local alignment search tool (BLAST), and FASTA, Variants of BLAST, PSI-BLAST.

4.4 Phylogenetic analysis- Tree style, tree building methods

- **Suggested Readings**

Tissue culture and Biotechniques

1. Animal cell culture – A practical approach, (III Edition) Ed. John R. W. Masters. IRL Press.
2. *In vtro*-cultivation of animal cell, biotechnology by open learning (BIOTOL),Butterworth Heinemann Ltd. Linaere house, Jordan Hill Oxford.
3. Introduction to instrumental analysis, Robert Broun, McGraw Hill International Edition.
4. A Biologist Guide to Principle and Techniques of Practical Biochemistry K. Wilson and K.H. Goulding ELBS Edition.
5. Molecular Cell Biology, J. Darnel, H. Lodish and D. Baltimore. W. H. Freeman and Company New York.
6. DNA Techniques by Alcamo.
7. Insect Cell Culturing Engineering, Ed. M. F. A. Goosen, A.J. Daugulis and P.Faulkner.
8. Biotechnlogy - B. D. Sings.
9. Biophysical Chemistry – Upadhyay, Upadhyay and Nath.

Toxicology

1. Animal Clinical Chemistry: A Primer for Toxicologists. G.O. Evans (Ed.) ISBN: 0748403515, Taylor & Francis, 1996.

2. Animal Models in Toxicology. S.C. Gad & C.P. Chengelis (Eds.), ISBN: 0824784561, Marcel Deker, 1992.
3. Annual Reviews of Pharmacology & Toxicology, ISBN: 0824304373, 1997
4. Basic Toxicology: Fundamentals, Target Organ & Risk Assessment. F.C. Lu, ISBN: 1560323809, Taylor & Francis, 1996.
5. Casarett&Doull's Toxicology: The Basic Science of Poisons. C.D. Klaassen (Ed), ISBN: 0071054766, McGraw-Hill, 1996.
6. Comprehensive Toxicology. I. Sipes, C.A. McQueen & A. Gandolfi (Eds.), ISBN: 0080423019, Elsevier Science, 1997.
7. General & Applied Toxicology. B. Ballantyne, T. Mars & P. Turner (Eds), Vol I & II, ISBN: 0333498011, Macmillon/Stockton Press, 1993.
8. Loomi's Essentials of Toxicology, T.A. Loomis & A.W. Hayes, ISBN: 0124556256, Academic Pess, 1996.
9. Encyclopaedia of Toxicology, Chemical and Concepts, P. Wexler, ISBN: 012227220-X, Academic Press, 1998.
10. Dictionary of Toxicology. E. Hogson, J.E. Chambers & R.B. Mailman, ISBN: 1561592161, Groves ic, 1997.

Biostatistics

1. Biostatistics-Arora and Malhan
2. Biostatistics- Jasraj and Gurudeep Raj
3. Biostatistics- P. Ramkrishan
4. Methods in Biostatistics-Mahajan

Bioinformatics

1. Mount W. 2004. Bioinformatics and sequence genome analysis 2nd Editon CBS Pub. New Delhi.
2. Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of Springer Science+BusinessMedia, 2007.
3. Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
4. Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings.
5. Des Higgins and Willie Taylor 2000. Bioinformatics: Sequence, structure and databanks. Oxford University Press.
6. Rashidi H. H. and Buehler 2002. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
7. Gibas Cynthia and Jambeck P. 2001. Developing Bioinformatics Computer Skills: Shroff Publishersand Distributors Pvt. Ltd. (O'Reilly), Mumbai.

Semester-IV

Paper-XIV, Special Group-Entomology-III

Sense organs, social life and Agriculture pests

Unit-I

1.1 Compound eyes- structure and functions.

1.2 Ocelli- structure and functions.

1.3 Sound producing organs: Structure and physiology.

1.4 Light producing organs: Structure and bioluminescent mechanism.

Unit-II

2.1 Mechanoreceptors: Senseroy hairs, campaniformsensilla and chordotonal organs.

2.2 Tympanal organs, Johanson's organ, Chemoreceptors- sensillatrichoidea, sensillabasiconica.

2.3 Pigments and mechanism of colour change, mimicry and camouflage.

2.4 Immunity in insect: Innate immunity and molecular mechanism.

Unit-III

3.1 Social life: Polymorphism, nest building and social behavior in Isoptera.

3.2 Social life: Polymorphism, nest building and social behavior in ants.

3.3 Parasitic Hymenoptera-types and significance.

3.4 Locust migration and swarming.

Unit-IV

4.1 Pest of major crops: Rice, Cotton and Sugarcane-classification, life history, damage and control.

4.2 Pest of fruits: Citrus and Mango-classification, life history, damage and control.

4.3 Pest of vegetables: Cabbage and Brinjal- classification, life history, damage and control.

4.4 Stored grain pests: classification, life history, damage and control measures.

Semester-IV

Paper-XV, Special Group-Entomology-IV

Pest control measures and Insects vectors

Unit-I

1.1 Inorganic insecticides: Properties, mode of action and use.

1.2 Chlorinated Hydrocarbons: Properties, mode of action and use.

1.3 Organophosphates: Properties, mode of action and use.

1.4. Natural organic compound and pyrethroids: Properties, mode of action and use.

Unit-II

2.1 Biological control: Historical and theoretical basis of biological control.

2.2 Desirable attributes of natural enemies of pests.

2.3 Parasitoids used in biological control programmes: life cycle and biological relationship.

2.4 Predators used in biological control programmes: life cycle and biological relationship.

Unit-III

3.1 Insect pathogenic bacteria used in biological control programmes, biological relationship, mass production and examples.

3.2 Insect pathogenic viruses used in biological control programmes, biological relationship, mass production and examples

3.3 Use of radiation, chemosterilants, hormones and pheromones in pest control programmes.

3.4 Integrated pest managements: principles, modeling, application and examples.

Unit-IV

4.1 Pest of horse and cattle: Nature of damage, life cycle and control measures.

4.2 Mosquitoes causing disease in man: life cycle, mode of transmission of pathogen and control measures.

4.3 Flies causing disease in man: life cycle, mode of transmission of pathogen and control measures.

4.4 Lice and fleas causing disease in man: life cycle, mode of transmission of pathogen and control measures.

Semester-IV, Practical-VII, Special Group-Entomology

1 Anatomical observations, demonstration and detailed explanation of the silkgland in mulberry and non mulberry silkworms with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

2 Anatomical observations, demonstration and detailed explanation of the male and female reproductive system in silk moths with the help of ICT tools/ models/ charts/ photographs etc.

3 Anatomical observations, demonstration and detailed explanation of the salivary, pharyngeal glands and sting apparatus in honey bees with the help of ICT tools/ models/ charts/ photographs etc.

4 Demonstration of disease causing pathogens in insects.

5 Histopathological Study of baculovirus and protozoan infected tissues with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

6 Collection of insect photographs, identification and classification of harmful insects, parasitic hymenopteran and other beneficial insects.

7 Listing of insects of different orders of central India.

8 Study of various systems of insects and their functional significance with the help of ICT tools/ charts/ models/ photographs etc.

9 Preparation of photographic life history of economical important insects.

10 Preparation of insect biodiversity register of a specific area by photographic collection/ observation.

11 Visit to Apiculture, Sericulture, Lac culture centers and entomology research laboratory/center.

Distribution of Marks:		**Marks**
1.	Anatomical observations	10
2.	Identification, classification and economic importance of spots (1 to 10)	20
3.	Demonstration of microbial pathogen in insect	10
4.	Whole mount preparation	10
5.	Class record and submission of slides	10
6.	Submission of life history	10
7.	Viva-voce	10
	Total marks	80

- **Project work** 100
  (80 marks project evaluation including viva + 20 marks Internal assessment)

- **Suggested Readings**

Entomology

1. Imms General text book of Entomology, Eds. O. W. Richards and R. G. Davis Chapman and Hall, London.
2. General and Applied Entomology, K.K. Nayar, T. N. Ananthkrishan and B.V. Davis Tata McGraw -Hill Co.Ltd. Bombay.
3. The Insect: Structure and function, R.F. Chapman, Cambridge University Press.
4. The Physiology of Insect , Ed. M.Rockstein ,Vol, 1-5, Academic Press, New York.
5. The Physiology of Insect Reproduction, F, Englemann, Pergamon Press, New York.
6. Comprehensive Insect Physiology , Biochemistry and Pharmocology , Eds. G.A. Kerkut and I. A. Gillberd, VOL. 1-13, Pergamon Press, New York.
7. Analytical Biochemistry of Insect, Ed. R. B. Turner, Elsevier, Amsterdam.
8. Insect Hormone, M. J. A. Novak. Chapman and Hall, London.
9. Modern Entomology(Second edition): D. B. Tembhare, Himalaya Publication House, Bombay.
10. Destruction and Useful Insect, Their Hanits and Control, C. L. Metcalf, W. P. Flint and R. I. Metcalf, Mc Grow I Ill Co. New York.
11. Integrated Pest Management, J.L. Apple and R. E. Smith, Plenum Publication Co., New Delhi.
12. An Introduction Of Biological Control RVD Boarscho, P. S. Y. Messenger and A. P. Gaiter, Plenum Publication Co.
13. Text Book of Entomology, K. P. Shivastava, Vol. 1 And 2 Kalyani Publication, Ludhiana.
14. Agriculture Entomology, H. S. Dennis, Timber Press Inc.
15. Entomology and Pest Management, Larry P. Pedigo, Prentice Hall.
16. Text Book of Agriculture Entomology, Alford V. David, Blackwell Science.
17. Biopesticides In Insect Pest Management, S. J. Ignacimulha and AlokSen , Phoenix Publishing House Pvt, Ltd.

18. Biotechnology in Invertebrate Pathology and Cell culture (Maramorosch, K. ed.). Academic Press, New York.
19. PEBFANS (2003)" (Solomon Raju, A. J. ed.). Andhara University Press, Visakhapatnam.
20. Living Resources for the Millennium 2000 (S. J. William ed.), Students Offset Press, Chennai.

Semester –IV

Paper-XIV, Special Group-Fish and Fisheries-III

General studies

Unit-I

1.1 Structure of alimentary canal in teleosts; feeding habits, histology of different parts

1.2 Modification of alimentary canal in relation to feeding habits, digestion and absorption of food.

1.3 Structure of kidney in teleosts: Head kidney and trunk kidney, histology, blood supply

1.4 Osmoregulation in Freshwater forms, Marine forms, Rays and Skates, Diadromous fishes.

Unit-II

2.1 Chaemoreceptors: Structure of olfactory system, morphology of peripheral olfactory organ, cellular composition of olfactory epithelium, olfactory bulb and central projections

2.2 Structure and functions of taste buds.

2.3 Migration in fishes: Types- Anadromous, Catadromous, Amphidromous, factors responsible for migration (Intrinsic and environmental), periodicity of migration.

2.4 Role of hormones in migration, Orientation and Navigation during migration.

Unit-III

3.1 Structure of male reproductive system

3.2 Mechanism of spermatogenesis and its hormonal control

3.3 Structure of female reproductive system

3.4 Oogenesis, egg development, hormonal control of oogenesis

Unit-IV

4.1 Structure, hormones and functions of pituitary gland in fishes

4.2 Structure, hormones and functions of other endocrine glands.

4.3 Stucture of Hypothalamo-hypophysial system in fishes.

4.4 Neurohormones and their functions.

Semester –IV

Paper XV, Special Group-Fish and Fisheries -IV

Fishery technology and Fish pathology

Unit-I

1.1 Pond management (sitting construction and problems)

1.2 Gear and crafts in inland water

1.3 Conservation of fish, Fish legislation and their importance.

1.4 Water pollution and inland fisheries

Unit-II

2.1 Plankton in relation to fish production,

2.2 Culture of phytoplankton and zooplankton (Daphnia, Artemia, Monia)

2.3 Manufacture and maintenance of Aquarium

2.4 Hybridization and transgenic fish

Unit-III

3.1 Fish marketing: Marketing practices, information, marketing channels and systems

3.2 Domestic and export marketing.

3.3 Sex control and sex reversal under condition and chromosome set manipulation in fish

3.4 Gamete preservation: cryopreservation and its application.

Unit-IV

4.1 Methods of curing and preservation of fish.
i. Refrigeration and freezing, ii. Drying, iii. Salting, iv. Smoking, v. Canning

4.2 Fish products and by-products: i. Fish body oil, ii. Fish liver oil, iii. Fish meal, iv. Isinglass, v. Fish protein concentrate, vi. Fish glue, vii. Fish manure

4.3 Fish pathology: i) Signs of sickness and effects on fish, ii) Pathological procedure for diagnosis of fish diseases

4.4 Fish diseases and its control: Biotic (fungal, bacterial and viral etc.) and Abiotic.
a) Viral diseases, b) Bacterial diseases, c) Fungal diseases, d) Protozoan diseases

Semester- IV, Practical-VII, Special Group-Fish and Fisheries

1 Elementary work on surgical ablation with reference to gonads with the help of ICT tools/ charts/ models / photographs etc.

2 Study of normal differential count in fish blood (Source of fish blood**:** Local recognized fish markets).

3 Effect of stress (cold) on differential count in fish blood (Source of fish blood**:** Local recognized fish markets).

4 Effect of stress (hot) on differential count in fish blood (Source of fish blood**:** Local recognized fish markets).

5 Estimation of protein in blood serum of fish (Source of fish blood**:** Local recognized fish markets).

6 Separation of proteins based on molecular weight by SDS-PAGE.

7 Study of permanent histological slides of various fish organs & endocrine glands with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

8 Study of skeletal system of *Wallago*&*Labeo* with the help of already available skeleton/ ICT tools/ charts/ models / photographs etc.

9 Study of weberrianossicles in *Heteropneustesfossilis, Clariasbatrachus*& *Wallago* with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

10 Study of accessory respiratory organs in some air breathing fishes with the help of already preserved material/ ICT tools/ charts/ models/ photographs etc.

11 Assessment of maturity of gonads using already available preserved specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.

Distribution of Marks:		**Marks**
1.	Surgical ablation of gonads	20
2.	Anatomical observations (Minor)	10
3.	Physiology Experiment	20
4.	Spotting	10
5.	Viva voce	10
6.	Practical Record	10

	Total marks	80

- **Project work** 100
  (80 marks project evaluation including viva + 20 marks Internal assessment)

- **Suggested Readings:**

1. Fish Physiology Vol. 1 to 13: Hoar H.S. & Randall (Eds.) (1964-1994) Academic press London, New York.
2. The physiology of fishes Vol. 1&2: Brown M.E.(1957) Academic press, New York.
3. Natural history of fishes & systematic of fresh water fishes:PDattaMunshi, J.S. &Shrivastva, M.P.(1988): Narendra pub. House, Delhi.
4. Air breathing fishes of India- Their structure, function and life history: Dutta Munshi, J. S., Hunghes G.M. (1992) .Oxford and JBH publication Co. New Delhi.
5. The freshwater fishes of India, Pakistan, Bangladesh, Burma and Shri Lanka Handbook: Jayaram, K.C. (1981): Zoological Survey of India, Calcutta.
6. Fish migration: Jones, F.R. S. (1968), E.Arnold, London
7. Aquaculture, Bardach, Ryther and Mc Lamy
8. Marine fisheries: D. K. Dal, K. V. Rao
9. Ichthyology: Lagler, K. F., Bardach, J. and Miller, R.(1977) John Wileys and sons.
10. Fish Endocrinology: Matty, A. J. (1985), Chapman and Hall, London.
11. An aid to the identification of common commercial fishes of India and Pakistan: Mishra K. S. (1982).

12. Aquaculture: The farming and husbandry of freshwater and marine organism: Bardach, J.E. (1974). Narendra Publication House, New Delhi.
13. Handbook of breeding of Indian Major Carps by pituitary hormone injection: Chonder, S. L. (1970). Satish book enterprises, Agra.
14. Diseases of fish: Duijin, C:VanInr. (1973), life books London.
15. Fish and fisheries of India: Jhingran , V. G. (1985). Hindustan Publication Company, New Delhi.
16. Prawns and prawn fisheries of India: Kurian, C.V. and Sebastian, V. O. (19876) . Hindustan Publication Company, New Delhi.
17. The Sea food Industry: Martin, R. E.(1990). Narendra Publication House, New Delhi.
18. Ecological effects of water, applied limnology and pollutant effect: Welch, E. B. (1992).
19. A compemendium of aquaculture technologies: Sinha, V.R. P.(1993). Oxford and JBH publication Co. New Delhi.

Semester-IV

Paper-XIV, Special Group-Mammalian Reproductive Physiology-III

Reproductive Endocrinology

Unit-I

1.1 Hypothalamus – Anatomy, cytoarchitecture.
1.2 Releasing and release inhibiting hormones.
1.3 Neurotransmitters and neural signals.
1.4 Feedback regulatory mechanism

Unit-II

2.1 Adenohypophysis: Anatomy, cytology.
2.2 Neurohypophysis: Anatomy, cytology.
2.3 Gonadotrophic hormones: structure, mechanism of secretion and function.
2.4 Anatomy and hormones of pars intermedia.

Unit-III

3.1 Hypothalamo – hypophyseal testis axis
3.2 The Androgen: Biosynthesis, mode of action, transport and functions of testosterone.
3.3 Physiology of inhibin-biosynthesis, mode of action and functions.
3.4 Hypothalamo – hypophyseal thyroid-gonad axis.

Unit- IV

4.1 Hypothalamo – hypophyseal ovarian axis.
4.2 The oestrogen: Biosynthesis, mode of action, transport and functions.
4.3 The progesterone: Biosynthesis, mode of action, transport and function.
4.4 Hypothalamo- hypophyseal adrenal-gonad axis.

Semester-IV

Paper-XV, Special Group-Mammalian Reproductive Physiology-IV

Reproductive Toxicology, Embryology and Fertility

Unit-I

1.1 Chemical toxicants and Testicular toxicity.

1.2 Environmental factors and reproductive health.

1.3 Induction of gonadal toxicity in females.

1.4 Interruption of pregnancy by pesticides.

Unit-II

2.5 Implantation of mammalian blastocyst.

2.6 Development of chorio–allantoic placenta.

2.7 Foetal membranes – Development, structure, function of chorion, amnion, allantois, yolk sac.

2.8 Onset and endocrine control of parturition.

Unit-III

3.1 Intrauterine and intra cervical devices (IUDS and IUCDS) medicated and non-medicated IUD's, Long acting steroidal contraceptives.

3.2 Surgical sterilization and medical termination of pregnancy (MTP).

3.3 Pregnancy vaccine (anti-HCG, Antizona vaccine, immunization with FSH).

3.4 Recent advances in female contraception (inhibin, prostagladin, hormone analogues, subdermal implants).

Unit- IV

4.1 Vasectomy and reversible vas occlusion.

4.2 LH-RH antagonist, estrogen antagonist, GnRH antagonist.

4.3 Anti-androgen and anti-spermiogenic compounds (LDH-Cy and Sp-10), Inhibin.

4.4 Antibodies for acrosomal enzymes and sperm surface proteins.

Semester-IV, Practical-VII, Special Group-Mammalian Reproductive Physiology

1 Demonstration of surgical operation in rat/ mice Ovariectomy or Hysterectomy or Unilateral adrenalectomy with the help of ICT tools/ Charts/ Models / Photographs etc.

2 Anatomical observations, demonstration and detailed explanation of the female reproductive system of rat or mice with the help of ICT tools/ models/ charts/ photographs etc.

3 Vaginal smear: Vaginal cytology with relation to estrous cycle with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

4 Pregnancy detection test.

5 Study of histochemical localization of proteins in rat/ mouse thyroid by Mercury-Bromophenol blue method with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

6 Study of histochemical localization of lipids in rat / mouse ovary by Sudan Black–B method (Propylene glycol method) with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

7 Experimental (histological slides for identification) study of the following with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

a) Effects of ovarictomy and oestrogen replacement on pituitary, uterus and vagina.

b) Effects of some female antifertility drugs on ovary and adrenal gland

8 Histology: (Identification of slides) Histological changes in female reproductive organs during different phases of oestrous cycle in continuous and seasonal breeder with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

9 Embryology: Study of various stages of development of mammalian egg, development of foetal membranes, different types of placenta, progestational changes in uterus with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.

10 Field work: Visit to laboratory for embryo transfer and family planning clinics.

Distribution of marks		**Marks**
1.	Surgical operation	15
2.	Anatomical observations	15
3.	Vaginal smear and oestrous cycle stages	10
4.	Experimental analysis	10
5.	Identification and comment on spots	10
6.	Practical Record	10
7.	Viva voce	10
	Total marks	80

- **Project work** 100

(80 marks project evaluation including viva + 20 marks Internal assessment)

- **Suggested Readings**

1. A textbook of in vitro fertilization and assisted reproduction edited by P.R. Brinsden and P. A. RainsburJaypee brothers 1992.
2. Advances in Reproductive Physiology, Vol. 1 to 6: Mclaren, (1968). Logos Press Ltd., London.
3. Advances in Reproductive Toxicology eds. S. C. Joshi and A. S. Ansari Pointer publishers.
4. Andrology. 2nd Edition Male Reproductive health and dysfunction (Eds. E. Nieschlag& H.M. Behre) 2000.
5. Biochemistry of Mammalian Reproduction: Zanveld, L.J.D. & R.T. Chatterton (1982). John Wiley & sons, New York. The Ovary. Vol. I, II & III: Zuckerman, S, (1962). Academic Press, London.

6. Biology of Gestation: Assalye, N.S. (1968). Academic Press, London.
7. Biology of ovarian follicles in mammals (1985). S. S. Guraya Springer-Verlag.
8. Comparative cellular and molecular biology of testis in vertebrates (Trends in endocrine, paracrine and autocrine regulation of structure of functions) (2001) S.S. Guraya, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, Calcutta.
9. Comparative Endocrinology and Reproduction. Eds. K.P. Joy, A. Krishna and C. Haldar, Narosa Publishing House (1998).
10. Contraceptive Technology Past, Present and Future: Das. R.P. (1989). N.I.H.F.W. New Delhi.
11. Control of ovulation: Crighton, D.B., Haynes, N.B. Foxcroft, G.R. & G.E. Lamming (1978). Butterworths, London.
12. Encylopedia of Reproduction Vol. I, II, III, IV eds. Ernst Knobil and J.D. Neill (1998).
13. Endocrinology and metabolism. 4th edition 2001. Philip Felig&Lowrence A. Frohmon McGraw Hill Inc. Medical Publishing Division.
14. Endocrinology. Vol. 1 to 3: L.J. Degroot et al. (1989). W.B. Saundors Co. Philadelphia.
15. General Endocrinolgoy: Turner, C.D. & J.T. Bagnara (1990) W.B. Saunders Co., & Toppan Co., Philadelphia, London & Tokyo.
16. Hormonal Control of Lactation: Cowie, A.T. Forryth, I.A. and I. Hart (1980). Springer-Verlag, Berlin & New York.
17. Mammalian Oviduct: Hafez, E.S., and R.J. Blandu. The University of Chicago Press, Chicago, London.
18. Marshall's Physiology of Reproduction. 4th Edition Vol. 3 Pregnancy and Lactation Part I, II, III edited by G.E. Lamming, Champan and Hall.
19. Ovarian Cycle of Mammals: Perry, J.S. Oliver and Boyd, Edinburgh.
20. Patterns of Reproduction: Asdell, S.A. (1964). Constable and Co. London.
21. Physiology of Lactation: Smith, Vearch, Constable & Co., London.
22. Postgraduate Reproductive endocrinology. 4th Edition. 1997. R. RajanJaypee brothers. Medical Publishers (P) Ltd.
23. Practice of fertility control, Choudhary S. K. Churchill and Livingstone.
24. Progress in Reproductive Biology, Vol. 4. The pineal and reproduction: Reiter, R.J. Series Ed. P.O. Hubinant, Karger, Basel. Paris, London (latest edition).
25. Reproduction in Mammals Series: 1 to 6: Austin, C.R. and R. V. Short (1984 & 1994),
    Cambridge University Press, Cambridge.
26. Reproductive Endocrinology: Ref. No. 1, Vol. 3 Hormones in Reproduction.
27. Seasonal Patterns of Stress, immune function and disease R.J. Nelson, G.E. Demas, S.L. Klein, L.J. Kriegsfeld. 2002. Cambridge Univ. Press.
28. Shaw's textbook of Gynaecology eds. V. G. Padubidri and S. N. Daftary. 2000.
29. The Biology of Blastocyst: Blandau, R.J. (1971). The University of Chicago Press, Chicago & London.
30. The Prostaglandins Vol. I & II: Ramwell, P.W. (1974). Prenum Press, New York and London.

31. The Testis Vol. 1 to 4: Jhonson, A.D. and W. R., Gomes.
32. Vertebrate FoetalMembrances: Mossman, H.W. (1989). Rutgress Press Ltd.
33. WHO laboratory manual for the examination of human semen and sperm – cervical mucus interaction. 4th Edition Cambridge Univ. Press. 2000.

Semester –IV
Paper- XIV, Special Group-Animal Physiology-III
Physiology of Brain, Nerve and Muscle

Unit-I

1.1 Morphological differentiation of mammalian brain
1.2 Brain stem
1.3 Cerebellum
1.4 Physiology of learning, memory and sleep

Unit-II

2.1 Types and functional properties of neurons
2.2 Ultrastructure of neuron
2.3 Ultrastructure of synapse and molecular mechanism of synaptic transmission
2.4 Bioelectrical properties of neurons- neuronal excitability, resting membrane potential- Nearnst equation, sodium and potassium pump, propagation of nerve impulses, generation of action potential.

Unit III

3.1 Biosynthesis, storage and release of neurotransmitters: Acetylcholine , GABA, Epinephrine, Nor-epinephrine , Serotonin.
3.2 Neuropeptides- oxitocin, vasopression, thyrotropin releasing hormone, cholecystokinin
3.3 Receptor physiology- Mechanoreception, photoreception, phonoreception, chemoreception
3.4 Disorders of nervous system: Alzheimer's disease, Parkinson's disease.

Unit-IV

4.1 Ultrastructure of skeletal muscle
4.2 Molecular mechanism of muscle contraction- muscle proteins, Calcium receptors, Calmodulin, Calcium pump, sliding filament theory, chemistry and role of ATP in muscle contraction.
4.3 Properties of muscle (twitch, tetanus, summation, tonus, all or none principle fatigue), muscular disorders.
4.4 Ultrastructure of Neuromuscular Junction.

Semester –IV

Paper XV, Special Group-Animal Physiology-IV

Physiology of Respiration and Reproduction

Unit I

1.1 Physiological anatomy of respiratory system.

1.2 Mechanism of respiration – Mechanism of breathing and the exchange of respiratory gases at pulmonary surface.

1.3 Transport of respiratory gases by blood.

1.4 Lung volumes and capacities, partial pressure of gases.

Unit II

2.1 Oxygen dissociation curve, Carbon -dioxide dissociation curve.

2.2 Carbonic anhydrate, chloride shift.

2.3 Neural and chemical regulation of respiration

2.4 Hypoxia, Cyanosis.

Unit III

3.1 Endocrine control of spermatogenesis and oogenesis

3.2 Leydig cells, sertoli cells and their hormones

3.3 Follicular cells and luteal cells and their hormones

3.4 Corpus luteum- formation, structure, hormones and functions

Unit IV

4.1 Placenta - structure, hormones and functions

4.2 Physiology of lactation

4.3 Role of hormones and pheromones in reproduction

4.4 Causes of infertility in male and female; In vitro fertilization (IVF) and Test Tube Baby

Semester-IV, Practical-VII, Special Group- Animal Physiology

I. Physiology Experiments

1 Study of Electrocardiograph (ECG) under different physiological conditions with the help of ICT tools/ charts/ models / photographs etc.

2 Body size and oxygen consumption in aquatic animals.

3 Effect of pH, temperature on oxygen and carbon dioxide concentration in pond water.

4 Biochemical estimation of tissue cholesterol (Source of tissue**:** Local recognized fish markets/ slaughter houses/ poultry farms etc.)

5 Measuring of heart beat under different physiological condition.

6 Study of nerve cells and neurosecretry cells of cockroach with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

7 Estimation of SGOT/SGPT from blood sample (Source of blood**:** Local recognized pathology laboratory)

II. **Quantitative Analysis**

1 Muscle & Liver glycogen (Source of muscle/ liver: Local recognized fish markets/ slaughter houses/ poultry farms etc.)

2 Determination of fructose in seminal vesicle/ semen (Source of semen: Government artificial insemination centre)

3 Separation of protein by SDS-PAGE

4 Determination of semen constituents (Source of semen: Government artificial insemination centre)

5 Estimation of percentage quantity of lactose in milk in vertebrates.

3.1 Qualitative Analysis

Estimation of lactate dehydrogenase (Source of blood: Local recognized pathology laboratory).

Estimation of RNA and DNA (Source of blood: Local recognized pathology laboratory).

Histochemical localization of a dehydrogenase (Source of tissue: Local recognized fish markets/ slaughter houses/ poultry farms etc.)

Histochemical localization of Carbohydrate (Source of tissue: Local recognized fish markets/ slaughter houses/ poultry farms etc.)

Histochemical localization of Glycogen (Source of tissue: Local recognized fish markets/ slaughter houses/ poultry farms etc.)

Histochemical localization of lipid (Source of tissue: Local recognized fish markets/ slaughter houses/ poultry farms etc.)

Histochemical localization of protein (Source of tissue: Local recognized fish markets/ slaughter houses/ poultry farms etc.)

IV. Histological Study of Brain, Testis, Ovary, Thyroid, Adrenal, Corpus luteum in ovary, Leydig cells in testis, T. S. Muscle fiber, T. S. Spinal cord, Cerebellum & cerebrum, Nerve fiber, Lung with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

Distribution of Marks:		**Marks**
1.	Physiology Experiment	15
2.	Major quantitative analysis	15
3.	Minor quantitative analysis	10
4.	Qualitative analysis	10
5.	Identification and comment on spots(1-5)	10
6.	Practical Record	10
7.	Viva-voce	10
	Total marks	80

- **Project work** 100

(80 marks project evaluation including viva + 20 marks Internal assessment)

Semester –IV

Paper-XIV, Special Group-Cell Biology-III

Molecular Cell Biology

Unit-I

1.1 Prebiological chemical evolution and proto cells.

1.2 Receptors.

1.3 Cytoskeleton – Microtubules & microfilaments – Structure and dynamics. Microfilaments membrane binding proteins and their function.

1.4 Cell-cell interactions and adhesion. Adhesion molecules involved. Cell-matrix interactions and adhesions. Adhesion molecules involved. Proteins of extracellular matrix. Types of junctions.

Unit-II

2.1 Protein structure – Primary, secondary, tertiary and quaternary, Domains and motifs, Protein folding, Ramchandran plot.

2.2 Molecular chaperons and heat shock proteins. Prion structure and functions.

2.3 Protein synthesis in eukaryotes. Up take into ER, Modifications in ER, Protein sorting in Golgi apparatus, Transport of proteins across nuclear membrane. Lysosomal assembly and functions.

2.4 DNA binding proteins – Leucine zipper, zinc finger, helix turn helix, beta barrel and OB fold.

Unit-III

3.1 Origin, epidemiology, causes and types of cancer.

3.2 Cytogenetical properties of normal and abnormal cells.

3.3 Proto-oncogenes and viral oncogenes, Mechanism of oncogene activation.

3.4 Tumor markers and tumor suppressor genes.

Unit-IV

4.1 Model organisms for molecular studies –Importance of *Drosophila melanogaster*, *C.elegans*, *S. cerevisae*, zebra fish studies.

4.2 Cell senescence and apoptosis.

4.3 Somatic cell hybridization and chromosome mapping, Cell fusion and applications.

4.4 Protein and tissue engineering.

Semester –IV

Paper-XV, Special Group-Cell Biology-IV

Applied Biotechnology

Unit-I

1.1 Marker assisted improvement of crop. Genetically modified food and future implications.

1.2 DNA and ribosomes as drug targets–Recent developments in drug delivery

System, Ion channels as drug target, Drug metabolism.

1.3 Nanobiotechnology – Nanomaterial and its applications. Molecular motors.

1.4 Bio-safety and bioethical considerations on biotechnology, biological warfare.

Unit-II

2.1 Biology, cause, diagnosis and treatment of influenza and hepatitis.

2.2 Biology, cause, diagnosis and treatment of Parkinson's disease.

2.3 Biology, cause, diagnosis and treatment of diabetes.

2.4 Biology, cause, diagnosis and treatment of cystic fibrosis.

Unit-III

3.1 Properties of stem cells. Types of stem cells – Embryonic, umbilical, adult.

3.2 Haemopoietic stem cells and formation of blood cells. Bone marrow transplantations.

3.3 Stem cell disorders. Stem cell therapy, Stem cell and cancer, Stem cell research in India.

3.4 Stem cells and tissue engineering, ethical, legal and social implications (ELSI) of Stem cell technology.

Unit-IV

4.1. World Trade Organization and trade related intellectual property rights (TRIPS).

4.2. Intellectual property rights – Patents and patent documentation.

4.3. Patent search methods & tools for patent search.

4.4. Indian patent laws and recent amendments, examples of patents in India & abroad.

Semester –IV Practical-VII, Special Group-Cell Biology

1 Measurement of maximum absorption of colored solutions & verification of Beer-Lambert's law.

2 Biochemical estimation of blood cholesterol (Source of blood: Local recognized pathology laboratory)

3 Biochemical estimation of blood glucose (Source of blood: Local recognized pathology laboratory)

4 Biochemical estimation of acid phosphatase (Source of blood: Local recognized pathology laboratory)

5 Biochemical estimation of alkaline phosphatase (Source of blood: Local recognized pathology laboratory)

6 Isolation of lymphocytes.

7 Comparison of RBC and WBC in different group of vertebrates with the help of already available permanent slides/ ICT tools/ Charts/ Photographs etc.

8 Media preparation for prokaryotic cell culture.

9 Different methods of sterilization (Dry, wet and UV sterilization).

10 Gram staining of micro-organisms.

11 Bacterial motility under microscope.

12 Preparation of neem extract as an antimicrobial agent.

13 Separation of amino acids by paper chromatography.

14 Separation of amino acids/ lipids by thin layer chromatography.

15 Uses and functioning of different types of microscopes.

16 Study of metaphase chromosomes from rat bone marrow with the help of already available permanent slides/ ICT tools/ charts/ models etc.

17 Study of G banding of metaphase chromosome with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.

18 Study of C banding with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

19 Study of histology of normal tissue and cancerous tissue with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.

20 Demonstration of tools used for patent search and patent filing system.

Distribution of marks		**Marks**
1.	Biochemical estimation of alkaline/acid phosphatase/ Cholesterol/ glucose	15
2.	Separation of amino acids/ lipids by paper/ thin layer Chromatography	15
3.	Isolation of lymphocytes/ Gram staining of micro-organisms/Bacterial motility	15
4.	Identification and comment on spots (1-5)	15
5.	Class record/ submissions	10
6.	Viva-voce	10
	Total marks	80

- **Project work** 100

(80 marks project evaluation including viva + 20 marks Internal assessment)

- **Suggested Readings**

1. The cell theory, QAMS: Vol. 89,96,1948-55,Bakar.
2. Synthetic activity of polythene chromosomes: Berendes (Int. Rev. Cytol. vol. 35, 1973)
3. The Nucleolus in the cell Metabolism: Bimstiel, Ann. Rev. Plant Physical vol.l1 1967.
4. Elements of cytology: Cohen.
5. The nucleic Acid: Chargaff & Davidson.
6. The Bio-chemistry of DNA: Davidson.
7. Cell Biology- De Reoberts.
8. The cell-Biology: DowbwnHaper.
9. Cell Biology: C. B. Powar.
10. DNA & Chromosomes, D.Praw.
11. Mitochondria structure & function: Ernster&Drahota.
12. Nuclear Envelope: Franke.

13. The structure of cell membrane: Fox.
14. Energy& Mitochondria: Green & H Baum.
15. Biological membrane: structure & function: Harrison & Lunt.
16. Studies in basic Genetics & Molecular Biology: Hayes & Wiley.
17. Cell Biology: Johan Paul.
18. The Mitochondria: Loghinger.
19. Hand book of Molecular Cytology: Lirna-de-Paria.
20. Cell structure & function: Loewy&Siskevit P.
21. Structure & function of biological membranes: Roth Field.
22. Molecular Genetics: Stent.
23. Cytogenetic: SwansonJ, YountYodyrdan Metz & W.J.
24. The molecular basic of membrane function: Yodyrdan.
25. Molecular Biology of Gene: W. Son.
26. The Chromosomes: White.
27. The Nuclear Envelope, Its ultra structure& functional Significance: Wisctinitzers, S.
28. Tissue Culture methods & Application: Kruse, P. F. Jr. Academic Press, M. KS Pattesrson, New York, San Francisco, London, 1973.
29. Tissue culture technique:2nd Ed. Cameron G. Academic press, N. Y.
30. Laboratory Techniquesin Biology & Medicine, Earle W.R
31. An Introduction to cell and tissue culture: Free, W. F. Burgess, Minneapolis.
32. Genes VI: Lwein, Benjamin(1997), Oxford University press, New York
33. Genetics: 3rd Ed., Stansfield W.D.(1991), Schaum's outline series, McGraw Hill Inc. New York.
34. Genetics in Medicine: Thompson M. W., Mcinnes RR& HF. Willard (1991),W. D. Saunders Co. Philadelphia.
35. A first course in Recombinant DNA Technology: Micklos D.A & G.A Freyer (1990), Cold Spring Harbor Lab. Press.
36. Scientific American Books: Watson, J.D., Gilman, M. Witnowski,I.& M. Zoller (1992), Distributed by W. H. Freeman & Co., New York.
37. Genetics, Weaver: RF. & P.W. Hedrick,(1989), Wnc Brown Publishers, Dubuque, TOWA (USA).
38. Gene Regulation: A Eukaryotic Perspective, Latchrnan, Davin (1990), Un win Hyman, London.
39. Gene Cloning: Brown.
40. Biotechonolgy: Higgins.
41. Essentials of Cytology: C.B. Powar (1996), Himalaya Pub. House, Bombay.
42. Cell Biology: David E. Sadava (1993), Jones & Bartlett Pub. Boston (London).
43. Biotechnology: Current Progress, Paul, N. Cherernisenoff& L.M. Ferrante (1991), A technomic Pub. Co., Lancaster, U.S.A
44. Microbial Genetics, David Freifelder (1987), NAROSA Pub. House, (India).
45. Molecular Biology: David Freifelder (1987), NAROSA Pub. House, Delhi, India

46. Molecular Cell Biology, Lodish*et. al.,* (2007), W.H. Freeman and Company, New York, USA.

47. Molecular Biology of the cell, Alberts *et. al.,* (2008), Graceland Science, Taylor & Francis Group, New York, USA.

48. Cell Physiology Source Book: A Molecular approach, Sperelakis, (2001), Academic Press, New York, USA.

49. Principles of Genome Analysis and Genomics, Primrose, S.B. and Twyman R.M., (7^{th} Ed., 2006), Blackwell Publishing Company, Malden, USA

50. Genomes 3, Brown, T. A., Garland Science Publishing, London, UK.

51. Bioinformatics: sequence and Genome Analysis, Mount, D.W., Cold Spring Harbor Laboratory Press, New York, USA.

Semester –IV

Paper XIV, Special Group-Fresh water Zoology-III

Aquatic Biology

Unit-I

3.1 Plankton: Definition and classification. Diurnal and vertical movement of plankton.

3.2 Collection and preservation of plankton. Qualitative and quantitative study, importance of plankton.

3.3 Periphyton: Definition and composition, Types & Qualitative study of Periphyton

3.4 Quantitative study of Periphyton& its importance.

Unit-II

4.1 Nekton: Definition and composition, Study of various forms of nekton from aquatic ecosystem.

4.2 Bottom material: Sedimentations, Sediments in lakes and rivers.

4.3 Benthos: Definition and collection of benthos. Qualitative and quantitative study.

4.4 Importance of benthic organisms with reference to water quality and aquatic pollution.

Unit-III

1.1 Definition of Aquatic pollution, types & sources of pollutants.

1.2 Heavy metal and pesticide residues from agriculture fields & control measures.

1.3 Pollution processes in aquatic ecosystem: dispersion, degradation, accumulation, biomagnificance, transformation, movement and recycling.

1.4 Eutrophication

Unit-IV

2.1 Methods of assessment of pollutional status.

2.2 Biological indicators of pollution.

2.3 Drinking water treatment and Disposal of sewage.

2.4 Aquatic toxicology: Toxicants, toxicity concentration response relation and Bioassay study

Semester –IV

Paper XV, Special Group-Fresh water Zoology-IV

Inland Fisheries

Unit-I

1.1 Inland fisheries resources - riverine, reservoir and lacustrine fisheries.

1.2 Fresh water fish culture and management techniques.

1.3 Basic experimental designs useful in aquaculture

1.4 Population dynamics of fish and stock assessment models.

Unit-II

2.1 Induced breeding of fish by hypophysation technique.

2.2 Bundh breeding of fish and use of natural & synthetic hormones in breeding.

2.3 Glass jar hatchery and Chinese hatchery systems for seed production

2.4 Nutritional requirement of carps and supplementary feeding.

Unit-III

3.1 Culture of air breathing fish and cage culture.

3.2 Mixed farming of fishes and culture of giant fresh water prawn.

3.3 Integrated fish farming with agriculture and live stock.

3.4 Culture of fresh water mussel for pearls.

Unit-IV

4.1 Fisheries extension and Co-operative societies.

4.2 Biochemical composition and economic importance of fishes.

4.3 Fish spoilage & preservation methods, and HACCP in processing industry.

4.4 Time series analysis and its significance.

Semester-IV, Practical-VII, Special Group- Fresh water Zoology

Section: A

1 Qualitative study of fresh water zooplankton.

2 Quantitative analysis of zooplankton.

3 Study of fresh water periphyton.

4 Study of fresh water benthic organisms with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.

5 Study of LC_{50} value of toxicant to aquatic organism by provided data.

6 Methodology of oxygen consumption rate of aquatic organisms.

7 Camera lucida drawings of zooplankton.

8 Study of ecological set up.

Section: B

1 Feed formulation by square method.

2 Estimation of Maximum sustainable yield (MSY) using surplus production model.

3 Study of preparation of pituitary extract with the help of ICT tools/ charts/ models / photographs etc.

4 Identification of aquatic weeds, insects and weed fishes with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.

5 Gram staining of bacteria.

6 Estimation of protein (Source of blood: Local recognized pathology laboratory)

7 Determination of acid value or free fatty acids (FFAs) in fish oil.

8 Identification of egg, spawn, fry & fingerlings of carps with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

9 Estimation of trend by using given data with the help of time series analysis.

10 Visit to a fish farm for studying the culture and breeding activities.

Distribution of marks		**Marks**
1.	Quantitative estimation of zooplankton / Oxygen consumption rate by provided data	10
2.	Comment on ecological setup / Preparation of artificial feed	10
3.	Estimation of MSY / Estimation of protein/ Time series analysis.	10
4.	Determination of acid value/ Gram staining of bacteria	10
5.	Identification of spots with the help of photos (1 to10).	20
6.	Camera lucida drawing.	05
7.	Practical record and submission of photos	05
8.	Viva – voce	10
	Total marks	80

- **Project work** 100

(80 marks project evaluation including viva + 20 marks Internal assessment)

- **Suggested Readings**

1. A textbook of fishery science and Indian fisheries- S. B. L. Srivastava
2. Fish and fisheries – Kamleshwar Pandey and J. P Shukala
3. A textbook of fish biology and fisheries – S.S. Khanna and H. R. Singh
4. A text book of fish biology and Indian fisheries- R.P. Parihar
5. General and Applied Ichthyology- S.K.Gupta and P.C.Gupta
6. An introduction to fishes- S. S. Khanna.
7. Fish processing technology – T. K. Govindon.
8. Hand book of breeding of major carps by pituitary hormones – S. L. Chonder.
9. Aquaculture – T. V. R. Pillay.
10. Diseases of cultivable freshwater fishes and their control – N. M. Chokraborty.
11. Fish and fisheries in India - V. G. Jhingran.
12. Indian fishes (Identification of Indian Teleosts) – T. A. Qureshi.
13. Introduction to tropical fish assessment per share, Erik Ursine and Siberian C. Verma.
14. Fish population dynamics – M. Devaraj.

Semester –IV

Paper XIV, Special Group-Aquaculture-III

Aquaculture and Management

Unit-I

1.1 Preparation of pond: Liming and manuaring.

1.2 Prestocking management of Nursery, Rearing and stocking ponds.

1.3 Control of aquatic weeds, predatory fishes, weed fishes and insects.

1.4 Post stocking management – stocking density, carrying capacity, enhancement of carrying capacity.

Unit-II

2.1 Nutritional requirements of culturable carps. Supplementary feeding. Artificial feed. Use of growth promoting hormones.

2.2 Transport of live fish seed, Brood fish and food fish.

2.3 Effect of dams on fisheries.

2.4 Development of reservoir fisheries in India.

Unit-III

3.1 Different systems of aquaculture, Monosex culture, cage culture and pen culture.

3.2 Polyculture of Indian and Exotic carps.

3.3 Culture of air breathing fishes.

3.4 Integrated aquaculture: fish-cum-poultry and fish-cum-paddy.

Unit-IV

4.1 Integrated fish farming: fish-cum-duck and fish-cum-pig

4.2 Sewage fed fish culture.

4.3 Cold water fish culture in India.

4.4 Extensive, Intensive, Semi-intensive and super- intensive culture.

Semester-IV

Paper XV, Special Group-Aquaculture-IV

Fish Pathology and Fish Genetics

Unit-I

1.1 Biochemical composition of raw fish.

1.2 Nutritional value of raw and preserved fish.

1.3 Fish preservation objective and principles..

1.4 Methods of fish preservation.

Unit-II

2.1 Fish decomposition, rigor mortis and fish spoilage.

2.2 Poisoning, Toxicity and allergies from fish as food.

2.3 Effect of water pollution on fishes.

2.4 Fish products and byproducts.

Unit-III

3.1 Fungal, bacterial, protozoan diseases of farm fish.

3.2 Nutritional diseases of fish.

3.3 Worm and crustacean diseases of farm fish.

3.4 Diseases caused by aquatic pollutants.

Unit-IV

4.1 Fish genetic resources and its application in fisheries management.

4.2 Hybridization, transgenic fish.

4.3 Gene banking and application of genetic engineering in aquaculture.

4.4 Cryopreservation of gametes.

Semester –IV Practical-VII, Special Group- Aquaculture

1 Study of feeding habits of herbivorous, carnivorous and omnivorous fish by gut content analysis with the help of ICT tools/ charts/ models / photographs etc.

2 Identification of egg, spawn, fry and fingerlings of Indian carps with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.

3 Preparation of artificial fish feed.

4 Anatomical observations, demonstration and detailed explanation of the reproductive system of carps with the help of ICT tools/ models/ charts/ photographs etc.

5 Identification and classification of palaemonoid prawns, crabs, bivalves, larvivorous and aquarium fishes using fishes available in the local fish market or with the help of already available specimens, permanent slides ICT tools/ charts/ models/ photographs etc.

6 Short term bioassay and determination of LC50 for fish exposed to pollutant using provided data.

7 Study of pathological changes in gills, liver, kidney and intestine of fish exposed to heavy metals or pesticides with the help of already available permanent slides ICT tools/ charts/ models/ photographs etc.

8 Biochemical estimation of proteins, lipids, glycogen, DNA and cholesterol (Source of Blood/ Tissue: Local recognized fish markets).

9 Preparation of bacteriological media and determination of bacterial plate count for skin and gut.

10 Gram staining of bacteria.

11 Visit to a fish market and collection of fish landing data.

Distribution of marks		**Marks**
1.	Analysis of gut content / preparation of artificial fish feed	10
2.	Study of pathological changes in gills, liver, kidney and intestine	10
3.	Biochemical estimation / determination of bacterial plate count.	10
4.	Gram staining	05
5.	Identification of spots (1 to10)	20
6.	Anatomical observation	05
7.	Practical record & submission	10

8.	Viva – voce	10
		80
	Internal Assessment	20
	Total marks	100

- **Project work** 100

(80 marks project evaluation including viva + 20 marks Internal assessment)

- **Suggested Readings**

1. A textbook of fishery science and Indian fisheries- S. B. L. Srivastava
2. Fish and fisheries – Kamleshwar Pandey and J. P Shukala
3. A textbook of fish biology and fisheries – S.S. Khanna and H. R. Singh
4. A text book of fish biology and Indian fisheries- R.P. Parihar
5. General and Applied Ichthyology- S.K.Gupta and P.C.Gupta
6. An introduction to fishes- S. S. Khanna.
7. Fish processing technology – T. K. Govindon.
8. Hand book of breeding of major carps by pituitary hormones – S. L. Chonder.
9. Aquaculture – T. V. R. Pillay.
10. Diseases of cultivable freshwater fishes and their control – N. M. Chokraborty.
11. Fish and fisheries in India - V. G. Jhingran.
12. Indian fishes (Identification of Indian Teleosts) – T. A. Qureshi.
13. Introduction to tropical fish assessment per share, Erik Ursine and Siberian C. Verma.
14. Fish population dynamics – M. Devaraj.

Semester –IV

Paper-XIV, Special Group-Environmental Biology-III

Environmental Pollution and Aquaculture

Unit-I

1.1 Pollution Ecology: definition, sources of pollution, classification of pollutants, primary and secondary pollutants.

1.2 Air pollution: definition, sources, air pollutants and its effects on human health and atmosphere, control of air pollution.

1.3 Water Pollution: definition and sources, water pollutants and its effects, control of water pollution.

1.4 Noise pollution, sources, physiological and psychological effects of noise pollution, control measures of noise pollution.

Unit-II

2.1 Land pollution: definition, sources, effects and control of insecticide pollution.

2.2 Radioactive pollution: definition, sources, effects and control measures of radioactive pollution.

2.3 Biomedical waste: sources, effects and control measures

2.4 Hazardous waste: definition, sources, effects.

Unit-III

3.1 Biological and general effects of pollutants on organism.

3.2 Bioassay studies: definition, purpose, methodology, calculation of LC50 value, significance.

3.3 Bioaccumulation and biomagnifications.

3.4 Biotransformation of xenobiotics.

Unit-IV

4.1 Aquaculture: basic concept of fisheries, marine, inland and brackish water fisheries.

4.2 Indian major carps and their culture: fish, seed resources, transport.

4.3 Planning and management of freshwater fish farm.

4.4 Fishery economics and management: role of fishery co-operative societies, economics of fishery, aquaculture and rural development.

Semester –IV

Paper-XV, Special Group-Environmental Biology-IV

Man and Environment

Unit-I

1.1 Natural resources: definition, concept , types of natural resources, use and abuse of natural resources.

1.2 Wild life: wild life in India, endangered species of mammals, birds, amphibian and reptiles,

1.3 Causes of wild life depletion, necessity of wild life conservation.

1.4 Modes of conservation, national parks and sanctuaries, strategies for biodiversity conservation, gene pool.

Unit-II

2.1 National resources: minerals, nutrient cycles, exploitation of nutrient resources.

2.2 Biomass, biogas and solar energy.

2.3 Conservation and sustainable development of natural resources, bacteria and biodegradation

2.4 Biodiversity- definition, types, hotspots of biodiversity.

Unit-III

3.1 Conservation of natural resources: potable water criteria, water supply, water borne diseases and control measures, bioremediation of ponds and lakes.

3.2 Process of soil formation, composition, soil profile, soil erosion, methods of conservation of soil.

3.3 Conservation of forest: needs, afforestation, deforestation, agroforestry, forest conservation through law.

3.4 Social forestry and environment.

Unit-IV

4.1 Environmental policy, social economic and legal aspects, social forestry, enforcement of anti pollution law.

4.2 Environmental education: environmental education programmes, environmental education in India

4.3 Formal environmental education, stages of environmental education, non formal environmental education.

4.4 Environmental Organizations and agencies.

Semester-III, Practical-VII, Special Group-Environmental Biology

1 Bioassay test- toxicity evaluation of heavy metals/pesticides using snail/fish as test animals, determination of LC50 value by using provided data.

2 Determination of oxygen consumption in fish.

3 Estimation and proximate composition (Protein / glycogen) in fish (Source of fish blood/ tissue: Local recognized fish market).

4 Determination of NO2 and SO2 in ambient air.

5 Determination of suspended particulate matters in ambient air.

6 Determination of oil and grease by Soxhlet apparatus and separating funnel.

7 Identification of common commercial important inland / marine fishes, Crustaceans and mollusc.

8 Identification of maturity stages in fish using fishes available in the local fish markets or with the help of already available permanent slides ICT tools/ charts/ models/ photographs etc.

9 Determination of gonadosomatic index (GSI) by using provided data.

10 Study of fecundity of fish.

11 Physiochemical analysis of Soil, pH, moisture.

12 Field work and study tour:

a. Visit to National Institute / Centre of Aquaculture.
b. Visit to a fish farm
c. Visit to National park / sanctuary to observed wildlife and maintaining the field diary.
d. Study tour and visit to national Institute of Oceanography.

Distribution of Marks		**Marks**
1.	Major experiment	20
2.	Minor experiment	10
3.	Minor experiment	10
4.	Identification and comments on given spots (1-10)	20
5.	Class record	10

6. Viva voce 10

Total marks 80

- **Project work** 100

(80 marks project evaluation including viva + 20 marks Internal assessment)

- **Suggested Readings**

1. The Science of Ecology: Brewer, A. (1998), Sanders Pub. New York.
2. The Science of Ecology: Ehrlich, P. R. &Roughsrden, J. (1987) McMillan Pub. Co. New York.
3. Population Biology: Emlein, J. M. (1984). McMillan Pub. London.
4. Current Ecology: Pattern & Progress: Killawa, J. & Anderson, G.J. (1986), Blackwell Science Publication, Oxford.
5. Basic Ecology: Odum, E. P. (1983), Sanders Pub. New York.
6. Systems of Ecology: Odum, H. T. (1983), John Wiley & Sons, New York.
7. Ecology with Special Reference to Animals and Man: Kendelgh, Prentice Hall Co.
8. National Resources & Conservation: Owen, O. S. (1985) McMillan Pub. New York.
9. Elements of Ecology: Smith, R. L. (1986), Harper & Row Pub. New York.
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12. Ecology: Ricklefts, R. E. (1973), Thomas Nelson & Sons Ltd.
13. Threatened Animals of India: Tikader, B. K. ZSI Calcultta.
14. Ecology & Field Biology: Smith, R. L. Harper &Rw Pub. New York.
15. Wildlife in India: Sharin, V. B. (1985), Natraj Pub. Dehradun.
16. Fresh Water in India: Kulkarni, K. H. (1957), ICAR, New Delhi.
17. Marine Fishes: Bal, D. V. & Rao, K.V. (1989), Tata McGraw Hill, New York.
18. Textbook of Marine Ecology: Balkrishnan, N. A. &Thumpy, D. N. (1980), McMillan Co.
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20. Treatise on Limnology: Hutchinson, G.E., (1967), John Willy Pub. New York.
21. Methods of Soil Analysis: De, S. K. (1962), Narayan Pub. House, Allahabad.
22. Fish & Fishes of India: Jhingran, V. G. (1985)
23. **Aquatic Pollution:** Edward A. (2000) Laws. 3rd edition**. John Wiley** and **Sons**, NewYork.
24. A Manual of Fresh Water Ecology: Santhanam, R., Velayntan, P. &Jagathesan, G. (1989), Daya Pub. House, Delhi.
25. Limnology: Welch, P. S. (1957), McGrall& Hill Co. New York.
26. **Air Pollution: Perkins, H.C.,** (1974) McGraw-Hill, New York.

Semester-IV

Paper-XIV, Special Group-Sericulture-III

Silkworm Genetics, Breeding and Seed Technology

Unit-I

1.1 Hereditary traits of egg, larva, cocoon, pupa and adult, characters and effect of environment on them.

1.2 Genetics of cocoon colours, linkage maps and inheritance of cocoon colour, environment influence and hormone control.

1.3 Inheritance of voltinism, moultinism, environment influence and hormone control.

1.4 Sex Determination in *B. mori*: Sex determination, sex linked, sex limited traits and their special significance in sericulture.

Unit-II

2.1 Breeding of Silkworm: Pre-requisites, aims and objectives, variability in breeds.

2.2 Methods of Breeding: Line breeding, cross breeding and mutation breeding, tropical and temperate races.

2.3 Silkworm breeding in India - its problems, advantages and disadvantages.

2.4 Heterosis, utilization of heterosis in sericulture.

Unit II

3.1 Selection, preservation and incubation of seed cocoons.

3.2 Grainage and basic equipments.

3.3 Management of grainage.

3.4 Silkworm Egg Production: Moth emergence, mating, egg laying (DFLs) and mother moth examination.

Unit-III

4.1 Disinfection and preservation of eggs.

4.2 Transportation and maintenance of eggs.

4.3 Artificial hatching (Acid treatment) of uni and biovoltine eggs.

4.4 Embryonic development, inhibition of embryonic development.

Semester-IV

Paper-XV, Special Group-Sericulture-IV

Rearing of silkworm and Silk Technology

Unit-I

1.1 Silkworm rearing, principles of silkworm rearing.

1.2 Types of rearing houses.

1.3 Rearing equipments.

1.4 Disinfection of rearing house and appliances.

Unit-II

2.1 Rearing Methods: Early age rearing (chowki rearing) and late age rearing.

2.2 Environmental conditions for silkworm rearing, Precautions for rearing.

2.3 Mounting, spinning and harvesting of cocoons.

2.4 Cocoon sorting, transportation of cocoons.

Unit-III

3.1 Grading of cocoons, stifling/ drying, storage and preservation of cocoon, deflossing.

3.2 Boiling of Cocoon: Appliances, methods of boiling and processing of cocoon for reeling.

3.3 Reeling appliances and methods of reeling.

3.4 Silk Reeling Operations: Re-reeling, silk testing and skeining of silk yarn, preparation and preservation of silk yarn, Process of winding, process of doubling, process of twisting, stifling of twisted yarn, process of reeling.

Unit-IV

4.1 Silk weaving, bleaching and dyeing of twisted yarn.

4.2 Warping unit and process of warping. Bobbin filling machine and process of filling, weaving machine, process of weaving, testing and storage of silk fabric.

4.3 Marketing of Silk: Indian market, international market, foreign exchange earning.

4.4 Silk industry in various states of India, role of silk industry in Indian economy.

Semester-IV, Practical VII-Special Group- Sericulture

1 Characterization of silkworm breeds/ races with the help of specimens/ ICT tools/ charts/ models/ photographs etc.

2 Cytological technique- Study of temporary preparation of the following with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.: i) Determination of somatic chromosome number of mulberry ii) Mitotic and meiotic chromosomes - preparation of the root tip, and iii) chromosomes of silkworm.

3 Study of rearing appliances and rearing of silkworm (100 dfls).

4 Disinfection - Type of sprayers and methods of their use.

5 Emergence of moths, selection of moths, pairing and de-pairing, oviposition, preservation of male moth.

6 DFL preparation (Card and Loose eggs) Cold and hot acid treatment methods.

7 Study of mounting of different embryonic stages of silkworm with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.

8 Rearing of silkworm and harvesting of cocoons.

9 Determination of good and defective cocoons and their percentage based on appearance and weight.

10 Determination of shell ratio, percentage and estimation of renditta.

11 Single cocoon reeling - Determination of average filament length and denier (size).

12 Reeling technique - Single cocoon reeling (Approuvet), charka reeling, cottage basin, filature (multi end).

13 Field work and study tour - Study tour and visit to sericulture centers.

Distribution of Marks:		**Marks**
1.	Identification and comment on the spots (1-5)	10
2.	Demonstration of meiotic and mitotic chromosomes in Mulberry plant	10
3.	Demonstration of reeling and production of yarn	10
4.	Determination of shell ratio, percentage and estimation of renditta	10
5.	Determination of average filament length and denier	10
6.	Mounting of embryonic stages of silkworm	10
7.	Practical record	10
8.	Viva voce	10
	Total marks	80

- **Project work** 100

(80 marks project evaluation including viva + 20 marks Internal assessment)

- **Suggested Readings**

1. Handbook of Practical Sericulture: Ullal, S.R. and Narasimhanna, M.N. (1987), Central Silk Board Publication, Bangalore.
2. Text Book of Tropical Sericulture: (1975), Publ., Japan Overseas Corporation Volunteers.
3. FAO Manual on Sericulture: Anonymous (1972), Vol. I - IV.
4. An Introduction to Sericulture: Ganga, G. and Chetty S.J. (1997), 2nd Edition, Oxford and IBH Publishing Co. Ltd., New Delhi.
5. Principles of Sericulture: HisaoAruga, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Modern Entomology: Tembhare, D.B. (1997), Himalaya Publishing House, Bombay.
7. General T.B. of Entomology: Imms, A.D. (1961), Edn. 9, Rev. by O.W. Richards and R.G. Davis.
8. A Text Book of Insect Morphology Physiology and Endocrinolory: Tembhare, D.B. (1984), S. Chand and Co. New Delhi.
9. Mulberry Cultivation: (1988) FAO Pub. by Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
10. Text Book of Soil Science: Biswas, T.D. and Mukherjee, S.K. (1997), Tata McGraw-Hill Pub., New Delhi.
11. Nutrient Deficiency Management in Mulberry: S. Chakrabarti*et al* (1997), Pub. by CSR&TI, Mysore.
12. The Nature and Properties of Soils: Nyle C. Brady (1984) Mac Millan Pub. Co. Inc.
13. Sericulture and Rural Development: G. Sandhya Rani (1988), Discovery Publishing House, New Delhi.
14. Sericulture Society and Economy: Hanumappa, H.G. (1993), Himalaya Publishing House, New Delhi.

15. Economics of Sericulture and Silk Industry in India: Ramana D.V. (1987), Deep and Deep Publishers, New Delhi.
16. An Introduction to Extension Eduction: Supe, S.V.
17. Silk Production, Processing and Marketing: Nanavaty, M.N., Economics of Sericulture under Irrigated and Rainfed Conditions (1982) M.S. Jolly, CSR & TI Mysore.
18. An analysis of Demand and Supply Prospectus for High Quality Raw Silk: Naik, G. and Babu, K.R. (1991) Centre for Management in Agriculture, Ahemadabad.
19. Tasar Culture: Joly, M.S., Sen, S.K. and Absan, M.M. (1974), CSTRI, Ranchi.
20. Ericulture in India: Sarkar, D.C. (1988), CSB Bangalore.
21. Handbook of Muga Culture: Thangavelu, K. *et al*. (1988), CSB Publication, Bangalore.
22. Muga Culture: Choudhary, S.N.
23. Ericulture: Choudhary, S.N.
24. Agricultural Pests of India: Atwal, A.S. (1986), South East Asia, Kalyani Publishers.
25. Agricultural Entomology and Pest Control: Pradhan, S. (1983), Pub. by ICAR, New Delhi.
26. Silkworm Diseases (1988): FAO Pub. by Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
27. Handbook of Pests and Diseases of Mulberry and Silkworm: (1990) Pub. by UNESCAP, Bangkok, Thailand.
28. Silkworm Genetics Illustrated: Yokoyama, T. (1964), Academic Press, London.
29. Silkworm Biology, Genetics and Breeding: Sarkar, D.D. (1998), Vikas Publication, New Delhi.
30. Principles and Techniques of Silkworm Breeding: (1993) United Nations, New York.
31. Silkworm Breeding: Reddy, G.S. (1998), Pub. by Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
32. Plant Breeding for Drought Resistance in Water Deficits and Plant Growth: Hurd, (1976) T.T. Kozlowaki, Academic Press New York.
33. Cytology and Cytogenetics: Swanson, C.P. (1975), Prentice Hall, New Jersey.
34. Diseases and Pests of Mulberry and their Control: (1991) Pub. by Director, CSR&TI, Mysore.
35. Silkworm Rearing and Diseases of Silkworm: (1956) Pub. by Director of Ptg. Sta. & Pub. Govt. Press, Bangalore.
36. Silkworm Rearing: Wupang Chun and Chen Da-Chung (1988), Pub. by FAO Rome.
37. Handbook of Silkworm Rearing: Anonymous (1972), Agriculture and Technical Manual - 1, Fuzi Pub. Co. Ltd., Tokyo, Japan.
38. Silkworm Rearing (Translated from Japanese): (1977), Oxford & IBH Pub. Co. Pvt. Ltd.
39. Manual on Silkworm Egg Production: Narasimhanna, M.N. (1988), CSB Publishing, Bangalore.
40. A Guide for Bivoltine Sericulture: Sengupta, K. (1989), Director, CSR&TI, Mysore.

41. Sericulture Training Manual: (1990), FAO, Rome.
42. A Treatise on the Acid Treatment of Silkworm Eggs: Biram, N.M. *et al.* (1990) Pub. by CSR&TI, Mysore.
43. New Technology of Silkworm Rearing: Krishnaswamy, S. (1986), Reprinted by CSB, Bangalore.
44. The Silkworm: An Important Laboratory Tool: Tazima, Y. (1978), Kodansha Ltd., Tokyo.
45. Silk Dyeing, Printing and Finishing: Gubrajani, M.L. (1986), New Delhi.
46. The Development of Indian Silk: Sinha, H., Oxford and IBh Publishing Co. Ltd. New Delhi.
47. Silk Reeling: Huang Gao Rui (1998), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
48. Silk Production and Weaving in India: Ghosh, C.C.
49. Sericulture and Silk Industry: Tripurari Sharma.
50. Silk Industry - Problem and Prospects: Ajas, A. and Lawpper, H.

Semester –IV
Paper-XVI, Foundation II,
Applied Zoology

Unit I: Human diseases and Disorders

1.1 Blood groups, blood transfusion

1.2 Heart failure: Cause, symptoms, precaution and remedy

1.3 Stress related disorders- Hypertension and Diabetes: cause, symptoms, precaution and remedy

1.4 Parasitic diseases: Malaria, Dengue, Swine flu

Unit II: Entomology

2.1 Sericulture: Life cycle and rearing of mulberry and non mulberry (tasar) silkworm and production of silk and its economic importance

2.2 Apiculture: culture of honey bees, bee products and its economic importance, Dance language of honeybee

2.3 Lac culture

2.4 Biological pest management

Unit III: Fisheries

3.2 Management of fish ponds, Breeding of fishes, Integrated fish farming

3.3 Prawn culture and Pearl culture

3.4 Fish products and byproducts, fish preservation

3.5 Fabrication and setting up of aquarium, its maintenance and aquarium fishes

Unit IV: Reproductive biology

4.1 Introduction to development of human embryo

4.2 Estrous and menstrual cycle
4.3 Introduction to contraceptives, In-vitro fertilization (IVF) and its significance
4.4 Infertility in male and female: Causes and remedy

Semester –IV, Paper-XVI, Foundation II,
Applied and Industrial Entomology

Unit 1- Mulberry sericulture
1.1 Mulberry sericulture:- life history and rearing.
1.2 Silk gland of mulberry silkworm:- structure and silk synthesis.
1.3 Cocoon formation, cocoon harvesting and reeling.
1.4 Mulberry plantation and silkworm rearing house.

Unit 2- Tasar sericulture
2.1 Tasar silkworm biology and life cycle.
2.2 Mature tasar larvae, silk gland and silk proteins.
2.3 Hammock and cocoon formation, cocoon harvesting.
2.4 Natural host plants and predators of tasar silkworm.

Unit 3- Eri, lac culture and medical entomology
3.1 Eri silkworm biology and life cycle.
3.2 Lac insect- biology, lac cultivation and economic importance.
3.3 Forensic entomology- basic concepts and importance.
3.4 Insect causes diseases in man- (Malaria, Filarial, Kala- Azar).

Unit 4- Apiculture
4.1 Types of honey bees, *Apisdorsata*, *A. indica* and *A. melifera.*
4.2 Colony formation and Apiary products.
4.3 Beekeeping techniques: moveable frame hive and bee rearing management.
4.4 Economic importance of honey, wax and other apiary products

Semester –IV, Paper-XVI, Foundation II, Applied Fresh Water Fisheries

Unit – I
1.1 Pre and post stocking management of pond.
1.2 Predators and their eradication.
1.3 Aquatic weeds and their control.
1.4 Manuring and liming of pond

Unit – II
2.1 Composite fish farming.
2.2 General outline of integrated fish farming.
2.3 Sewage fed fisheries.
2.4 Prawn culture.

Unit – III
3.1 Role of co-operative societies in fish marketing.

3.2 Introduction to fisheries economics

3.3 Economics of fish seed & fish production.

3.4 Fisheries extension services.

Unit- IV

4.1 Fresh water pearl culture.

4.2 Cage and Pen culture.

4.3 Setting up of aquarium and its maintenance.

4.4 General outline of fish diseases

Semester –IV, Paper-XVI, Foundation II, Applied Human Physiology

Unit 1- Circulation

1.1. Structure of Heart and its function

1.2. Cardiac cycle, ECG and blood pressure

1.3. Blood groups, blood transfusion

1.4. Heart failure; Trade milk test (TMT); Angioplasty and Angiography

Unit 2- Brain

2.1 Structure of human brain

2.2 Sense organ- Eye

2.3 Sense organ- Ear

2.4 Disorders of nervous system- Alzheimer's and Parkinson's disease

Unit 3- Reproduction

3.1 Reproductive organs and its function- Ovary and testis

3.2 Menstrual cycle, pregnancy, menopause and andropause

3.3 Role of placents

3.4 Parturition and lactation

Unit 4- Reproduction

4.1 Contraceptive methods in male and female- Barrier methods, natural methods, oral contraceptives and IUCD

4.2 Polycystic ovary syndrome; Brest cancer

4.3 Prostate cancer; Impotency

4.4 IVF; Surrogacy

Suggested Readings for foundation I and Foundation II

Entomology

1. Imms General text book of Entomology, Eds. O. W. Richards and R. G. Davis Chapman and Hall, London.
2. General and Applied Entomology, K.K. Nayar, T. N. Ananthkrishan and B.V. Davis Tata McGraw -Hill Co.Ltd. Bombay.
3. The Insect: Structure and function, R.F. Chapman, Cambridge University Press.
4. The Physiology of Insect , Ed. M.Rockstein ,Vol, 1-5, Academic Press, New York.
5. The Physiology of Insect Reproduction, F, Englemann, Pergamon Press, New York.
6. Comprehensive Insect Physiology , Biochemistry and Pharmocology , Eds. G.A.

Kerkut and I. A. Gillberd, VOL. 1-13, Pergamon Press, New York.

7. Analytical Biochemistry of Insect, Ed. R. B. Turner, Elsevier, Amsterdam.
8. Insect Hormone, M. J. A. Novak. Chapman and Hall, London.
9. Modern Entomology(Second edition): D. B. Tembhare, Himalaya Publication House, Bombay.
10. Destruction and Useful Insect, Their Hanits and Control, C. L. Metcalf, W. P. Flint and R. I. Metcalf, Mc Grow I Ill Co. New York.
11. Integrated Pest Management, J.L. Apple and R. E. Smith, Plenum Publication Co., New Delhi.
12. An Introduction Of Biological Control RVD Boarscho, P. S. Y. Messenger and A. P. Gaiter, Plenum Publication Co.
13. Text Book of Entomology, K. P. Shivastava, Vol. 1 And 2 Kalyani Publication, Ludhiana.
14. Agriculture Entomology, H. S. Dennis, Timber Press Inc.
15. Entomology and Pest Management, Larry P. Pedigo, Prentice Hall.
16. Text Book of Agriculture Entomology, Alford V. David, Blackwell Science.
17. Biopesticides In Insect Pest Management, S. J. Ignacimulha and AlokSen , Phoenix Publishing House Pvt, Ltd.
18. Biotechnology in Invertebrate Pathology and Cell culture (Maramorosch, K. ed.). Academic Press, New York.
19. PEBFANS (2003)" (Solomon Raju, A. J. ed.). Andhara University Press, Visakhapatnam.
20. Living Resources for the Millennium 2000 (S. J. William ed.), Students Offset Press, Chennai.

Fresh water Zoology

1. Fish Physiology Vol. 1 to 13: Hoar H.S. & Randall (Eds.) (1964-1994) Academic press London, New York.
2. The physiology of fishes Vol. 1&2: Brown M.E.(1957) Academic press, New York.
3. Natural history of fishes & systematic of fresh water fishes:PDattaMunshi, J.S. &Shrivastva, M.P.(1988): Narendra pub. House, Delhi.
4. Air breathing fishes of India- Their structure, function and life history: Dutta Munshi, J. S., Hunghes G.M. (1992) .Oxford and JBH publication Co. New Delhi.
5. The freshwater fishes of India, Pakistan, Bangladesh, Burma and Shri Lanka Handbook: Jayaram, K.C. (1981): Zoological Survey of India, Calcutta.
6. Fish migration: Jones, F.R. S. (1968), E.Arnold, London
7. Aquaculture, Bardach, Ryther and Mc Lamy
8. Marine fisheries: D. K. Dal, K. V. Rao
9. Ichthyology: Lagler, K. F., Bardach, J. and Miller, R.(1977) John Wileys and sons.
10. Fish Endocrinology: Matty, A. J. (1985), Chapman and Hall, London.
11. An aid to the identification of common commercial fishes of India and Pakistan: Mishra K. S. (1982).
12. Aquaculture: The farming and husbandry of freshwater and marine organism: Bardach, J.E. (1974). Narendra Publication House, New Delhi.

13. Handbook of breeding of Indian Major Carps by pituitary hormone injection: Chonder, S. L. (1970). Satish book enterprises, Agra.
14. Diseases of fish: Duijin, C:VanInr. (1973), life books London.
15. Fish and fisheries of India: Jhingran , V. G. (1985). Hindustan Publication Company, New Delhi.
16. Prawns and prawn fisheries of India: Kurian, C.V. and Sebastian, V. O. (19876) . Hindustan Publication Company, New Delhi.
17. The Sea food Industry: Martin, R. E.(1990). Narendra Publication House, New Delhi.
18. Ecological effects of water, applied limnology and pollutant effect: Welch, E. B. (1992).
19. A compemendium of aquaculture technologies: Sinha, V.R. P.(1993). Oxford and JBH publication Co. New Delhi.

Human Physiology

1 Text Book of Physiology & Biochemistry : Bell, G.E. & Davidson, J.N. &Emslie D. Smith, 1922
2 Medical Physiology : A Wiley Medical Publication, John Wiley & Sons, New York.
3 Mineral Metabolism :Comar, C.L. & Felix Bronner (1961) Acad Press, New York & London.
4 A Text Book of General Physiology :Dayson (1964) : Little Brown & Co. Boston.
5 Animal Physiology : R. Eckert & D. Randall (1983) 2nd Edn., W.H. Rexeman& Co.
6 Biochemistry & Physiology of the Cell : (2nd Edn.), M.A. Edwards & K.A. Hassall (1980) Mc. Graw Hill Co.
7 The Physiology of Cells :Cuthe F. (1968) : The Macmillan Co.
8 Textbook of Medical Physiology: Guyton, A.G. (1968). 7th Edn. Saunders Pub.
9 Samson Wrights Applied Physiology : Oxford University Press.
10 Comparative Animal Physiology C.L. Prosser, W.B. Saunders & Company.
11 Animal Physiology : Mechanism & Application, R. Eckert, W.H. Freeman & Company.
12 General & Comparative Animal Physiology : W.S. Hoar.
13 Medical Physiology : W.F. Ganong (1981) : 10th Edn. Lange Medical Publications.
14 Principles of Anatomy and Physiology: Tortora Grabowski, 9th Edn., John Willey & Sons.
15 Reproductive Physiology of Vertebrates: Van Tienhoven, A. (1983): 2nd Edn. Cornell Univ. Press, New York
16 A textbook of in vitro fertilization and assisted reproduction edited by P.R. Brinsden and P. A. RainsburJaypee brothers 1992.
17 Advances in Reproductive Physiology, Vol. 1 to 6: Mclaren, (1968). Logos Press Ltd., London.
18 Advances in Reproductive Toxicology eds. S. C. Joshi and A. S. Ansari Pointer publishers. Andrology. 2nd Edition Male Reproductive health and dysfunction (Eds. E. Nieschlag& H.M. Behre) 2000

19 Biochemistry of Mammalian Reproduction: Zanveld, L.J.D. & R.T. Chatterton (1982). John Wiley & sons, New York. The Ovary. Vol. I, II & III: Zuckerman, S, (1962). Academic Press, London.

20 Biology of Gestation: Assalye, N.S. (1968). Academic Press, London.

21 Biology of ovarian follicles in mammals (1985). S. S. Guraya Springer-Verlag.

22 Comparative cellular and molecular biology of testis in vertebrates (Trends in endocrine, paracrine and autocrine regulation of structure of functions) (2001) S.S. Guraya, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, Calcutta

23 Comparative Endocrinology and Reproduction. Eds. K.P. Joy, A. Krishna and C. Haldar, Narosa Publishing House (1998).

24 Contraceptive Technology Past, Present and Future: Das. R.P. (1989). N.I.H.F.W. New Delhi.

25 Control of ovulation: Crighton, D.B., Haynes, N.B. Foxcroft, G.R. & G.E. Lamming (1978). Butterworths, London

26 Encylopedia of Reproduction Vol. I, II, III, IV eds. Ernst Knobil and J.D. Neill (1998).

27 Endocrinology and metabolism. 4th edition 2001. Philip Felig&Lowrence A. Frohmon McGraw Hill Inc. Medical Publishing Division.

28 Endocrinology. Vol. 1 to 3: L.J. Degroot et al. (1989). W.B. Saundors Co. Philadelphia.

29 General Endocrinolgoy: Turner, C.D. & J.T. Bagnara (1990) W.B. Saunders Co., & Toppan Co., Philadelphia, London & Tokyo.

30 Hormonal Control of Lactation: Cowie, A.T. Forryth, I.A. and I. Hart (1980). Springer-Verlag, Berlin & New York

31 Mammalian Oviduct: Hafez, E.S., and R.J. Blandu. The University of Chicago Press, Chicago, London.

32 Marshall's Physiology of Reproduction. 4th Edition Vol. 3 Pregnancy and Lactation Part I, II, III edited by G.E. Lamming, Champan and Hall.

33 Ovarian Cycle of Mammals: Perry, J.S. Oliver and Boyd, Edinburgh.

34. Patterns of Reproduction: Asdell, S.A. (1964). Constable and Co. London.

35. Physiology of Lactation: Smith, Vearch, Constable & Co., London.

36. Postgraduate Reproductive endocrinology. 4th Edition. 1997. R. RajanJaypee brothers. Medical Publishers (P) Ltd.

37. Practice of fertility control, Choudhary S. K. Churchill and Livingstone.

38. Progress in Reproductive Biology, Vol. 4. The pineal and reproduction: Reiter, R.J. Series Ed. P.O. Hubinant, Karger, Basel. Paris, London (latest edition).

39. Reproduction in Mammals Series: 1 to 6: Austin, C.R. and R. V. Short (1984 & 1994),
Cambridge University Press, Cambridge.

40. Reproductive Endocrinology: Ref. No. 1, Vol. 3 Hormones in Reproduction.

41. Seasonal Patterns of Stress, immune function and disease R.J. Nelson, G.E. Demas, S.L. Klein, L.J. Kriegsfeld. 2002. Cambridge Univ. Press.

42. Shaw's textbook of Gynaecology eds. V. G. Padubidri and S. N. Daftary. 2000.

43. The Biology of Blastocyst: Blandau, R.J. (1971). The University of Chicago Press,

Chicago & London.

44. The Prostaglandins Vol. I & II: Ramwell, P.W. (1974). Prenum Press, New York and London.
45. The Testis Vol. 1 to 4: Jhonson, A.D. and W. R., Gomes.
46. Vertebrate FoetalMembrances: Mossman, H.W. (1989). Rutgress Press Ltd.
47. WHO laboratory manual for the examination of human semen and sperm – cervical mucus interaction. 4th Edition Cambridge Univ. Press. 2000.

Question paper pattern: Guidelines to paper setters

The theory question papers comprises of **four** questions. All questions are compulsory and carry equal marks.

Q. 1. One long answer question from Unit-I
OR
Two short notes from Unit-I

Q. 2. One long answer question from Unit-II
OR
Two short notes from Unit-II

Q. 3. One long answer question from Unit-III
OR
Two short notes from Unit-III

Q. 4. One long answer question from Unit-IV
OR
Two short notes from Unit-IV