KARNATAK UNIVERSITY, DHARWAD

B.Sc. Programme

***

DRAFT SYLLABUS FOR

PHYSICS (Optional)

subject

AS DISCIPLINE SPECIFIC COURSE (DSC) , DISCIPLINE SPECIFIC ELECTIVE (DSE) and SKILL ENHANCEMENT COURSE (SEC)

UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

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Effective from 2020-21

Karnatak University, Dharwad
CBCS syllabus for Under Graduate Programme in Physics (optional)
Effective from 2020-21

Semester	Theory/ Practical	Subject Code	Total Teaching hours per week	Total Teaching hours per Semester	Duration of Exams.	Internal Assessment Marks	Semester end Exam Marks	Total Marks	Credits
I	Theory	DSC PHYT:101	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC PHYP:102	04 hrs	60	03 hrs	10	40	50	02
II	Theory	DSC PHYT:201	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC PHYP:202	04 hrs	60	03 hrs	10	40	50	02
III	Theory	DSC PHYT:301	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC PHYP:302	04 hrs	60	03 hrs	10	40	50	02
IV	Theory	DSC PHYT:401	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC PHYP:402	04 hrs	60	03 hrs	10	40	50	02
V	Theory	DSE PHYT:501A **OR** PHYT:501B	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSE PHYP:502	04 hrs	60	03 hrs	10	40	50	02
	Practical	SEC-1 PHYP:503	04hrs	60	03hrs	10	40	50	02
		SEC-2 PHYP:504	04hrs	60	03hrs	10	40	50	02
VI	Theory	DSE PHYT:601A **OR** PHYT:601B	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSE PHYP:602	04 hrs	60	03 hrs	10	40	50	02
	Practical	SEC-1 PHYP:603	04hrs	60	03hrs	10	40	50	02
		SEC-2 PHYP:604	04hrs	60	03hrs	10	40	50	02
Total						220	880	1100	44

*Credit means the unit by which the course work is measured. One hour session of Lecture per week for 16 weeks amounts to 1 credit. Four hours session of Practicals per week for 16 weeks amounts to 2 credits per semester.

** Student has to choose only one elective(DSE) during his/her fifth and sixth semester.

Discipline Specific Course(DSC), Discipline Specific Elective and Skill Enhancement Course Topics under CBCS in Physics.

Sem	Type	Course
1	DSC PHYT:101	**Mechanics and properties of Matter** Newtonian Mechanics, Classical Mechanics, Special Theory of Relativity, Gravitation and Elasticity
	DSC PHYP:102	**Practicals 1**
2	DSC PHYT:201	**Thermal Physics and Fluid Mechanics** Thermodynamics, Kinetic theory of gases, Statistical Physics, Radiation, Astrophysics, Surface Tension and Viscosity
	DSC PHYP:202	**Practicals 2**
3	DSC PHYT:301	**Electrostatics and Electricity** Dielectrics, Transients, Alternating Current, Electrical instruments and measurements, Electromagnetic induction and Thermoelectricity
	DSC PHYP:302	**Practicals 3**
4	DSC PHYT:401	**Electromagnetic theory and Optics** Electromagnetic theory, Geometrical optics, Interference, Diffraction and Polarisation
	DSC PHYP:402	**Practicals 4**
5	DSE PHYT:501A **OR** PHYT:501B	**Modern Physics-I** Quantum Mechanics, Spectroscopy and Nuclear Physics **OR** **Modern Physics-II**
	DSE PHYP:502	**Practicals 5**
	SEC-1 PHYP:503	**Basic instrumentation skills-I** **Practicals 6**
	SEC-2 PHYP:504	**Basic instrumentation skills-II** **Practicals 7**
6	DSE PHYT:601A **OR** PHYT:601B	**Solid State Physics and Electronics-I** Crystal structure, Specific heats, Semiconductors, Magnetic Materials, Superconductivity, BJT, FET, IC's, Digital electronics and Communication. **OR** **Solid State Physics and Electronics-II**
	DSE PHYP:602	**Practicals 8**
	SEC-1 PHYP:603	**Applied Physics-I** **Practicals 9**
	SEC-2 PHYP:604	**Applied Physics-II** **Practicals 10**

Question Paper Pattern
B.Sc. I, II, III, IV & V and VI Sem (CBCS)
Subject: PHYSICS

I) Maximum Marks = 80
II) Question paper is divided into four parts such as PART A, PART B, PART C and PART D.
III) Each PART is set for 20 marks.
IV) Equal weightage may be given to all the topics.
V) The pattern of questions in each part is given below.

PART A: TWO MARKS Questions

1. This part should contain 12(Twelve) questions covering all the topics of syllabus.
2. Each Question carries 2 Marks.
3. Students are required to answer any 10 questions.
4. Questions are of short answer type/simple problems involving one or two steps/ Drawing circuit/Ray diagram.
5. Minimum 3 Questions in this part should be of problem solving type.
6. Multiple choice Questions should be avoided.
7. Total Marks for Part A: 2x10 =20

PART B: FIVE MARKS Questions

1. This part should contain 06(Six) questions covering all the topics of syllabus.
2. Each Question carries 5 Marks.
3. Students are required to answer any 4 questions.
4. Questions are of descriptive type/derivation type/Shortnote type.
5. Questions on Numerical problems should not be asked in this part.
6. Total Marks for Part B: 5x4 = 20

PART C: FOUR MARKS Questions

1. This part should contain 08(eight) Numerical problems covering all the topics of syllabus.
2. Each Question carries 4 Marks.
3. Students are required to answer any 5 questions.
4. Total marks for Part C: 4x5=20

PART D: TEN MARKS Questions

1. This part should contain 04(four) questions covering all the topics of syllabus.
2. Each Question carries 10 Marks.
3. Students are required to answer any 2 questions.
4. Questions are of descriptive type/derivation type/Shortnote type/long answer type only.
5. Questions on Numerical problems should not be asked in this part.
6. Wherever necessary each Question may be split into two or 3 sub questions as required by paper setter.
7. Total Marks for part D: 10x2 = 20

Note: This is main structure of question paper. Question paper setter may be permitted to make small modification while giving equal weightage to topics in descriptive type and numerical type questions.

B.Sc. I, II, III, IV, V and VI semester (CBCS)

Scheme of evaluation for practical examinations in physics

1.	Basic formula with description of quantities, Units & Nature of graph.	-04 Marks.
2.	Circuit Diagram/Ray Diagram/ Schematic diagram with proper labeling.	-04 Marks.
3.	Tabular Column with Quantitieies and Unit Mentioned.	-04 Marks.
4.	Experimental Skills.	-04 Marks.
5.	Recording of observations	-08 Marks
6.	Calculations and drawing graph	-06 Marks
7.	Accuracy of Result	-02 Marks
8.	Viva-Voce	-04 Marks
9.	Completed & Certified Journal	-04 Marks
10.	Total	-40 Marks

Scheme of evaluation for calculation type experiments

1.	Basic Formula with description	-05 Marks
2.	Tabular Column	-05 Marks
3.	Calculation of Required Quantities for a data set1	-10 Marks
4.	Calculation of Required Quantities for a data set-2	-10 Marks
5.	Accuracy of Result	-02 Marks
6.	Viva-Voce	-04 Marks
7.	Completed & Certified Journal	-04 Marks
8.	Total	-40 Marks

CBCS syllabus w.e.f. 2020-21
B.Sc. FIRST SEMESTER
Optional Subject: PHYSICS(DSC-PHYT:101)
Mechanics and properties of Matter
(Credits:Theory-04, Practicals-02) Theory: 60 Hours

Newtonian Mechanics:

Frames of References (5 hours):

Inertial frames, Galilean transformation equations (derivation), Invariance of Newton's Laws under Galilean Transformations, Invariance of the laws of conservation of momentum and energy under Galilean transformations, Non-inertial frames and fictitious force(in brief), rotating frame of reference, concept of the Coriolis force and mention of its expression.

Linear Momentum (10 hours):

Linear Momentum, Law of conservation of linear momentum for a system of particles, Centre of mass of a system of particles, Position coordinates of the Centre of Mass, Motion of center of mass, collision between two particles which stick together (inelastic collision, one dimentional) and do not stick together (elastic collision, two dimensional) in laboratory frame of reference and in the centre of mass frame of reference , Conservation of linear momentum in case of variable mass: examples i) Single stage rocket (expression for velocity neglecting the weight) ii) Double stage rocket(derivation for final velocity).

Angular momentum (5 hours):

Angular momentum and its relation to angular velocity, Torque and its relation to angular velocity, Relation between angular momentum and Torque, Law of conservation of angular momentum, Work done by a Torque, Central force, Kepler's second law of Planetary motion (derivation).

Classical Mechanics(15 hrs):

Constraints (Holonomic, Non-holonomic, Scleronomic, and Rheonomic constraints with examples), Degrees of freedom, space point and configuration space, virtual displacement and principle of virtual work, Generalized co-ordinates, Generalised velocity and generalized force, D'Alembert's Principle, Derivation of Lagrange's equation of motion using D'Alembert's Principle (For holonomic case), some applications of the Lagrangian method: Newton's equation of motion from Lagrange equations, Simple pendulum, Atwood's machine & Linear Harmonic Oscillator. Qualitative discussion on Hamiltonian formulation.

Special Theory of Relativity (10 hours):

The Michelson-Morley experiment, Significance of negative result. Postulates of special theory of relativity. The Lorentz transformation equations (Derivation), Length contraction, Time dilation, Simultaneity, Twin paradox, Addition of velocities, Variation of mass with velocity, Mass-Energy Equivalence (with derivation). Space-Time diagram: Minkowski's four dimensional space-time.

Gravitation (5 hours):

Newton's Law of Gravitation. Determination of Gravitational constant by Cavendish's method. Density and mass of the Earth. Satellite in circular orbit and Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Qualitative discussions on applications of artificial satellites.

Elasticity (6 hours):

Stress, Strain, Elastic limit, Hooke's law, Modulii of elasticity for isotropic materials, Relation between elastic constants (Derivation), Poisson's Ratio, Work done for unit Volume in stretching a wire, Bending of Beams- Neutral surface, Neutral axis, Plane of Bending, Bending Moment, Expression for bending moment (Derivation), uniform bending (mention formula), Theory of light cantilever (Derivation), Torsion expression for the couple per unit twist.

Cathode Ray Oscilloscope(4 hours, without numerical problem):

Introduction to CRO, Basic diagram of CRT: Brief introduction to Electron Beam,Operating voltage, Deflecting plates, Deflecting voltages, Phosphor Screen. Block diagram of CRO: Brief mention of functions of Verticle and Horizontal Amplifier, Delay Line, Time Base, Trigger Circuit, Power supply and brief explanation of waveform display. Mention of uses of CRO.

Note:

1. **Number of teaching hours per week are four.**
2. **Total teaching hours are inclusive of solving numerical problems on all the topics.**
3. **Preference may be given to solve maximum number of numerical problems.**

Reference books:

1. Mechanics (VI-Edition) - J.C.Upadhyay –Ramprasad & Sons,Agra, 2005.
2. Mechanics (XX-Edition) – D.S.Mathur- S. Chand & Company Ltd., New-Delhi, 2007.
3. Mechanics & Electrodynamics (XVII-Edition, Course- 1 & 2) – Brijlal, Subramanyam & Jivan Seshan, S. Chand & Company Ltd., New-Delhi, 2008.
4. Properties of Matter (XIII-Edition) – Brijlal & Subramanyam, Eurasia Publishing House Pvt. Ltd., New-Delhi, 2001.
5. Elements of Properties of Matter (XXVIII-Edition), D.S.Mathur - S. Chand & Company Ltd., New-Delhi, 2005.
6. Physics , Vol. No.I (V-Edition)– Resnick, Halliday & Krane – John Wiley & Sons Inc., New-York, Singapore, 2005.
7. Berkely Physics, Vol. No.I – ABC Publications, Bangalore & New-Delhi.
8. University Physics (XI-Edition)- Young & Freedman – Pearson Education, 2004.
9. Principles of Physics (V-Edition)- Serway & Jewett , THOMSON BROOKS/COLE.
10. Classical Mechanics(X Ed)- Takwale and Puranik-Tata.McGraw Hill,Newdehli,1989.
11. Classical Mechanics(XIV ed)- Gupta,Kumar & Sharma.
12. Classical Mechanics(XVII ed)- Goldstein-Narosa Publishing Newdehli,1998.
13. Introduction to Relativity- R.Resnik.
14. Relativistic Mechanics- Gupta and Kumar.
15. Physics For Degree Students B. Sc. First Year, S. Chand & Company.
16. Electronics Instrumentation by H S Kalasi.
17. B.Sc. practical Physics – C.L.Arora.
18. Advanced practical Physics – Samir Kumar Ghosh.
19. Advanced practical Physics – Worsnop and Flint.

List of first semester Physics (DSC-PHYP:102) Experiments:

1. Estimation of errors(Average deviation, Standard deviation, standard error and Probable error) in the experimental determination of physical quantities like length, diameter, thickness, time, mass, temperature and resistance from the given data. And also fit the given data to a straight line graph and calculate from the given observations Standard deviation, standard error and Probable error.
2. To study (i) the law of conservation of linear momentum, (ii) the law of conservation of kinetic energy and (iii) to calculate coefficient of restitution using one dimensional apparatus of two hanging spheres.
3. Moment of Inertia of the Fly-Wheel.
4. Bar pendulum/Kater's Pendulum.
5. Verification of Parallel axes theorem of Moment of Inertia using Bar Pendulum.
6. Y- by bending using Cantilever.
7. Modulus of Rigidity of a wire using disc/ Maxwell's needle.
8. To find Youngs modulus, modulus of rigidity and poisson's ratio for the material of a wire by Searle's method.
9. To determine gravitational constant 'G'by Cavendish Method.
10. Use of CRO – Measurement of AC and DC voltage. Measurement of frequency of sine and square waves.
11. Problem based learning in physics: Problems on classical mechanics, gravitation (especially on satellite communication), special theory of relativity, rigid body dynamics and center of mass of different bodies.
12. Simulation experiments (if any demonstration purpose only).
13. Use of both analog and digital Multimeters for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses. (Demonstration purpose only).

Note:

1. **Experiments are of four hours duration.**
2. **Minimum of Eight experiments to be performed.**
3. **Any new experiment may be added to the list with the prior approval from the BOS.**

CBCS syllabus w.e.f. 2020-21
B.Sc. SECOND SEMESTER
Optional Subject: PHYSICS(DSC-PHYT:201)
Thermal Physics and Fluid Mechanics
(Credits:Theory-04, Practicals-02) Theory: 60Hours

Thermodynamics (15 hours):
Review of basic concepts.
Heat engines: Otto engine, Otto cycle and expression for efficiency. Diesel engine, Diesel cycle, expression for efficiency and Carnot's theorem.
Entropy: Concept of entropy, change in entropy in reversible and irreversible processes, entropy-temperature diagram, second law of thermodynamics.
Enthalpy, Helmoltz, Gibbs and Internal energy functions, Relation among these functions. Maxwell's Thermodynamical relations(with derivation). Applications of Maxwell's Thermodynamical relations: (i) to derive Clausius-Clapeyron's latent heat equation and (ii) Joule-Thomson expansion.
Kinetic theory of gases (10 hours):
Maxwell's law of distribution of velocities (qualitative) & its experimental verification by Zartman and Ko method. Expressions for Average, r.m.s. & most probable velocities(with derivation). Qualitative discussions on Mean free path, mention of Clausius and Maxwell's expressions for mean free path. Transport phenomena — Brief discussion on Viscosity, Thermal conductivity and Diffusion. Expressions for Coefficient of Viscosity, Coefficient of Thermal conductivity and Coefficient of Diffusion (with derivations) and relation between them. Theory of Brownian motion, Einstein's expression for coefficient of Diffusion from the knowledge of mean square displacement and partial pressure difference(with derivation), Determination of Avogadro's number by Perrin method.
Statistical Physics (5 hours):
Introduction to statistical Physics, Statistics of identical particles – Derivation for distribution functions in case of Maxwell-Boltzmann statistics, Bose-Einstein statistics and Fermi-Dirac statistics and the comparision between them.
Radiation (7 hours):
Concept of Radiation and Radiation pressure(qualitative), Stefan's law & its derivation using radiation pressure. Laboratory method for determination of Stefan's constant. Wein's displacement law(with derivation), Rayleigh-Jeans's law (qualitative), Planck's law of radiation & its derivation. Ferry's total radiation Pyrometer.
Astrophysics (8hours):
Units of stellar distances: light year and Parsec,luminosities of stars, absolute and apparent magnitude,relation between absolute,apparent magnitude and distance. Expression for radius of the star. Spectral classification of stars: E. C. Pickering classification (Harvard classification). H-R diagram, main sequence stars, general properties of main sequence stars.Surface temperature of star and its color, linear density model of star, expression for average temperature of star, binary stars, stellar masses. Evolution of stars to white dwarfs, different stages, formation of neutron stars and black holes (qualitative).

Fluid Mechanics (15 hours):

Surface Tension: Review of basics of Surface Tension. Pressure difference across a liquid surface: Excess pressure inside a spherical liquid drop and Excess pressure inside a soap Bubble. Derivation of relation between radius of curvature, pressure and Surface tension. Angle of Contact: Case of two liquids in contact with each other and with air, case of solid, liquid and air in contact. Theory of Rise of liquid in a capillary tube. Experimental determination of surface tension by Jeager's method with relevant theory.

Viscosity: Viscosity of a liquid, Expression for co-efficient of viscosity, Expression for Critical velocity, Significance of Reynold's number. Derivation of Poiseuille's equation. Experimental determination of co-efficient of viscosity for a liquid by Poiseuille's method. Motion of a spherical body in a viscous medium: Expression for co-efficient of viscosity from Stoke's law, Theory of Rotation Viscometer.

Note:

1. **Number of teaching hours per week are hour.**
2. **Total teaching hours are inclusive of solving numerical problems on all the topics.**
3. **Preference may be given to solve maximum number of numerical problems.**

Reference books:

1. Kinetic Theory of Gases(I-Edition) – V.N.Kelkar – Ideal Book Service, Pune, 1967.
2. Kinetic Theory of Gases(II-Edition) – R.S.Bhoosnurmath – IBH Prakashana, Bangalore, 1981.
3. Heat & Thermodynamics and Statistical Physics(XVIII-Edition) – Singhal, Agarwal & Satyaprakash – Pragati Prakashan, Meerut, 2006.
4. Heat & Thermodynamics and Statistical Physics(I-Edition) – Brijlal , Subramanyam & Hemne - S. Chand & Company Ltd., New-Delhi, 2008.
5. Heat and Thermodynamics (I-Edition) – D.S.Mathur - S. Chand & Company Ltd., New-Delhi, 1991.
6. A Treatise on Heat – Shaha and Srivatsava.
7. A text book of heat - J.B.Rajam.
8. Properties of Matter (XIII-Edition) – Brijlal & Subramanyam, Eurasia Publishing House Pvt. Ltd., New-Delhi, 2001.
9. Elements of Properties of Matter (XXVIII-Edition), D.S.Mathur - S. Chand & Company Ltd., New-Delhi, 2005.
10. Physics , Vol. No.I (V-Edition)– Resnick, Halliday & Krane – John Wiley & Sons Inc., New-York, Singapore, 2005.
11. Berkely Physics, Vol. No.I – ABC Publications, Bangalore & New-Delhi.
12. University Physics (XI-Edition)- Young & Freedman – Pearson Education, 2004
13. Introduction to Astrophysics(XV ed)- Baidyanath Basu-Prantice Hall of India-2006.
14. Astrophysics(III ed)- K.D.Abhyankar-Universities Press India Pvt. Ltd. 2009.
15. Introduction to Astrophysics and Astronomy- M. Zeilik, Gregory and Smith.
16. B.Sc. practical Physics – C.L.Arora.
17. Advanced practical Physics – Samir Kumar Ghosh.
18. Advanced practical Physics – Worsnop and Flint.

List of second semester Physics(DSC-PHYP:202) Experiments:

1. To study the adiabatic expansion of a gas and hence to find the value of ratio of specific heat (γ) at constant pressure to specific heat at constant volume for air using Clement and Desorme's apparatus.
2. Lee's method of determination of thermal conductivity of a bad conductor.
3. Verification of Stefan's Law (Electrical method).
4. 'J' by continuous flow method.
5. Determination of thermal conductivity of copper by Searle's method.
6. Determination of Stefan's constant.
7. Surface Tension by Jeager's method.
8. Surface Tension by Quincke's method.
9. H-R Diagram: Study of classification of stars and stellar evolution.
10. To determine the Coefficient of Viscosity of water by Capillary Flow method (Poiseuille's method).
11. Use of CRO- Study of Lissajous figures and determination of Phase Shift using CR network by continuous wave method and Lissajous figures.
12. Problem based learning in physics: Problems on entropy, heat engines, fluid mechanics and statistical physics.

Note:

1. **Experiments are of four hours duration.**
2. **Minimum of Eight experiments to be performed.**
3. **Any new experiment may be added to the list with the prior approval from the BOS.**

CBCS syllabus w.e.f. 2021-22
B.Sc.THIRD SEMESTER
Optional Subject: PHYSICS(DSC-PHYT:301)
Electrostatics and Electricity
(Credits:Theory-04, Practicals-02) Theory: 60 Hours

Dielectrics (10 hours):
Introduction to dielectric materials with examples.
Concepts of scalar and vector fields with examples, Properties of vector fields: flux and circulation, flux of an electric field, Gauss law of electrostatics in vacuum and in dielectric medium.
Dielectric in an electric field, electric polarization (P), electric displacement(D), electric susceptibility(χ) and atomic polarizability(α), relation between D,E and P. Boundary condition at a dielectric surface (Derivation), Expression for force between two charges in a dielectric medium separated by a distance, Expression for Stored energy in a dielectric medium, dielectric medium in a capacitor, dielectric constant and its determination for liquids and solids by Hopkinson's method. Mention of Clausius–Mosotti equation and its limitations.
Transient currents (8 hours):
Theory of growth & decay of current through RL circuit. Theory of charging & discharging of capacitor through RC circuit. Time constants of RL & RC circuits. Measurement of high resistance by leakage method.
Alternating current, AC bridges and Filters (15 hours):
Operator j, Argand diagram. LCR series ciruit – Expression for current, impedence & phase (using j–operator method). Condition for resonance, resonant frequency, Band width, quality factor & their relation (qualitative).
LCR parallel circuit (Series L-R in parallel with C) - Expression for admittance & condition for resonance (using j-operator method). Comparison between series & parallel resonant circuits.
A.C. Bridge, Measurement of inductance, Theory of Maxwell's bridge and Anderson's bridge. Measurment of capacity by de Sauty's method.
Theory of Low pass and high pass constant K–type filters.
Network theorems (5 hours):
Current and voltage sources, Thevenin and Norton's Theorems.
Power Supplies (5 hours): Power Supplies with filters (C, L, LC and π-section), Ripple factor(mention expression).
Electrical instruments, measurements and Electromagnetic induction (10 hours):
Theory of moving coil galvanometer to be ballistic & dead beat. Charge and current sensitivity and their relationship, correction for damping. Measurement of capacitance of a capacitor using Ballistic Galvanometer by absolute method.
Brief discussions on Faraday's laws and Lenz's law, self and mutual inductance. Determination of self inductance (L) by Rayleigh's method and mutual inductance by direct method with necessary theory.

Thermoelectricity (7 hours):

Seebeck effect, Variation of thermo emf with temperature, neutral temperature & temperature of inversion. Thermoelectric series. Peltier effect, Thomson effect. Thermoelectric laws. Derivation of the relations $\pi = T\ (de/dT)$ and σ_a-$\sigma_b = T\ (d^2e/dT^2)$. Tait diagram and its uses. Applications of Thermoelectricity, Qualitative discussion on different types of Thermocouples (J-type, K-type and RTD type).

Note:

1. **Number of teaching hours per week are four.**
2. **Total teaching hours are inclusive of solving numerical problems on all the topics.**
3. **Preference may be given to solve maximum number of numerical problems.**

Reference books:

1. Fundamentals of Electricity and Magnetism – Basudev Ghosh – Books & Allied New Central Book Agency, Calcutta, 2009.
2. Electricity and magnetism- D.N. Vasudev- S.Chand Publication, New Dehli.
3. Electricity and Magnetism- B.S.Agarwal- S.Chand Publication,New Dehli.
4. Electricity and magnetism- Brij lal & Subramasnyam.
5. Electricity and magnetism and Atomic physics vol-I – John Yarwood.
6. Electricity and magnetism – A.N.Matveer-Mir publisher,Moscow 1986.
7. Introduction to electrodynamics- D.J.Griffith(3rd ed)Prentice Hall of India,New Dehli.
8. Vector Analysis-Hague
9. Electricity and Magnetism- D.Chattopadhya & Rakshit.
10. Electricity and magnetism- K.K.Tiwari
11. Fundamentals of electricity and magnetism- D.N.Vasudev.
12. Electricity and Magnetism- Segal and Chopra
13. Text book of Electrical Technology, Vol. 1 – B.L. Theraja and A.K Theraja.
14. B.Sc. practical Physics – C.L.Arora.
15. Advanced practical Physics – Samir Kumar Ghosh.
16. Advanced practical Physics – Worsnop and Flint.

List of third semester Physics(DSC-PHYP:302) Experiments:

1. Determination of dielectric constant of a liquid.
2. Calibration of Ballistic Galvanometer (BG): Determination of the constants of B.G.
3. Measurement of capacity by absolute method, using B.G.
4. Verification of Thevenin and Norton's theorem using ladder network.
5. Study of low pass filter.
6. Full wave bridge rectifier with LC-section and π-section filter.
7. Determination of coefficient of self-inductance (L) by Rayleigh's method/ Anderson's bridge method.
8. Measurement of emf of a thermocouple at various temperatures and verification of any one law of thermoelectric effect.
9. Calibration of a spectrometer.
10. Dispersive curve and dispersive power of a prism.
11. Polarimeter
12. Diffraction at a wire or aperture using laser.

Note:

1. **Experiments are of four hours duration.**
2. **Minimum of Eight experiments to be performed.**
3. **Any new experiment may be added to the list with the prior approval from the BOS.**

CBCS syllabus w.e.f. 2021-22
B.Sc.FOURTH SEMESTER
Optional Subject: PHYSICS(DSC-PHYT:401)

Electromagnetic theory and Optics

(Credits:Theory-04, Practicals-02) Theory: 60 Hours

Electromagnetic theory (10 hours):

Concept of fields and their classification. The gradient of a scalar field. The divergence and curl of a vector field. The physical significance of gradient, divergence and curl. Gauss, Green's and Stokes theorems.

Maxwell's equations: Amperes circuital law and its drawback, continuity theorem. Derivation of Maxwell's equations in differential forms, mention of integral forms & their physical significance. Derivation of general plane wave equations in free space. Transverse nature of radiation. Poynting theorem (Discussion without derivation).

Geometrical Optics (8 hours):

Cardinal points: Cardinal points of a optical system. Equivalent focal length of two thin lenses separated by a distance. location of cardinal points of a thick lens (derivation). Experimental determination of cardinal points of a lens system using Searle's Goniometer and Turn Table(Nodal slide).

Occulars and Aberrations (5 hours):

Huygen's eye piece:Construction, Theory and cardinal points. Ramsden eye piece: Theory and cardinal points.

Spherical & chromatic aberrations. Methods to reduce spherical aberrations (qualitative). Condition for achromatism of two thin lenses (i) in contact and (2) separated by a distance.

Interference (15 hours):

Interference due to division of wave front: Fresnel's biprism. Detemination of wavelength of monochromatic light & thickness of a thin film using biprism.

Interference due to division of amplitude:

The colours of thin films. Interference phenomenon with a plane parallel thin film: in case of reflected light and transimitted light(with derivation). Interference using wedge shaped film . Theory of Newton's rings. Determination of wavelength of monochromatic light by Newton's rings. Michelson interferometer: Principle, construction and working. Formation of circular & straight fringes (qualitative). Determination of wavelength of monochromatic light using Michelson interferometer.

Diffraction (15 hours):

Introduction to diffraction and classification of diffraction phenomena.

Fresnel diffraction: Fresnel's treatment of the wave front and Fresnel assumptions. Theory of half period zones considering plane wave fronts. Zone plate:construction, theory and expression for focal length. Comparison between zone plate and convex lens. **Fraunhoffer diffraction**: Fraunhoffer diffraction at a single slit, at a double slit and N slits with detailed theory (Geometrical method). Diffraction grating. Theory of Plane transmission grating. Dispersive power of grating. Rayleigh's criterion for resolution. Distinction between Fresnel diffraction and Fraunhoffer diffraction. Comparision of grating and Prism spectra.

Polarisation (7 hours):

Review of basics of polarization. Malus law. Huygen's theory of double refraction. Positive and negative crystals. Theory of circularly & elliptically polarized light. Production of circularly and elliptically polarized light. Wave plates: quarter wave plate and half wave plate. Optical activity, Fresnel's explanation of optical rotation, analytical treatment and specific rotation. Laurent's Half Shade Polarimeter: Construction and working.

Note:

1. **Number of teaching hours per week are four.**
2. **Total teaching hours are inclusive of solving numerical problems on all the topics.**
3. **Preference may be given to solve maximum number of numerical problems.**

Reference books:

1. Principles of Optics (I-Edition) – B.K.Mathur – New Gopal Printing Press, 1962.
2. Fundamentals of Optics (V-Edition) – Khanna & Bedi – R. Chand & Co., New-Delhi, 1971.
3. A Text book of Optics (I-Edition) – Brijlal & Subramanyam - S. Chand & Company Ltd., New-Delhi, 2006.
4. Fundamentals of optics- Khanna and Gulati.
5. Optics (IV-Edition) – Ajay Ghatak –Tata Mc Graw-Hill, New-Delhi, 2006
6. Fundamentals of Optics (III-Edition) – Jenkins & White - Mc Graw-Hill, 1957.
7. Geometrical Optics (I-Edition) – D.P.Acharya – Oxford & IBH Pub. Co., New-Delhi,1970.
8. Optics & Spectroscopy (VI-Edition) – Murugeshan, Kirutiga & Shivaprasath - S. Chand & Company Ltd., New-Delhi, 2006.
9. Geometrical Optics – A. Verstraeten.
10. Introduction to electrodynamics- D.J.Griffith(3rd ed)Prentice Hall of India,New Dehli.
11. Vector Analysis- Hague
12. University Physics (XI-Edition)- Young & Freedman – Pearson Education, 2004.
13. B.Sc. practical Physics – C.L.Arora.
14. Advanced practical Physics – Samir Kumar Ghosh.
15. Advanced practical Physics – Worsnop and Flint.

List of fourth semester Physics(DSC-PHYP:402) Experiments:

1. Goniometer
2. Turn table
3. Newton’s rings
4. R.P. of a prism/ R.P. of grating.
5. Biprism: Determination of wavelength of monochromatic light.
6. Michelson interferometer
7. Determination of wavelength of laser light by Young’s double slit method.
8. Study of elliptically polarized light using polariser-analyser setup and sodium vapour source.
9. Determination of high resistance by leakage method, using B.G.
10. Determination of coefficient of mutual inductance by direct method/Carey-Foster’s method.
11. Verification of Thevenin and Norton’s theorem using Wheatstone’s bridge (unbalanced)
12. Study of high pass filter.

Note:

1. **Experiments of four hours duration.**
2. **Minimum of Eight experiments to be performed.**
3. **Any new experiment may be added to the list with the prior approval from the BOS.**

CBCS syllabus w.e.f. 2022-23
B.Sc. FIFTH SEMESTER
Optional Subject: PHYSICS(DSE-PHYT:501A)

Modern Physics-I(Elective 1)

(Credits:Theory-04, Practicals-02) Theory: 60 Hours

<u>Quantum Mechanics (15 hours):</u>

Brief discussion on failure of classical physics to explain black body radiation, Photoelectric effect, Compton effect, stability of atoms and spectra of atoms.

Compton Scattering: Expression for energy of the scattered photon, kinetic energy of the recoil electron and Compton shift(with derivation).

Matter Waves: de Broglie hypothesis. Expression for group velocity and Phase velocity of matter waves. G.P.Thomson's experiment and its significance.

Uncertainty principle: Statement and illustration by Gamma ray microscope and diffraction of electrons at a single slit.

Wave Mechanics: Setting up of time independent Schrodinger's equation. Physical interpretation of wave function. Eigen function and Eigen values. Expression for energy: Particle in a one-dimensional infinite potential well(derivation), mention of expression in three dimensions, degeneracy and Particle in a finite potential well (qualitative). Concept of potential barrier and quantum mechanical tunneling. Qualitative discussion on quantum treatment of Linear Harmonic Oscillator.

<u>Atomic Spectra (15 hours):</u>

Vector-Atom model. The Pauli exclusion principle. Electron configuration in a atom with some examples. Studies on LS and jj Coupling schemes in case of one valence electron and two valence electron atoms. Spectral terms and their arrangement following Hund's and n+l rules. Selection rules for transitions. Principal, Sharp, diffuse and fundamental spectral series for Sodium(Na) element.

Magnetic field effect on light: Magnetic moment due to orbital and spin motion. Stern-Gerlach Experiment. Larmor precession. Normal and Anomalous Zeeman effect. Expression for Zeeman shift (using quantum theory). Theory of anamolous Zeeman effect and expression for Lande 'g' factor. Energy level diagram for sodium D lines in a weak magnetic field.

<u>Molecular spectra (8 hours):</u>

Different types motions (electronic, vibration and rotation) in a molecule. Molecular energy distribution in the electromagnetic spectrum. General features of band spectra compared to atomic spectra. The diatomic molecule as a rigid rotator: Energy, energy levels and spectra(with derivation). Diatomic molecule as a non-rigid rotator(qualitative).

<u>Lasers: (4 hours):</u>

Einstein's theory of spontaneous emission, stimulated emission and stimulated absorption. Conditions for laser action. Types of lasers: Theory, construction and working of Gas lasers (He-Ne) and Diode laser. Applications of Lasers.

<u>Raman effect: (3 hours):</u>

Rayleigh's Scattering and Raman Scattering. Quantum theory of Raman effect. Applications of Raman effect.

<u>Nuclear Physics: (15 hours):</u>

Nuclear forces: Properties of nuclear forces, Meson Theory of nuclear forces.

Nuclear models: Liquid-drop model: Semi-emperical mass formula and explanation of the terms, nuclear fission on the basis of liquid-drop model. Shell model(qualitative), Magic numbers.

Nuclear Reactions: Types of nuclear reactions with examples. Energy balance in Nuclear reactions and the Q-value. Brief discussions on compound nucleus formation in nuclear reactions.

Alpha decay: Gammow's theory of Alpha decay(Without derivation). Derivation of expression for alpha disintegration energy. Range of Alpha particles. Experimental determination of range of alpha particles. Geiger-Nuttal relation and its significance(qualitative). Alpha particle spectra with examples.

Beta decay: Types of beta decay with examples.The neutrino Theory of Beta decay(qualitative). Decay scheme of Tl-204.

Gamma decay: Origin of Gamma rays**.** Decay schemes of Cs-137, Na-22, Mn-54 and Co-57. Mention different types of interaction of gamma radiation with matter.

Detectors and Accelerators:

Detectors:Variation of pulse height with applied voltage in gas filled detector. Brief explanation of Ionisation chamber and Proportional counter. Theoretical and experimental studies on Characteristics and dead time of Geiger-Muller counter.

Accelerators:Theory, construction and working of Linear accelerators and Cyclotron.

<u>Note:</u>

1. **Number of teaching hours per week are four.**
2. **Total teaching hours are inclusive of solving numerical problems on all the topics.**
3. **Preference may be given to solve maximum number of numerical problems.**

Reference books:

1. Quantum Mechanics vol 1 and vol 2(I ed)- Shrivatsav-Pragati Prakashan, Meerat,1977
2. Quantum Mechanics- Gupta,Kumar & Sharma- Jayprakashnath &Co,Meerat,2004
3. Quantum Mechanics(I ed)- Powell-Oxford& IBH Publishing, NewDehli, Bombay, Culkatta,1961
4. Quantum Mechanics - Pauling& Wilson.
5. Moden Physics- Duggal and Chabra.
6. Modern physics- R. Murugeshan-- S.Chand Publication,New Dehli.
7. Introduction to modern physics- Ritchmeyer,Kennerd & Lauritser-TMH Publishing NewDehli
8. Perspective of modern physics(VI ed)- A.Baiser- Tata McGraw Hill,Newdehli.2002
9. Modern physics- J.B.Rajam
10. Introduction to atomic spectra(IV ed)- H.E.White- McGraw Hill,Newdehli,2004
11. Molecular spectra and molecular structure– G.Herzberg
12. Modern spectroscopy – J.Michael Hollas
13. LASERs and Non linear Optics- B.B.Laud
14. Nuclear Physics(IV ed)- D.C.Tayal-Himalaya Publishing House,1982
15. Fundamentals of Nuclear Spectroscopy- Basswell- Tata McGraw Hill, Newdehli, 2004
16. Nuclear physics- I.Kaplan
17. B.Sc. practical Physics – C.L.Arora.
18. Advanced practical Physics – Samir Kumar Ghosh.
19. Advanced practical Physics – Worsnop and Flint.

CBCS syllabus w.e.f. 2022-23
B.Sc. FIFTH SEMESTER
Optional Subject: PHYSICS(DSE-PHYT:501B)

Modern Physics-II(Elective 2)

(Credits:Theory-04, Practicals-02) Theory: 60 Hours

Fundamentals of Quantum Mechanics (10hours): Brief discussion on failure of classical physics to explain black body radiation, Photoelectric effect, Compton effect, stability of atoms and spectra of atoms.

Matter Waves: de Broglie hypothesis. Expression for group velocity and Phase velocity of matter waves. Davisson - Germer experiment with result and its significance.

Uncertainty principle: Statement and illustration by Gamma ray microscope and diffraction of electrons at a single slit. Mention of Time-Energy Uncertainty relation and Angular Momentum- Angular position Uncertainty relation.

Necessity of Quantum Mechanics, basics of Schrodinger Formulation and Heisenberg Formulation of Quantum mechanics.

Wave Mechanics (10 hours): Wave packet; Derivation of Group and phase velocity of wave packet. Setting up of one-dimensional time dependent Schrodinger equation for free particle and hence Schrodinger equation for particle in a force field drivable from potential. Mention of three-dimensional time dependent Schrodinger equation. Setting up of time independent Schrodinger's equation from time dependent equation. Physical interpretation of wave function, Normalization condition, Probability current density, Expectation value, Eigenfunction and Eigenvalues.

Applications of time independent Schrodinger equation to one dimensional systems (12 hours): Eigenvalues and Eigenfunctions of particle in one dimensional infinite square well potential (Derivation). Mention of Eigenvalues and Eigenfunctions of particle in three dimensional infinite square well potential, Concept of degeneracy. Eigenvalues and Eigenfunctions of Particle in a one-dimensional finite square potential well (Qualitative). Particle passing through Step Potential: derivation of transmission and reflection coefficients. Qualitative discussion on quantum treatment of Linear Harmonic Oscillator (One dimensional), concept of zero point energy. Comparison of eigenvalues of particle in infinite potential well and Linear Harmonic Oscillator.

Applications of quantum mechanics to nuclear and particle physics (10 hours): Quantum properties of nuclei and particles; Quantum mechanical tunneling and its applications to alpha decay; Study of nuclear potentials and quantum states of nuclei using deuteron (theory of deuteron); Scattering of free nucleons; Shell model of the nucleus (Including spin-orbit coupling).

Heisenberg Formulation(8 hours) : Vector representation of a state, Ket Vector, Bra Vector, Dirac Notation, Linear vector space and correspondence between Ket and Bra. Orthogonal property and Normalization. Linear Operators; Addition, multiplication and scalar product, scalar multiplication, Dynamical variables, Eigenvalues and Eigenvectors.

Atoms in Magnetic Fields (10 hours): Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. Normal and Anomalous Zeeman Effect.

Reference Books:

1. The development of Quantum mechanics" 1933 Nobel Lecture by Werner Heisenberg.
2. The fundamental idea of wave mechanics" 1933 Nobel Lecture by Erwin Schrödinger
3. Quantum Mechanics vol 1 and vol 2(I ed)- Shrivatsav-Pragati Prakashan,
4. Quantum Mechanics- Gupta,Kumar & Sharma- Jayprakashnath &Co,
5. Quantum Mechanics(I ed)- Powell-Oxford& IBH Publishing, NewDehli,
6. Quantum Mechanics - Pauling& Wilson.
7. Moden Physics- Duggal and Chabra.
8. Foundation of Quantum Mechanics by A B Gupta;
9. Modern physics- R. Murugeshan-- S.Chand Publication,New Dehli.
10. Introduction to modern physics- Ritchmeyer,Kennerd & Lauritser-TMH
11. A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan,
12. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEdn., 2002, Wiley.
13. Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
14. Quantum Mechanics, G. Aruldhas, 2ndEdn. 2002, PHI Learning of India.
15. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
16. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press
17. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
18. Introduction to Quantum Mechanics, David J. Griffith, 2nd Ed. 2005
19. Quantum Mechanics, Walter Greiner, 4thEdn., 2001, Springer
20. Physics of nuclei and particles, Volume 1 : Pierre Marmier and Eric Sheldon.
21. Introductory nuclear physics: Kenneth S. Krane; John Wiley and sons, 1988.
22. Introduction to nuclear physics: Herald A. Enge; Addisoin - Wesley, 1983.
23. Introductory nuclear physics: Samuel S. M. Wong; Prentice - Hall, 1996.
24. Nuclear Physics - Theory and experiment: R. R. Roy and B. P. Nigam.
25. Atomic spectra – H.E.White.

<u>Note:</u>

1. **Number of teaching hours per week are four.**
2. **Total teaching hours are inclusive of solving numerical problems on all the topics.**
3. **Preference may be given to solve maximum number of numerical problems.**

List of fifth semester Physics(DSC-PHYP:502) Experiments common to both Elective 1 and Elective 2:

1. Millikan's oil drop method to determine electron charge.
2. Determination of specific charge (e/m) of an electron by Thomson's method.
3. Study of hydrogen spectrum - determination of Rydberg constant
4. Ionisation potential of Xenon/Mercury
5. Planck's constant using Photo cell /LED
6. Analysis of molecular spectra (Rotational spectra)
7. Study of Divergence of Laser Beam using Photo Diode
8. Characteristics of GM counter and GM tube (dead time).
9. Attenuation of β- radiation (absorption coefficient of aluminium)
10. Attenuation of Gamma rays in lead using GM tube and Cs-137 source.
11. DC hybrid parameters of BJT.
12. CE- amplifier.

Note:

1. **Experiments are of four hours duration.**
2. **Minimum of Eight experiments to be performed.**
3. **Any new experiment may be added to the list with the prior approval from the BOS.**

CBCS syllabus w.e.f. 2022-23
B.Sc. FIFTH SEMESTER
Skill Enhancement Course(SEC) in Physics(SEC-PHYP:503)

BASIC INSTRUMENTATION SKILLS -I

(Credits: -02) Total practical Teaching hours: 60 Hours

1. To observe the loading effect of a table top multimeter while measuring voltage across a low resistance and high resistance and To observe the limitations of a multimeter for measuring high frequency voltage and currents.
2. Measurement of time period, frequency, average period using universal counter/ frequency counter.
3. Measurement of distortion of a RF signal generator using distortion factor meter.
4. Converting the range of a given measuring instrument (voltmeter, ammeter)
5. Basics of wiring-Star and delta connection.
6. AC and DC motors.
7. Basics and working of Voltage Stabilisers.
8. Design and construct telescope refraction/reflection type.
9. Measurement of refractive index of transparent liquid using Searle's Goniometer.
10. Soldering and desoldering techniques: Use discrete components to assemble a given circuit on general/specific PCB.

Note:

1. **Experiments are of four hours duration.**
2. **Minimum of five experiments to be performed.**
3. **Any new experiment may be added to the list with the prior approval from the BOS.**

CBCS syllabus w.e.f. 2022-23

B.Sc. FIFTH SEMESTER

Skill Enhancement Course(SEC) in Physics(SEC-PHYP:504)

BASIC INSTRUMENTATION SKILLS -II

(Credits: -02) Total practical Teaching hours: 60 Hours

1. To measure Q of a coil and its dependence on frequency, using a Q-meter.
2. Measurement of rise, fall and delay times using a CRO.
3. Measurement of R, L and C using a LCR bridge/ universal bridge.
4. Basics of transformers. Winding a coil / transformer.
5. Basics of Relays, Fuses and disconnect switches, Circuit breakers and Overload devices.
6. Basics and working of Refrigerators.
7. Basics and working of Different types of batteries.
8. Design and construct Eye-piece.
9. Construct circuits (electrical circuits with switch) to verify the truth table of OR, AND, NAND and NOR gates.
10. Design of a mobile battery charger.

Note:

11. **Experiments are of four hours duration.**
12. **Minimum of five experiments to be performed.**
13. **Any new experiment may be added to the list with the prior approval from the BOS.**

CBCS syllabus w.e.f. 2022-23
B.Sc. SIXTH SEMESTER
Optional Subject: PHYSICS(DSE-PHYT:601A)

Solid State Physics and Electronics-I (Elective 1)

(Credits:Theory-04, Practicals-02) Theory: 60 Hours

Solid state Physics:

Crystal structure, Crystal diffraction and Specific heat of solids(15 hours):

Crystal structure: Lattice, lattice translational vectors, basis of crystal structure, Types of unit cells, Co-ordination numbers, Bravais lattices, Seven crystal Systems, Miller indices, expression for inter-planar spacing, crystal structure of NaCl and CsCl.

Crystal diffraction: X-ray spectrum (Continuous & Characteristic), Bragg's law, Bragg's X-ray spectrometer.

Specific heat of solids: Experimental facts; classical theory, Einstein's and Debye's theory of lattice specific heats(qualitative).

Free electron theory of metals, Semiconductors, Magnetic materials and Superconductivity(15 hours):

Free electron theory of metals: Classical free electron model, expressions for electrical and thermal conductivity, Wiedemann-Franz law, failure of classical free electron theory.

Semiconductors: Intrinsic and extrinsic semiconductors. Expression for electrical conductivity in case of intrinsic semiconductors. Hall effect and expressions for Hall co-efficient. Applications of Hall effect.

Magnetic materials : Classification of Magnetic materials. Classical Langevin's theory of diamagnetism and paramagnetism. Determination of paramagnetic susceptibility by Gouy's method. Ferromagnetism and Weiss Theory of Ferromagnetism. Ferromagnetic domain. Nuclear Magnetic Resonance:Expression for resonance frequency.

Superconductivity : Occurrence of superconductivity. Destruction of superconductivity by magnetic field. Meissner effect. Type-I and Type-II super conductors. Isotope effect. BCS theory of superconductivity(Qualitative). Applications of superconductors.

Electronics:

Bipolar Junction Transistors, JFET and Integrated Circuits (ICs)(15 hours):

Bipolar Junction Transistors: BJT characterisitics in CE mode, DC load line analysis. Operating point. BJT biasing methods: Mention different types of biasing in CE mode. Analysis of Voltage Divider method with derivation I_c and V_{CE}. DC h-parameters and their determination , mention of h- parameter model of transistor , analysis of single stage RC coupled CE amplifier using h-parameter, Expression for current gain and Voltage gain, Input impedance and output impedance, frequency response, Brief explanation of positive and negative feedback. Transistor as an oscillator, Hartley and Phase shift oscillators (Qualitative only).

JFET: Types, characteristics and parameters of JFET. JFET as an amplifier (CS mode, qualitative).

Integrated Circuits (ICs): Brief discussion on Fabrication of IC's, types of ICs, IC555 internal configuration; operation of Timer 555 as Astable multivibrator (qualitative.

Digital Electronics and **communication(15 hours):**

Digital Electronics: Review of basics of number systems. Boolean algebra, truth tables, basic theorems, Basic and Universal gates. Demorgan's theorems.

Communication : classification of radio waves; Types of radio wave propagation, radio waves propagation through ionosphere. Critical frequency, critical angle, MUF, virtual height, secant law.

Modulation and Demodulation: Need of modulation, types of modulation,

Amplitude modulation(AM): modulation index, frequency spectrum of AM, AM modulator using BJT (emitter modulation).

Frequency Modulation (FM): modulation index, FM spectrum, Carson's rule, applications of FM, Comparison between FM & AM**.** Demodulation: Need for demodulation, AM detection using PIN diode (qualitative). Super heterodyne receiver (Block diagram).

Note:

1. **Number of teaching hours per week are four.**
2. **Total teaching hours are inclusive of solving numerical problems on all the topics.**
3. **Preference may be given to solve maximum number of numerical problems.**

Reference books:

1. Solid State Physics- C.Kittel-Wishey Publishing
2. Solid state physics(I ed)- A.J.Dekkar-McMillan,NewDehli,2003
3. Solid state physics(I ed)- Keer-New age international Pvt. Limited.2002
4. Solid state physics- Kumar And Gupta
5. Solid state physics- Kumar and Gupta and Saxena
6. Solid state physics – S.O.Pillai
7. Basic electronics and solid state physics- B.L.Theraja- S.Chand Publication,New Dehli
8. Basic Electronics- B.L.Theraja- S.Chand Publication,New Dehli
9. Integrated Electroniics- Millmans Ans Halkias-McGraw Hill,Newdehli
10. Electronic devices and circuits- Allan Mottersed-.McGraw Hill,Newdehli
11. Basic Electronics linear circuits,TTTI- Bhargav&etal-Bharat Book Prakashan Dharwad
12. Electronics communication system- Kennedy & Davis.
13. B.Sc. practical Physics – C.L.Arora.
14. Advanced practical Physics – Samir Kumar Ghosh.
15. Advanced practical Physics – Worsnop and Flint.

CBCS syllabus w.e.f. 2022-23
B.Sc. SIXTH SEMESTER
Optional Subject: PHYSICS(DSE-PHYT:601B)

Solid State Physics and Electronics-II (Elective 2)

(Credits:Theory-04, Practicals-02) Theory: 60 Hours

Crystal Structure(12 hours): Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.

Elementary Lattice Dynamics(10 hours): Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law

Magnetic Properties of Matter(10 hours): Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.

Elementary band theory(10 hours): Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.

Superconductivity(3 hours): Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors,. Isotope effect.

Electronics(15 hours):

Bipolar Junction Transistors, JFET and Integrated Circuits (ICs):

Bipolar Junction Transistors: BJT characterisitics in CE mode, DC load line analysis. Operating point. BJT biasing methods: Mention different types of biasing in CE mode. Analysis of Voltage Divider method with derivation I_c and V_{CE}. DC h-parameters and their determination , mention of h- parameter model of transistor , analysis of single stage RC coupled CE amplifier using h-parameter, Expression for current gain and Voltage gain, Input impedance and output impedance, frequency response, Brief explanation of positive and negative feedback. Transistor as an oscillator, Hartley and Phase shift oscillators (Qualitative only).

JFET: Types, characteristics and parameters of JFET. JFET as an amplifier (CS mode, qualitative).

Integrated Circuits (ICs): Brief discussion on Fabrication of IC's, types of ICs, IC555 internal configuration; operation of Timer 555 as Astable multivibrator (qualitative).

Note:

1. **Number of teaching hours per week are four.**
2. **Total teaching hours are inclusive of solving numerical problems on all the topics.**
3. **Preference may be given to solve maximum number of numerical problems.**

Reference Books:

1. Solid State Physics- C.Kittel-Wishey Publishing
2. Solid state physics(I ed)- A.J.Dekkar-McMillan,NewDehli,2003
3. Solid state physics(I ed)- Keer-New age international Pvt. Limited.2002
4. Solid state physics- Kumar And Gupta
5. Solid state physics- Kumar and Gupta and Saxena
6. Solid state physics – S.O.Pillai
7. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006
8. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
9. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976.
10. Solid State Physics, Rita John, 2014, McGraw Hill
11. Solid-state Physics, H. Ibach and H Luth, 2009, Springer
12. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
13. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
14. Basic electronics and solid state physics- B.L.Theraja- S.Chand Publication,New Dehli
15. Basic Electronics- B.L.Theraja- S.Chand Publication,New Dehli
16. Integrated Electroniics- Millmans Ans Halkias-McGraw Hill,Newdehli
17. Electronic devices and circuits- Allan Mottersed-.McGraw Hill,Newdehli
18. Basic Electronics linear circuits,TTTI- Bhargav&etal.
19. Electronics communication system- Kennedy & Davis.
20. B.Sc. practical Physics – C.L.Arora.
21. Advanced practical Physics – Samir Kumar Ghosh.
22. Advanced practical Physics – Worsnop and Flint.

List of sixth semester Physics(DSC-PHYP:602) Experiments common to both Elective 1 and Elective 2:

1. Analysis of x-ray diffraction spectra
2. Hall effect
3. Determination of energy gap of semiconductor (Ge) by four probe method.
4. BH curve
5. Application of LDR: using BJT as Switch .
6. Study of Voltage Regulator 78XX / 79XX & Construction of Dual Power Supply using 78XX and 79XX.
7. Hartely Oscillator Using BJT / Phase Shift Oscillator Using BJT.
8. FET Amplifier.
9. D'Morgan's theorems & verification of Boolean expressions using IC 7400.
10. Astable Multivibrator (using 555 timer).
11. Generation of A M wave using BJT(emitter modulation or collector modulation) / IC AD633 : Study of modulation index.
12. Study of A M detector using PIN Diode / 1N4007 for different modulation frequencies

Note:

1. **Experiments of four hours duration.**
2. **Minimum of Eight experiments to be performed.**
3. **Any new experiment may be added to the list with the prior approval from the BOS.**

CBCS syllabus w.e.f. 2022-23
B.Sc. SIXTH SEMESTER

Skill Enhancement Course(SEC) in Physics(SEC-PHYP:603)
APPLIED PHYSICS-I
(Credits: -02) Total practical Teaching hours: 60 Hours

Experiments On Applied Optics:

1. Construction, working and characteristics/applications of LED.
2. Construction, working and characteristics/applications of IR sensor.
3. Construction, working and experimental determination of numerical aperture of an optical fibre.

Experiments On Medical Physics:

4. Understanding the working of a manual / Digital Hg Blood Pressure monitor and measure the Blood Pressure.
5. Correction of Myopia (short sightedness) using a combination of lenses on an optical bench/breadboard.
6. Familiarization with Radiation meter and to measure background radiation.

Experiments On Renewable Energy And Energy Harvesting:

7. Conversion of thermal energy into voltage using thermoelectric modules.

Experiments on applied Electronics:

8. Experiments on Diac/Triac and SCR as a power controlling device.
9. Baiscs of op-amp and its application to Construct and test multirange DC ammeter using op-amp.
10. Construct and test DC voltmeter using FET.

Note:

1. **Experiments of four hours duration.**
2. **Minimum of five experiments to be performed.**
3. **Any new experiment may be added to the list with the prior approval from the BOS.**

CBCS syllabus w.e.f. 2022-23
B.Sc. SIXTH SEMESTER
Skill Enhancement Course(SEC) in Physics(SEC-PHYP:604)
APPLIED PHYSICS-II
(Credits: -02) Total practical Teaching hours: 60 Hours

Experiments On Applied Optics:

1. Construction, working and characteristics/applications of LDR.
2. Photovoltaic Cell/ Solar cell characteristics and its application.
3. To study the variation of the bending loss in a multimode fibre

Experiments On Medical Physics:

4. Correction of Hypermetropia/Hyperopia (long sightedness) using a combination of lenses on an optical bench/breadboard.
5. Familiarization with the Use of a Vascular Doppler.

Experiments On Renewable Energy And Energy Harvesting:

6. Demonstration of Training modules on Solar energy, wind energy, etc.
7. Conversion of vibration to voltage using piezoelectric materials

Experiments on applied Electronics

8. Construct and test capacitance meter using operational amplifier and microammeter.
9. UJT as relaxation oscillator.
10. Construct and test multirange DC voltmeter using Operational amplifier.

Note:

1. Experiments of four hours duration.
2. Minimum of five experiments to be performed.
3. Any new experiment may be added to the list with the prior approval from the BOS.

KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ

NAAC Accredited 'A' Grade 2014

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No. KU/Aca(S&T)/SVB-02/BOS /Chemistry (UG) /20-21/ 983 Date] 6 OCT 2020

NOTIFICATION

Sub: Regarding introduction of the syllabus of Chemistry UG under C.B.C.S. w.e.f. the academic year 2020-21 & onwards.

Ref: 1. UGC Letter DO No. 1-1/2016(SECY), dt. 10.08.2016.
2. Special BOS Res. No. 02, dt. 13.07.2020.
3. Special Faculty Res. No. 03, dt. 11.08.2020.
4. Special Academic Council Res. No. 35, dt. 21.08.2020.
5. Vice-Chancellor's order dated - 07-10-2020

Adverting to the above, it is hereby notified to the Principals of all constituent and affiliated degree colleges coming under the jurisdiction of Karnatak University, Dharwad that the Chemistry UG syllabus for I to VI Semester which is annexed herewith in Annexure-A is introduced under C.B.C.S. from the academic year 2020-21 & onwards.

Hence, the contents of this notification may please be brought to the notice of the students and all the concerned. The prescribed C.B.C.S. syllabus may also be obtained through K.U website (www.kud.ac.in).

15/10/2020
(Dr. Hanumantappa K.T)
REGISTRAR

To,

1. The Chairman, BOS Chemistry (UG), Dept. of Chemistry, K.U.Dharwad.
2. The Chairman, Dept. of Chemistry, K.U.Dharwad.
3. The Principals of all the constituted and affiliated degree colleges under the jurisdiction of Karnatak University, Dharwad. (The same may be sent through e-mail)
4. The Registrar (Evaluation), K.U.Dharwad.

Copy fwcs to:

1. Dr. Ch.Ramesh, Dean, Faculty of Science & Tech., Dept. of Botany, K.U.Dharwad.
2. The Director, IT Section, Examination Section, K.U.Dharwad for information and to upload on K.U.Website (www.kud.ac.in).

Copy to:

1. PS to Vice-Chancellor, K.U.Dharwad.
2. S.A. to Registrar, K.U.Dharwad.
3. O.S., Exam UG / Confl / QP / GAD Section, K.U.Dharwad.
4. The System Analysist, Computer Unit Exam Section, K.U.Dharwad.

KARNATAK UNIVERSITY, DHARWAD

B.Sc. Programme

***

SYLLABUS FOR

CHEMISTRY (OPTIONAL)

AS DISCIPLINE SPECIFIC COURSE (DSC) and

SKILL ENHANCEMENT COURSE (SEC)

UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

*****

Effective from 2020-21

B.Sc. Programme structure under CBCS

Semester	*Core			Elective			Ability Enhancement Course						Total Credits
	DSC			**DSE			***SEC			AECC			
	Course	L+T+P	Credit	Course	L+T+P	Credit	Course	L+T+P	Credit	Course	L+T+P	Credit	
I	DSC-1A	4+0+4	4+2=6							English-1	2+1+0	2+1=3	26
	DSC-2A	4+0+4	4+2=6							MIL-1	2+1+0	2+1=3	
	DSC-3A	4+0+4	4+2=6							ENVIRONMENTAL SCIENCE	2+0+0	2+0=2	
II	DSC-1B	4+0+4	4+2=6							English-2	2+1+0	2+1=3	26
	DSC-2B	4+0+4	4+2=6							MIL-2	2+1+0	2+1=3	
	DSC-3B	4+0+4	4+2=6							CONSTITUTION OF INDIA	2+0+0	2+0=2	
III	DSC-1C	4+0+4	4+2=6							English-3	2+1+0	2+1=3	24
	DSC-2C	4+0+4	4+2=6							MIL-3	2+1+0	2+1=3	
	DSC-3C	4+0+4	4+2=6										
IV	DSC-1D	4+0+4	4+2=6							English-4	2+1=0	2+1=3	24
	DSC-2D	4+0+4	4+2=6							MIL-4	2+1=0	2+1=3	
	DSC-3D	4+0+4	4+2=6										
V				DSE-1E	4+0+4	4+2=6	SEC-1E	2+0+0	2				22
				DSE-2E	4+0+4	4+2=6	SEC-2E	2+0+0	2				
				DSE-3E	4+0+4	4+2=6							
VI				DSE-1F	4+0+4	4+2=6	SEC-1F	2+0+0	2				22
				DSE-2F	4+0+4	4+2=6	SEC-2F	2+0+0	2				
				DSE-3F	4+0+4	4+2=6							
TOTAL			72			36			08			28	144

L+T+P= Lecturing in Theory + Tutorial + Practical Hours per Week (no tutorial for practical subject).

* If the core course is Mathematics, there shall be two papers of 75 marks each. Then L+T+P = (2x3)+(2x1)+0, but credit shall be 6 only.

** Each DSE shall have at least two papers and student shall choose any one paper from each DSE.

*** SEC 1 & 2 shall be from all three DSC but student shall choose any two in each semester (SEC may be practical or theory for 2 credits only).

Note: 1. Each DSC/DSE Shall have 60hrs syllabus / semester for 100 marks in theory (80 Sem. End exam +20 IA Exam) and 52 hrs practical/sem for 50 marks(40 Sem. End exam +10 IA Exam).

2. English/MIL Shall have 45 hrs syllabus / semester for 100 marks in theory (80 Sem. End exam +20 IA Exam).

3. Environmental Science/ Constitution of India / SEC shall have 30 hrs syllabus / semester for 50 marks in theory/ Practical (40 Sem. End exams +10 IA Exam).

Karnatak University, Dharwad

CBCS syllabus for Under Graduate Programme in Chemistry (opt.) as

DISCIPLINE SPECIFIC COURSE (DSC)

Effective from 2020-21

Sem ester	Theory / Practical	Subject Code	Instruction hour per week	Total hours of Syllabus / Sem	Duration of Exam.	Internal Assess ment Marks	Sem final Exam. Marks	Total Marks	Credits
I	Theory	DSC (CHT: A)	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC (CHPr: A)	04 hrs	52	03 hrs	10	40	50	02
II	Theory	DSC (CHT: B)	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC (CHPr: B)	04 hrs	52	03 hrs	10	40	50	02
III	Theory	DSC (CHT: C)	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC (CHPr: C)	04 hrs	52	03 hrs	10	40	50	02
IV	Theory	DSC (CHT: D)	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC (CHPr: D)	04 hrs	52	03 hrs	10	40	50	02
V	*Theory P-I /P- II	DSE (CHT: P-I E CHT: P-II E)	04 hrs / 04 hrs	60/60	03 hrs	20	80	100	04
	Practical	DSE (CHPr: E)	04 hrs	52	03 hrs	10	40	50	02
VI	*Theory P-I /P- II	DSE (CHT: P-I F CHT: P-II F)	04 hrs / 04 hrs	60/60	03 hrs	20	80	100	04
	Practical	DSE (CHPr: F)	04 hrs	52	03 hrs	10	40	50	02
Total						180	720	900	36

*Candidate shall choose either paper –I or P-II but not both in DSE theory.

SKILL ENHANCEMENT COURSE (SEC) for Chemistry opted as DSC

Sem ester	Theory	Subject Code	Instruction hour per week	Total hours of Syllabus / Sem	Duration of Exam.	Internal Assess ment Marks	Sem final Exam. Marks	Total Marks	Credits
V	Theory	(SEC-CH- 1E)	02 hrs	30	1.5 hrs	10	40	50	02
V	Theory	(SEC-CH- 2E)	02 hrs	30	1.5 hrs	10	40	50	02
VI	Theory	(SEC-CH- 1F)	02 hrs	30	1.5 hrs	10	40	50	02
VI	Theory	(SEC-CH- 2F)	02 hrs	30	1.5 hrs	10	40	50	02
Total						40	160	200	08

Discipline Specific Course(DSC) under CBCS

B.Sc. Semester - I

CHEMISTRY: CHT: A

Credits: I. Theory	**: 04**	**Theory class 4hrs /wk. Total theory: 60 Lectures**
		80 marks for Sem end Examination(3 hrs) & 20 marks IA
II. Practical	**: 02**	**Practical: 4 hrs./wk. Total Practical: 52 hrs.**
		40 marks for Sem end Examination(3 hrs) & 10 marks IA
Total Credits	**: 06**	**Total Theory marks 100 and Practical marks 50**

Atomic Structure: Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations. **(14 Lectures)**

Chemical Bonding and Molecular Structure: Ionic Bonding*:* General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures of NO_3^-, CO_3^{2-}, and SO_4^{2-}.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches. **(16 Lectures)**

Fundamentals of Organic Chemistry: Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. **(8 Lectures)**

Stereochemistry: Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds. Threo and erythro; D and L; *cis* - *trans* nomenclature; CIP Rules: R/ S (for up to 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). **(10 Lectures)**

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Up to 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Up to 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition(alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

Alkynes: (Up to 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$. **(12 Lectures)**

CHEMISTRY LAB: CHPr: A

1) Volumetric analysis – Meaning of terms such as standard solution, Normality, Molarity, Molality, Equivalent mass. Types of titrations, equations and indicator used in the titration. Calibration of glass wares (burette, pipette, volumetric flask) and weights (both grams and milligrams).Use of analytical balance.

2) Standardization of NaOH solution using standard oxalic acid solution and estimation of HCl in the given solution.

3) Standardization of HCl solution using standard sodium carbonate solution and estimation of total alkalinity or sodium carbonate and sodium bicarbonate in the given solution using double titration method.

4) Standardization of $KMnO_4$ solution using standard oxalic acid solution and estimation of Mohr's salt and water of crystallization in Mohr's salt.

5) Standardization of $K_2Cr_2O_7$ solution using standard Mohr's salt solution and estimation of ferrous and ferric ions in a given mixture.

6) Standardization of $Na_2S_2O_3$ solution using standard $K_2Cr_2O_7$ solution and estimation of iodine in the given solution.

7) Standardization of EDTA solution using standard $ZnSO_4$ solution and estimation of Zn^{2+} in the given solution.

8) Estimation of temporary, permanent and total hardness of water using standard EDTA solution.

9) Estimation of Phenol/Aniline by bromination method.

10) Estimation of acetamide by hydrolysis method.

11) Estimation of Ethyl benzoate by hydrolysis method.

12) Estimation of aspirin in the tablet by hydrolysis method.

- Standard solution for all the experiments shall be prepared by students for both regular practicals and examinations.

Note: There shall be instructions / training for the students about laboratory etiquettes, handling of reagents, laboratory safety measures, use of apparatus / instruments pertaining to the semester before commencement of the regular practicals. The same shall be recorded in the Journal.

Examination

In a batch of ten students, at least five different experiments may be given in the practical examination. Selection of experiments may be done by the students based on the picking up of chits. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Accuracy for Standardization/blank titration - 09 marks , Accuracy for main titration 15 marks, Reactions and calculations – 4 marks, Technique and Presentation-2 marks, Journal-5 marks, Viva-Voce-5 marks, Total=40 marks.

Deduction of Marks for accuracy:

Standardization /blank titration: ±0.2 CC -09 marks, ± 0.4 CC- 07 marks, ±0.6 CC- 06marks, ±0.8 CC- 04 marks, above ±0.8 CC- zero marks.

Main titration: ±0.2 CC -15 marks, ± 0.4 CC- 12 marks, ±0.6 CC- 09 marks, ±0.8 CC- 06 marks, ±0.9 CC- 03 marks, above ±0.9 – zero marks.

Discipline Specific Course (DSC) under CBCS

B.Sc. Semester - II

CHEMISTRY: CHT: B

Credits: I. Theory	**: 04**	**Theory class 4hrs /wk. Total theory: 60 Lectures**
		80 marks for Sem end Examination(3 hrs) & 20 marks IA
II. Practical	**: 02**	**Practical: 4 hrs./wk. Total Practical: 52 hrs.**
		40 marks for Sem end Examination(3 hrs) & 10 marks IA
Total Credits	**: 06**	**Total Theory marks 100 and Practical marks 50**

Kinetic Theory of Gases: Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behavior, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation (numerical problems). Andrews isotherms of CO_2. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities and their comparisons. Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

(8 Lectures)

Liquids: Surface tension and parachor and its applications. Determination of surface tension using stalagmometer (drop weight and drop number method). Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). Refractive index and its determination by Abbe's refractometer(numerical problems).

(7 Lectures)

Solids: Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals. **(7 Lectures)**

Chemical Kinetics: The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction(numerical problems). Methods for determination of order of a reaction by half life period and differential equation method. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). **(8 Lectures)**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure

Aromatic hydrocarbons: *Preparation* (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions*: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene). **(8 Lectures)**

Alkyl and Aryl Halides:

Alkyl Halides (Up to 5 Carbons): Types of Nucleophilic Substitution (S_N1, S_N2 and S_Ni) reactions. *Preparation:* from alkenes *and* alcohols. *Reactions:* hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs. substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. *Reactions (Chlorobenzene):* Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides. **(8 Lectures)**

Alcohols, Phenols and Ethers (Up to 5 Carbons)

Alcohols: *Preparation:* Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. *Reactions:* With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer- Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde) *Preparation:* from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, $R\text{-}NH_2$ derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

(14 Lectures)

CHEMISTRY LAB: CHPr: B

1. Explanation regarding crystallization, fractional crystallization, sublimation, reflux, distillation, fractional distillation, distillation under reduced pressure , steam distillation and determination of melting point of the crystallized solid & boiling point of the liquid. (Students should write in the journal regarding the above).
2. Experiment No 2 to 7 : **Systematic qualitative analysis** of organic compounds (without preparation of the derivative).**The following any twelve compounds may be given**.
   Phthalic acid, cinnamic acid, phenol, β- naphthol, aniline , p-toluidine, benzaldehyde, acetophenone, acetanilide , benzamide, thiourea, chlorobenzene, m-dinitro benzene, di-phenyl and ethyl acetate.
3. Experiment No 8 to 12: **Preparation of organic compounds.**
   i. Bromination – Phenol / aniline to 2,4,6-tribromo phenol/aniline or acetanilide to p-bromo acetanilide (any one).
   ii. Nitration – Salicylic acid to 5-nitro salicylic acid / acetanilide to p-nitro acetanilide (any one).
   iii. Dehydration – Phthalic acid to phthalic anhydride.
   iv. Hydrolysis - Benzamide to benzoic acid.
   v. Oxidation – Benzaldehyde to benzoic acid.
   vi. Reduction – m-dinitrobenzene to m- nitro aniline.

Note: There shall be instructions / training for the students about laboratory etiquettes, handling of reagents, laboratory safety measures, use of apparatus / instruments pertaining to the semester before commencement of the regular practicals. The same shall be recorded in the Journal.

Examination

In a batch of ten students, each student should perform qualitative analysis of organic compound and preparation of organic compound. Not more than 2 students should get the same experiment. Selection of experiments may be done by the students based on the picking up of chits. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Journal – 05 marks , Viva-Voce-5 marks,(Total=40 marks.)

1. For Preparation Experiments (10 Marks):

Reaction and calculation of theoretical yield – 2 mark, technique and presentation-2 marks , observed yield -04 marks, M.P- 02 marks. Total – 10 marks.

Deduction of Marks:

Error yield- less than 10%- 04 marks, 11-15% 03 marks, 16-20% 02 marks, 21-25% 01 marks, more than 25% Zero marks

2. For qualitative analysis of organic compound(20 Marks)

Nature of the compound – 4 marks. element test – 4 marks, functional group and confirmative test – 05marks , melting point/ boiling point – 3 marks, name and structure-04 marks, Total - 20marks.

Discipline Specific Course (DSC) under CBCS

B.Sc. Semester - III

CHEMISTRY: CHT: C

Credits: I. Theory	**: 04**	**Theory class 4hrs /wk. Total theory: 60 Lectures**
		80 marks for Sem end Examination(3 hrs) & 20 marks IA
II. Practical	**: 02**	**Practical: 4 hrs./wk. Total Practical: 52 hrs.**
		40 marks for Sem end Examination(3 hrs) & 10 marks IA
Total Credits	**: 06**	**Total Theory marks 100 and Practical marks 50**

Chemical Energetics: First Law of Thermodynamics. Enthalpy, concept of standard state, standard enthalpy, Types of enthalpies: formation, combustion, neutralization, integral and differential enthalpies of solution and dilution, lattice enthalpy(numerical problems). Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. **(08 Lectures)**

Chemical Equilibrium: Limitations of first law of thermodynamics, concept of entropy, Second law of thermodynamics, Free energy, free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^{o}, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases(numerical problems). Third Law of thermodynamics and calculation of absolute entropies of substances. **(08 Lectures)**

Ionic Equilibria: Strong, moderate and weak electrolytes with examples, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle(numerical problems). **(10 Lectures)**

Distribution law: Nernst distribution law and its derivation. Limitations of law. Modification of distribution law for change in molecular state(association and dissociation). Application in solvent extraction- simple and multiple extractions. Derivation for multiple extraction(numerical problems). **(4 Lectures)**

Carboxylic acids and their derivatives: Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Carboxylic acids (aliphatic and aromatic):*Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic) (Up to 5 carbons) : *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. *Reactions:* Comparative study of acylation of acyl derivatives. Reformatsky Reaction, Perkin condensation. **(6 Lectures)**

Amines and Diazonium Salts: Amines (Aliphatic and Aromatic): (Up to 5 carbons)

Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.

Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Diazonium salts: *Preparation:* from aromatic amines. *Reactions:* conversion to benzene, phenol, dyes. **(6 Lectures)**

Heterocyclic Compounds: Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structural elucidation of Indole, Fischer indole synthesis, Structural elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis.

Alkaloids: Natural occurrence, General structural features, Hoffmann's exhaustive methylation, Structure elucidation and synthesis of Hygrine and Nicotine.

Terpenes: Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Neral and α-terpineol. **(18 Lectures)**

CHEMISTRY LAB: CHPr: C

1. Explanation regarding errors, types of errors, accuracy, precision, significant figures, standard deviation, and Use of log table (students should write in the journal regarding the above).
2. Study of effect of acid strength on hydrolysis of methyl acetate using HCl and H_2SO_4.
3. Determination of velocity constant and effect of concentration on velocity constant of second order reaction $KI + K_2S_2O_8$ (a = b).
4. Study of adsorption of acetic acid on animal charcoal.
5. Determination of surface tension and parachor of benzene series or alcohol series.

6. Determination of surface tension and parachor of toluene, xylene and n-hexane and calculate the atomic parachor of Carbon and Hydrogen
7. Determination of viscosity of toluene and carbon tetrachloride by Ostwald's Viscometer method.
8. Determination of viscosity of binary liquid mixtures of Toluene & carbon tetrachloride and to calculate the percentage composition of the unknown mixture.
9. Study of distribution of acetic acid/ benzoic acid between water and toluene.
10. Determination of enthalpy of ionization of acetic acid by calorimetric method.
11. Determination of heat of solution of KNO_3 by calorimetric method.
12. Determination of degree of dissociation of KCl by Landsberger's method.

Note: There shall be instructions / training for the students about laboratory etiquettes, handling of reagents, laboratory safety measures, use of apparatus / instruments pertaining to the semester before commencement of the regular practicals. The same shall be recorded in the Journal.

Examination

In a batch of ten students, not more than two students should get the same experiment in the practical examination. Selection of experiments may be done by the students based on the picking up of chits. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Accuracy-18 marks, Technique and Presentation-3marks Calculation and graph- (5+4) 9 marks, Journal-5 marks, Viva-Voce-5 marks, Total=40 marks.

Deduction of Marks for accuracy:

Error up to 5% - 18 marks, 6 - 10% 15 marks, 11-15%- 12 marks, 16-20% 09 marks, above 20% zero (0) marks

Discipline Specific Course (DSC) under CBCS

B.Sc. Semester - IV

CHEMISTRY: CHT: D

Credits: I. Theory	**: 04**	**Theory class 4hrs /wk. Total theory: 60 Lectures**
		80 marks for Sem end Examination(3 hrs) & 20 marks IA
II. Practical	**: 02**	**Practical: 4 hrs./wk. Total Practical: 52 hrs.**
		40 marks for Sem end Examination(3 hrs) & 10 marks IA
Total Credits	**: 06**	**Total Theory marks 100 and Practical marks 50**

Chemistry of *s* and *p* Block Elements:

Diagonal relationship and anomalous behaviour of first member in s block elements. Complex formation tendency of *s* and *p* block elements. Structure, bonding, preparation, and uses of boron nitrides, borohydrides (diborane), carboranes, silicates, oxides and oxoacids of nitrogen, peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens. Bonding inXeF_2, XeF_4 and XeO_3. **(10 Lectures)**

Chemistry of *d* and *f* Block Elements:

Transition Elements: General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states. Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states (excluding their metallurgy)

Lanthanides and Actinides: Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).Preparation of Trans-uranic elements. **(10 Lectures)**

Coordination Chemistry-I: Werner's theory**,** IUPAC system of nomenclature, Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Drawbacks of VBT. **(5Lectures)**

Nuclear Chemistry: Nuclear particles (positron, neutrino, mesons, pions and quarks), nuclear instability, Nuclear reactions [(α, n), (n, α), (α, p), (p, α), (p, n), & (n, p)], nuclear fission, nuclear reactor and types of nuclear reactors in India, applications of radioisotopes in tracer technique, and carbon dating(numerical , problems). **(05Hours)**

Solutions: Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature- composition curves of ideal and non-ideal solutions. Distillation of solutions.

Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. **(6 Lectures)**

Phase Equilibrium: Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-H_2O and Na-K only). **(8 Lectures)**

Conductance: Ionic conductance, ohms law**,** conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Conductivity cell, measurement of conductance of ionic solution and its applications in : a) determination of degree of ionization of weak electrolyte b) solubility and solubility products of sparingly soluble salts c) ionic product of water d) hydrolysis constant of a salt and e) conductometric titrations of acid-base(numerical problems).

Ionic mobility, transference number and its experimental determination using Hittorf and Moving boundary methods (numerical problems). **(6 Lectures)**

Electrochemistry: Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential, standard electrode, type of electrodes, reference electrodes, sign convention of cell. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode, quinhydrone electrode and glass electrode . Potentiometric titrations-qualitative treatment (acid-base and oxidation-reduction only).

Battery technology: Primary and secondary cells, lead storage battery and its applications, Ni-Cd cells, Lithium battery, fuel cells and their applications. **(10 Lectures)**

CHEMISTRY LAB: CHPr: D

1. Explanation regarding solubility, solubility product, common ion effect and applications of these in physico-chemical principles of separation of cations into groups in qualitative analysis of in-organic salts (students should write in the journal regarding the above).

2 to 10: Semi-micro qualitative analysis of mixtures of two simple inorganic salts containing two anions and two cations.

ANIONS: CO_3^{2-}, S^{2-}, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, $C_2O_4^{2-}$, BO_3^{3-} and PO_4^{3-}

CATIONS: Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{2+}, Fe^{+3}, Mn^{2+}, Co^{2+}, Ni^{2+}, Zn^{2+}, Ca^{2+}, Ba^{2+}, Mg^{2+}, Na^+, K^+ and NH_4^+.

Phosphate separation technique is to be demonstrated but not to be given at the time of examination.

11. Determination of dissolved oxygen present in water by Winkler's method.

12. Determination of C.O.D in polluted water.

Note: There shall be instructions / training for the students about laboratory etiquettes, handling of reagents, laboratory safety measures, use of apparatus / instruments pertaining to the semester before commencement of the regular practicals. The same shall be recorded in the Journal.

Examination

In a batch of ten students, not more than two students should get the same mixture in the practical examination. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Preliminary tests and presentation (6+2) - 8 marks , Negative radicals (group test + C.T) (2+3)×2=10 marks, positive radicals (group test + C.T) (2+4)×2=12 marks, Journal-5 marks, Viva-Voce-5 marks, Total=40 marks.

Discipline Specific Elective (DSE) under CBCS

B.Sc. Semester - V

CHEMISTRY: Paper-I (CHT:P-I E)

(Candidate shall choose either Paper-I or paper-II)

Credits: I. Theory	**: 04**	**Theory class 4hrs /wk. Total theory: 60 Lectures**
		80 marks for Sem end Examination(3 hrs) & 20 marks IA
II. Practical	**: 02**	**Practical: 4 hrs./wk. Total Practical: 52 hrs.**
		40 marks for Sem end Examination(3 hrs) & 10 marks IA
Total Credits	**: 06**	**Total Theory marks 100 and Practical marks 50**

I. Coordination Chemistry-II and Organometallic Compounds:

Crystal Field Theory: Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for O_h and T_d complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

Organometallic Compounds: Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds), heptacity. Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Structure and bonding of mononuclear and polynuclear carbonyls of 3d metals. π-acceptor behaviour of carbon monoxide. **(15 Lectures)**

II: Analytical Chemistry

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Thermal methods of analysis: Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

Separation techniques: Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions.Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: GLC, and TLC. **(15 Lectures)**

III. Biochemistry:

Carbohydrates: Classification of carbohydrates, reducing and non-reducing sugars, their open chain structure. Epimers, mutarotation and anomers. Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Amino Acids, Peptides and Proteins: Classification *of Amino Acids,* Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups.

Enzymes and correlation with drug action: Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and their role in biological reactions, Specificity of enzyme action(Including stereospecificity), Drug action-receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group,-NH_2 group, double bond and aromatic ring,

Nucleic Acids: Components of Nucleic acids: Adenine, guanine, thymine, Uracil and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides **(nomenclature**), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA(**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

Lipids: Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol). **(15 Lectures)**

IV. Quantum Chemistry:

Black body radiation, Spectral distribution of black body radiation, Plank's theory, derivation for Planck's radiation law, photoelectric effect, Compton effect, wave nature of electron, derivation of Schrödinger's wave equation, wave function and its interpretation, Eigen function and Eigen values, normalization and orthogonality.

Equation of motion for a particle, Newtonian, Lagrangian and Hamiltonian equations of motion, elementary wave motion. Operators, eigen values and expectation values, commuting operators, linear operator and hermitian operators. Solutions of Schrödinger equations of a free particle, particle in a box problem: in one and three dimensions, degeneracy, reflection and penetration of a particle in a one dimensional box of semi-infinite barrier, a particle in a box of finite walls.

Rigid rotator, derivation of selection rules for transitions in rotating molecule, linear harmonic oscillator, Hermite polynomials. Equation for the hydrogen atom in spherical polar coordinates and an indication of the method of its solution, the quantum numbers and their significance. **(15 Lectures)**

Discipline Specific Elective (DSE) under CBCS

B.Sc. Semester - V

CHEMISTRY: Paper-II (CHT:P-II E)

(Candidate shall choose either Paper-I or paper-II)

Credits: I. Theory	**: 04**	**Theory class 4hrs /wk. Total theory: 60 Lectures**
		80 marks for Sem end Examination(3 hrs) & 20 marks IA
II. Practical	**: 02**	**Practical: 4 hrs./wk. Total Practical: 52 hrs.**
		40 marks for Sem end Examination(3 hrs) & 10 marks IA
Total Credits	**: 06**	**Total Theory marks 100 and Practical marks 50**

I. Coordination Chemistry-II and Organometallic Compounds:

Crystal Field Theory: Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for O_h and T_d complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

Organometallic Compounds: Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds), heptacity. Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Structure and bonding of mononuclear and polynuclear carbonyls of 3d metals. π-acceptor behaviour of carbon monoxide. **(15 Lectures)**

II. Industrial chemistry

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Alloys: Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels. **(15 Lectures)**

III. Introduction to Green Chemistry

Meaning of Green Chemistry. Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry Twelve principles of Green Chemistry with their explanations and examples

Examples of Green Synthesis/ Reactions and some real world cases

1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)
2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction
3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)
4. Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.
5. Designing of Environmentally safe marine antifoulant.
6. Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.
7. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.
8. Healthier fats and oil by Green Chemistry: Enzymatic interesterification for production of no Trans-Fats and Oils **(15 Lectures)**

IV. Quantum Chemistry:

Black body radiation, Spectral distribution of black body radiation, Plank's theory, derivation for Planck's radiation law, photoelectric effect, Compton effect, wave nature of electron, derivation of Schrödinger's wave equation, wave function and its interpretation, Eigen function and Eigen values, normalization and orthogonality.

Equation of motion for a particle, Newtonian, Lagrangian and Hamiltonian equations of motion, elementary wave motion. Operators, eigen values and expectation values, commuting operators, linear operator and hermitian operators. Solutions of Schrödinger equations of a free particle, particle in a box problem: in one and three dimensions, degeneracy, reflection and penetration of a particle in a one dimensional box of semi-infinite barrier, a particle in a box of finite walls.

Rigid rotator, derivation of selection rules for transitions in rotating molecule, linear harmonic oscillator, Hermite polynomials. Equation for the hydrogen atom in spherical polar coordinates and an indication of the method of its solution, the quantum numbers and their significance. **(15 Lectures)**

CHEMISTRY LAB: CHPr: E

(Common for both Paper I and II)

SET –I: INORGANIC EXPERIMENTS

A. Gravimetric Analysis (20 marks)

1. Determination of barium as $BaSO_4$.
2. Determination of Aluminium as Al_2O_3.
3. Determination of iron as Fe_2O_3.

B. Complex Preparation(10 marks)

4. Preparation of trans-potassium diaqua di oxalato chromate (III).
5. Preparation of tris(thiourea) copper (I) sulphate monohydrate.
6. Preparation of sodium tris oxalate ferrate (III).

SET –II: PHYSICAL EXPERIMENTS

1. Determination of concentration of HCl and CH_3COOH or mixture of HCl + CH_3COOH by conductometric titrations using standard NaOH.
2. Determination of equivalent conductance of strong electrolyte (NaCl) and equivalent conductance at infinite dilution (λ_∞).
3. Determination of concentration of strong acid by potentiometric titration against standard solution of 0.1 N NaOH.
4. Determination of K_a of a weak acid potentiometrically.
5. Verification of Beer- Lambert's law by colorimetric method. Calculation of molar extinction coefficient and determination of unknown concentration of tetraammine copper (II) complex / ferric thiocyanate complex.
6. Determination of critical solution temperature of two partially miscible liquids (water and phenol).

Note: There shall be instructions / training for the students about laboratory etiquettes, handling of reagents, laboratory safety measures, use of apparatus / instruments pertaining to

the semester before commencement of the regular practicals. The same shall be recorded in the Journal.

Examinations

In a batch of 10 students in the practical examination, 05 students shall be given Set – I experiments: **Inorganic** (one each from A and B) and the other 05 students be Set–II experiments (**PHYSICAL EXPERIMENTS**). Selection of experiments may be done by the students based on the picking up of chits.

Distribution of Marks:

Journal-5 marks and Viva-Voce-5 marks

SET-I: INORGANIC EXPERIMENTS

Note: At least two different experiments from set I (one each from A and B) shall be given in a batch of 05 students. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

A. Gravimetric Determination (20 Marks)

Technique-02 marks, Accuracy-16 marks, calculation - 02marks, Total - 20 marks

Deduction of Marks for accuracy:

±6mg -16 marks, ± 8mg-14 marks, ±10 mg -12 marks, ±12mg-10 marks, ±14mg-08 marks, ±16mg-06 marks, above ±16 mg -zero marks.

B. Complex Preparation(10 marks)

Technique-02 marks, Yield of the complex- 08marks, Total -10 marks

Deduction of Marks for accuracy:

Preparation Error yield- Less than 10%- 08 marks, 11-15% -06 marks, 16-20% -04 marks, 21-25% -03 marks, more than25% -zero marks

SET –II: PHYSICAL EXPERIMENTS

NOTE: In a batch of 05 students, not more than two students should get the same experiment in the practical examination. Selection of experiments may be done by the students based on picking up of chits. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Technique and Presentation-3 Calculation and graph- (5+4) 9 marks, Accuracy-18 marks, Journal-5 marks, Viva-Voce-5 marks, Total=40 marks.

Deduction of Marks for accuracy:

Error up to 5% - 18 marks, 6 - 10% 15 marks, 11-15% 12 marks, 16-20% 6 marks, above 20% zero (0) marks

Discipline Specific Elective (DSE) under CBCS

B.Sc. Semester - VI

CHEMISTRY: Paper-I (CHT: P-I F)

(Candidate shall choose either Paper-I or II)

Credits: I. Theory	**: 04**	**Theory class 4hrs /wk. Total theory: 60 Lectures**
		80 marks for Sem. end Examination (3 hrs) & 20 marks IA
II. Practical	**: 02**	**Practical: 4 hrs. / wk. Total Practical: 52 hrs.**
		40 marks for Sem. end Examination (3 hrs) & 10 marks IA
Total Credits	**: 06**	**Total Theory marks 100 and Practical marks 50**

I. Metallurgy, Inorganic Polymers and Bio-Inorganic chemistry

Metallurgy: Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy(Ag and Au), Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.

Inorganic Polymers: Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Bio-inorganic chemistry: Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones). **(15 Lectures)**

II. Application of Spectroscopy to Simple Organic Molecules

a)Ultraviolet Spectroscopy:

Electromagnetic radiations, electronic transitions, λ_{max} & ε_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λ_{max} of conjugated dienes- alicyclic homo nuclear and hetero nuclear. cis – trans isomerism, α, β – unsaturated compounds, aldehydes, ketones, carboxylic acids and esters.

b)Infrared Spectroscopy:

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

c) Nuclear Magnetic resonance(NMR):

Basic principles of PMR, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constant, areas of signals. Interpretation of PMR structure of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, ethyl acetate, toluene, acetophenone and acetanilide. **(15 Lectures)**

III. Molecular Spectroscopy:

Electromagnetic spectrum, Interaction of electromagnetic radiation with matter.

(a). Rotational spectroscopy:

Rotation of molecules, diatomic: rigid rotator, selection rule: derivation for expression of energy and bond length (HCl), problems on bond length, polyatomic molecules: linear, symmetric top, asymmetric top molecules (qualitative approach).

(b). Vibrational spectroscopy:

Vibrating diatomic molecules - energy of diatomic molecules, Hooks law and force constant, Vibrational spectra: harmonically vibrating diatomic molecules (HCl) and anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies, and problems on force constants. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectra: Classical theory, Rotational Raman spectroscopy (Linear and symmetric top molecules for S and R branch), Vibrational Raman spectroscopy; vibration - rotational Raman spectra(Rotational fine structures), complementary of Raman and IR.

(c). Electronic spectroscopy:

Diatomic molecules: Born- Oppenheimer approximation, Vibrational course structure of electronic transition and intensity, Franck – Condon principle, pre-dissociation, 'g' and 'u' transitions and their applications in organic molecules. **(15 Lectures)**

IV. Photochemistry and Chemical Kinetics-II

Photochemistry: Characteristics of electromagnetic radiation, Beer –Lambert's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry, quantum yield and its determination using thermopile and actinometer, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching. Role of photochemical reactions in biochemical processes, photo stationary states, chemiluminescence, Fluorescence and phosphorescence. (numerical problems). **(10 Lectures)**

Chemical Kinetics-II : Reversible, Parallel, Consecutive and Chain reactions. Derivations of rate constant for first order parallel, reversible and consecutive reactions. Reaction kinetics of thermal and photochemical Hydrogen – Bromine Reactions. **(05 Lectures)**

Discipline Specific Elective (DSE) under CBCS

B.Sc. Semester - VI

CHEMISTRY: Paper-II (CHT:P-II F)

(Candidate shall choose either Paper-I or paper-II)

Credits: I. Theory	**: 04**	**Theory class 4hrs /wk. Total theory: 60 Lectures**
		80 marks for Sem end Examination(3 hrs) & 20 marks IA
II. Practical	**: 02**	**Practical: 4 hrs./wk. Total Practical: 52 hrs.**
		40 marks for Sem end Examination(3 hrs) & 10 marks IA
Total Credits	**: 06**	**Total Theory marks 100 and Practical marks 50**

I. Environment Chemistry

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Methods of estimation of CO, NO_X, SO_X and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens.

Water Pollution: Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.

Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water. **(15 Lectures)**

II. Application of Spectroscopy to Simple Organic Molecules

a)Ultraviolet Spectroscopy:

Electromagnetic radiations, electronic transitions, λ_{max} & ε_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λ_{max} of conjugated dienes-alicyclic homo nuclear and hetero nuclear. cis – trans isomerism, α, β – unsaturated compounds, aldehydes, ketones, carboxylic acids and esters.

b)Infrared Spectroscopy:

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

c) Nuclear Magnetic Resonance (NMR):

Basic principles of PMR, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constant, areas of signals. Interpretation of PMR structure of simple organic molecules such as ethylbromide, ethanol, acetaldehyde, ethyl acetate, toluene, acetophenone and acetanilide. (15 **Lectures)**

III. Molecular Spectroscopy:

Interaction of electromagnetic radiation with matter, electromagnetic spectrum.

(a). Rotational Spectroscopy:

Rotation of molecules, diatomic: rigid rotator, selection rule : derivation for expression of energy and bond length (HCl), problems on bond length, polyatomic molecules: linear, symmetric top, asymmetric top molecules(qualitative approach).

(b). Vibrational Spectroscopy:

Vibrating diatomic molecules - energy of diatomic molecules, force constant, vibrational spectra: harmonically vibrating diatomic molecules (HCl) and anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies, and problems on force constants. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectra: Classical theory, Rotational Raman spectroscopy (Linear and symmetric top molecules for S and R branch), Vibrational Raman spectroscopy; vibration - rotational Raman spectra(Rotational fine structures), complementary of Raman and IR.

(c). Electronic Spectroscopy:

Diatomic molecules: Born- Oppenheimer approximation, vibrational course structure of electronic transition and intensity, Franck – Condon principle, pre-dissociation, ‘g’ and ‘u’ transitions and their applications in organic molecules. **(15 Lectures)**

IV. Polymer Chemistry and Micelle:

Polymer Chemistry: Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Crystallization and Crystallinity: Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. Nature and structure of polymers-Structure Property relationships.

Determination of molecular weight of polymers (M_n, M_W, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Properties of Polymers: (Physical, thermal, Flow & Mechanical Properties). Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, polyamides. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

(12 Lectures)

Micelle: Emulsions, micro emulsions or micellar emulsions, and its Stability, Properties of Micro emulsions**:** electro kinetic effects. Colloidal electrolytes or association colloids, types of Colloidal electrolytes. **Micelles:** surface-active agents or surfactants. (**03 Hours**)

CHEMISTRY LAB: CHPr-F

(Common for both Paper I and II)

SET – I: PHYSICAL EXPERIMENTS

1. Determination of dissociation constant of acetic acid conductometrically.
2. Determination of solubility of sparingly soluble salt ($BaSO_4$/$PbSO_4$) conductometrically.
3. Determination of redox potentials of Fe^{3+}/Fe^{2+} using of $FeSO_4.7H_2O$ solution (0.1N) by potentiometric titration against the standard solution of $K_2Cr_2O_7$ (0.1N)
4. Determination of solubility and solubility product of sparingly soluble salts (AgCl) potentiometrically.
5. Preparation of standard acidic buffer solutions using 0.1M acetic acid & 0.1M sodium acetate using Henderson-Hasselbatch and determination of mole ratio of buffer solutions of unknown pH.
6. Determination of percentage composition of unknown mixture of A and B liquids using Abbe's refractometer (formula and graphical method).

SET-II: INORGANIC / ORGANIC

A. Ore / Alloy Analysis (20 marks)

1. Extraction of Iron (III) from haematite ore or solid Fe_2O_3 and determination of percentage of iron in the solution using standard $K_2Cr_2O_7$ solution (internal indicator method).
2. Extraction of Cu and Zn from brass and determination of percentage of copper in the solution using standard $Na_2S_2O_3$ solution.
3. Extraction of calcium from limestone and determination of percentage of calcium in the solution by oxalate method.

B. Organic analysis (10 marks)

4. Separation of amino acids by paper chromatography, measuring R_f value and determination of glycine present in the solution volumetrically.
5. Saponification value of oil or fat.
6. Determination of Iodine number of an oil/ fat.

Note: There shall be instructions / training for the students about laboratory etiquettes, handling of reagents, laboratory safety measures, use of apparatus / instruments pertaining to the semester before commencement of the regular practicals. The same shall be recorded in the Journal.

Examinations

A batch of 10 students in the practical examination, 05 students may be given Set – I experiments (**PHYSICAL EXPERIMENTS**) and the other 05 students may be given Set – II experiments **(SET-II: INORGANIC / ORGANIC)**. Selection of experiments may be done by the students based on the picking up of chits.

Distribution of Marks:

Journal-5 marks and Viva-Voce-5 marks

SET – I : PHYSICAL EXPERIMENTS

NOTE: In a batch of 05 students, not more than two students should get the same experiment in the practical examination. Selection of experiments may be done by the students based on the picking up of chits. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Technique and Presentation-3 Calculation and graph- (5+4) 9 marks, Accuracy-18 marks, Journal-5 marks, Viva-Voce-5 marks, Total=40 marks.

Deduction of Marks for accuracy:

Error up to 5% - 18 marks, 6 - 10% 15 marks, 11-15% 12 marks, 16-20% 6 marks, above 20% zero (0) marks

SET-II: INORGANIC / ORGANIC

Note: At least two different experiments from set II (one each from A and B) shall be given in a batch of 05 students. Selection of experiments may be done by the students based on the picking up of chits. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

A. Ore / Alloy Analysis(20 marks)

Technique-02 marks, Accuracy- 14 marks, calculation -4 marks, Total 20 marks.

Deduction of Marks for accuracy:

Determination ±0.2 CC -14marks, ± 0.4 CC- 12marks, ±0.6 CC- 10 marks, ±0.8 CC- 06 marks, above ±0.9 - zero marks.

B. Organic analysis (10 marks)

Technique-02 marks, Accuracy – 08 marks, Total 10 marks.

Deduction of Marks for accuracy:

Determination ±0.2 CC -08marks, ± 0.4 CC- 06marks, ±0.6 CC- 04 marks, ±0.8 CC- 03 marks, above ±0.9 - zero marks.

GENERAL PATTERN OF THEORY QUESTION PAPER FOR ALL THE SEMESTERS

1. **Question number 1-12 carries 2marks to answer any 10 questions : 20 marks**
2. **Question number 13-21 carries 5marks to answer any 6 questions : 30 marks**
3. **Question number 22-26 carries 10marks to answer any 3 questions : 30 marks**
   (10 marks questions may be 6+4 or 7+3 or 10) Total: 80 marks

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REFERENCE BOOKS

Inorganic Chemistry

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
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4. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
5. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
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7. Rodgers, G.E. *Inorganic & Solid State Chemistry,* Cengage Learning India Ltd.,2008.
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11. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
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Organic Chemistry

1. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
2. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi,2004
3. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
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8. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
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10. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
11. Organic Chemistry-F.A. Carey, 4th Edition, McGraw Hill (2000).
12. Advanced Organic Chemistry - J. March, John Wiley & Sons, 1992
13. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983
14. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998
15. Organic Chemistry - L.Ferguson, Von Nostrand, 1985
16. Organic Chemistry - M. K. Jain, Nagin & Co., 1987

Physical Chemistry

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. P.W. Atkins: Physical Chemistry.

5. W.J. Moore: Physical Chemistry
6. Text Book of Physical Chemistry - P.L. Soni, S. Chand & Co.,1993
7. Text Book of physical chemistry - S. Glasstone, Mackmillan India Ltd., 1982
8. Principles of Physical Chemistry - B. R. Puri, L.R. Sharma and M.S.Patania, S.L.N. Chand & Co. 1987
9. Physical Chemistry - Alberty R. A. and Silbey, R.J.John Wiley and sons, 1992
10. Physical Chemistry - G.M.Barrow, Mc Graw Hill, 1986
11. Physical Chemistry(3rd Edition) - Gilbert W. Castilian, Narosa Publishing House,1985
12. Chemical Kinetics by K. J. Laidler, Tata McGraw Hill Publishing Co., New Delhi.
13. Kinetics and Reaction Mechanisms by Frost and Pearson, Wiley, New York.

Analytical Chemistry

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
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Biochemistry

1. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.,* W. H. Freeman.
2. Berg, J.M., Tymoczko, J. L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.
3. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.

Polymer Chemistry

1. Seymour, R.B. & Carraher, C.E. *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.
2. Odian, G. *Principles of Polymerization*, 4th Ed. Wiley, 2004.
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4. Lenz, R.W. *Organic Chemistry of Synthetic High Polymers.* Interscience publishers, New York, 1967.
5. Text Book of Polymer Chemistry, Fred W. Billmeyer, Jr., Wiley Publisher, 1984.
6. Polymer Science, V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar, New Age International Publisher, 2001.

Green Chemistry

1. Ahluwalia, V.K. & Kidwai, M.R. *New Trends in Green Chemistry*, Anamalaya Publishers (2005).
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6. Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2 Edition, 2010.

Industrial and environmental Chemistry

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Harwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. A. Kent: *Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.*
4. *S. S. Dara: A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
5. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
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11. P. C. Jain & M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
12. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* Vikas Publications, New Delhi
13. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

Quantum Chemistry

1. Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).
2. House, J. E. *Fundamentals of Quantum Chemistry* 2^{nd} Ed. Elsevier: USA (2004).
3. Lowe, J. P. & Peterson, K. *Quantum Chemistry*, Academic Press (2005).
4. Quantum Chemistry by R. K. Prasad, New Age International Publications, New Delhi,1997.
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Spectroscopy

1. John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds,* Prentice Hall.
2. R.M. Silverstein, G.C. Bassler & T.C. Morrill*: Spectroscopic Identification of Organic Compounds*, John Wiley & Sons.
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4. Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
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6. Introduction to Spectroscopy, Donald L. Pavia, Gary M. Lampman, and George S. Kriz, Cenage Learning, USA, (2015).

Practical Chemistry

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
4. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5^{th} edition, 1996.
5. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
6. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
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9. Experiments in Physical Chemistry by Daniels, Alberty and Willams, McGraw Hill, New York.
10. Experimental Physical Chemistry by W. G. Palmer, Cabridge University Press, London.
11. Experimental Physical Chemistry by V. D. Athawale and Parul Mathur, New Age International, New Delhi.

SKILL ENHANCEMENT COURSES (SEC) in Chemistry

B.Sc. Semester - V

CHEMISTRY : SEC- I (SEC-CH- 1E)

Total Syllabus: 30 hrs / Sem.: 2 hrs / Week

Examination: Maximum Marks- 50 (40 Semester End exam + 10 IA Exam)

Duration of Exam: 1.5 hrs

ANALYTICAL CHEMISTRY

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators.

a. Determination of pH of soil samples.
b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

a. Determination of pH, acidity and alkalinity of a water sample.
b. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
b. Analysis of preservatives and colouring matter.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

a. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).
b. To compare paint samples by TLC method.

Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Analysis of cosmetics: Major and minor constituents and their function

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration
c. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
b. d. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft drinks. **30 Lectures**

Reference Books:

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
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4. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.
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7. Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
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9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.
10. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
11. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

SKILL ENHANCEMENT COURSES (SEC) in Chemistry

B.Sc. Semester - V

CHEMISTRY : SEC- II (SEC-CH- 2E)

Total Syllabus: 30 hrs / Sem.: 2 hrs / Week

Examination: Maximum Marks- 50 (40 Semester End exam + 10 IA Exam)

Duration of Exam: 1.5 hrs

PHARMACEUTICAL CHEMISTRY

Drugs & Pharmaceuticals: Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti- inflammatory agents (Aspirin, paracetamol, Ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Fermentation: Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Practical in one hour, nevertheless no practical examination.

a. Preparation of Aspirin and its analysis.
b. Preparation of magnesium bisilicate (Antacid). **30 Lectures**

Reference Books:

1. G.L. Patrick: Introduction to *Medicinal Chemistry, Oxford University* Press, UK.
2. Hakishan, V.K. Kapoor: *Medicinal and Pharmaceutical Chemistry,* VallabhPrakashan, Pitampura, New Delhi.
3. William O. Foye, Thomas L., Lemke , David A. William: *Principles of Medicinal Chemistry*, B.I. Waverly Pvt. Ltd. New Delhi.

SKILL ENHANCEMENT COURSES (SEC) in Chemistry

B.Sc. Semester - VI

CHEMISTRY: SEC- III (SEC-CH- 1F)

Total Syllabus: 30 hrs / Sem.: 2 hrs / Week

Examination: Maximum Marks- 50 (40 Semester End exam + 10 IA Exam)

Duration of Exam: 1.5 hrs

PESTICIDE CHEMISTRY

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes:

Organochlorines (DDT, Gammexene,);

Organophosphates (Malathion, Parathion);

Carbamates (Carbofuran and carbaryl);

Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Practical in one hour, nevertheless no practical examination.

1 To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.

2 Preparation of simple organophosphates, phosphonates and thiophosphates.

30 Lectures

Reference Book:

1. Cremlyn, R. *Pesticides. Preparation and Modes of Action*, John Wiley & Sons, NewYork, 1978.

SKILL ENHANCEMENT COURSES (SEC) in Chemistry

B.Sc. Semester - VI

CHEMISTRY: SEC- IV (SEC-CH- 2F)

Total Syllabus: 30 hrs / Sem.: 2 hrs / Week

Examination: Maximum Marks- 50 (40 Semester End exam + 10 IA Exam)

Duration of Exam: 1.5 hrs

FUEL CHEMISTRY

Review of energy sources (renewable and non-renewable).Classification of fuels and their calorific value.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

30 Lectures

Reference Books:

1. Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
2. Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
3. Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).

GENERAL PATTERN OF THEORY QUESTION PAPER FOR ALL SEC PAPERS

1. **Question number 1-6 carries 2marks to answer any 5 questions : 10 marks**
2. **Question number 7-14 carries 4marks to answer any 5 questions : 20 marks**
3. **Question number 15-17 carries 5marks to answer any 2 questions : 10marks**

Total: 40 marks

Name and signature of Committee members of BOS in B.Sc. Chemistry, prepared the syllabi pertaining to B.Sc. Chemistry (General) under CBCS for Karnatak University, Dharwad, effective from 2020-21.

1	Prof. M.Y.Kariduraganavar , Chairman , UG BOS in Chemistry and Chairman P. G. Department of Chemistry K.U. Dharwad	Chairman
2	Smt. K.K Kerwadikar Principal Govt. First Grade College Karwar.	Member
3	Dr. S.N. Setty Principal KCS, Dr. A. V. Baliga Arts/ Science College Kumta	Member
4	Dr. Smt. Shobha Sharma Principal B. N. Degree College Dandeli	Member
5	Dr. S. M. Tuwar Associate Professor Dept. of Chemistry Dharwad	Member(Co-opted)
6	Prof. K.V. Pai Department of Industrial Chemistry Kuvempu University Shivamogga	Member(External)

KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION
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No.KU/Aca(S&T)/RPH-394A/2021-22/ 954   Date: 30 SEP 2021

ಅಧಿಸೂಚನೆ

ವಿಷಯ: 2021–22ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಎಲ್ಲ ಸ್ನಾತಕ ಕೋರ್ಸಗಳಿಗೆ 1 ಮತ್ತು 2ನೇ ಸೆಮಿಸ್ಟರ್ NEP-2020 ಮಾದರಿಯ ಪಠ್ಯಕ್ರಮವನ್ನು ಅಳವಡಿಸುವ ಕುರಿತು.

ಉಲ್ಲೇಖ:
1. ಸರ್ಕಾರದ ಅಧೀನ ಕಾರ್ಯದರ್ಶಿಗಳು(ವಿಶ್ವವಿದ್ಯಾಲಯ 1) ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ ಇವರ ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 260 ಯುಎನ್ಇ 2019(ಭಾಗ–1), ದಿ:7.8.2021.
2. ವಿಶೇಷ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯ ದಿನಾಂಕ: 19.08.2021
3. ಈ ಕಚೇರಿ ಸುತ್ತೋಲೆ ಸಂ.No. KU/Aca(S&T)/RPH-394A/2021-22/18 ದಿ.21.08.2021
4. ಸರ್ಕಾರದ ಆದೇಶ ಸಂಖ್ಯೆ ಇಡಿ 260 ಯುಎನ್ಇ 2019(ಭಾಗ–1), ಬೆಂಗಳೂರು ದಿನಾಂಕ: 15.9.2021
5. ಎಲ್ಲ ಅಭ್ಯಾಸಕ್ರಮಗಳ ಮಂಡಳಿ ಸಭೆಗಳ ನಡವಳಿಗಳು.
6. ಎಲ್ಲ ನಿಕಾಯಗಳ ಸಭೆಗಳು ಜರುಗಿದ ದಿನಾಂಕ: 24,25–09–2021.
7. ವಿಶೇಷ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯ ಸಂಖ್ಯೆ 01 ದಿನಾಂಕ 28.9.2021.
8. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಆದೇಶ ದಿನಾಂಕ: 30.09.2021

ಮೇಲ್ಕಾಣಿಸಿದ ವಿಷಯ ಹಾಗೂ ಉಲ್ಲೇಖಗಳನ್ವಯ ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಆದೇಶದ ಮೇರೆಗೆ, 2021–22ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ, ಎಲ್ಲ B.A./ BPA (Music)/BVA/ BTTM/ BSW/ B.Sc./B.Sc. Pulp & Paper Science/ B.Sc. (H.M)/ BCA/ B.A.S.L.P./ B.Com/ B.Com (CS)/ & BBA ಸ್ನಾತಕ ಕೋರ್ಸಗಳ 1 ಮತ್ತು 2ನೇ ಸೆಮಿಸ್ಟರಗಳಿಗೆ NEP-2020 ರಂತೆ ವಿಶೇಷ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯು ಅನುಮೋದಿಸಿದ ಕೋರ್ಸಗಳ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ www.kud.ac.in ದಲ್ಲಿ ಬಿತ್ತರಿಸಲಾಗಿದೆ. ಸದರ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲದಿಂದ ಡೌನಲೋಡ ಮಾಡಿಕೊಳ್ಳಲು ಸೂಚಿಸುತ್ತ ವಿದ್ಯಾರ್ಥಿಗಳ ಹಾಗೂ ಸಂಬಂಧಿಸಿದ ಎಲ್ಲ ಬೋಧಕರ ಗಮನಕ್ಕೆ ತರಲು ಅದರಂತೆ ಕಾರ್ಯಪ್ರವೃತ್ತರಾಗಲು ಕವಿವಿ ಅಧೀನದ/ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ ಸೂಚಿಸಲಾಗಿದೆ.

ಅಡಕ: ಮೇಲಿನಂತೆ

30/09/21
(ಡಾ. ಹನುಮಂತಪ್ಪ ಕೆ.ಟಿ.)
ಕುಲಸಚಿವರು.

ಗೆ,
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಎಲ್ಲ ಅಧೀನ ಹಾಗೂ ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ. (ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ ಹಾಗೂ ಮಿಂಚಂಚೆ ಮೂಲಕ ಬಿತ್ತರಿಸಲಾಗುವುದು)

ಪ್ರತಿ:
1. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
2. ಕುಲಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ
3. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ) ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
4. ಅಧೀಕ್ಷಕರು, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ / ಗೌಪ್ಯ / ಜಿ.ಎ.ಡಿ. / ವಿದ್ಯಾಮಂಡಳ (ಪಿ.ಜಿ.ಪಿಎಚ್.ಡಿ) ವಿಭಾಗ, ಸಂಬಂಧಿಸಿದ ಕೋರ್ಸುಗಳ ವಿಭಾಗಗಳು ಪರೀಕ್ಷಾ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
5. ನಿರ್ದೇಶಕರು, ಕಾಲೇಜು ಅಭಿವೃದ್ಧಿ / ವಿದ್ಯಾರ್ಥಿ ಕಲ್ಯಾಣ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.

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KARNATAK UNIVERSITY, DHARWAD

B.Sc. (Hons.) Program

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DRAFT SYLLABUS

CHEMISTRY

[Effective from 2021-22]

DISCIPLINE SPECIFIC COURSE (DSC) FOR SEM I & II,

OPEN ELECTIVE COURSE (OEC) FOR SEM I & II and

SKILL ENHANCEMENT COURSE (SEC) FOR SEM I

Karnatak University, Dharwad

Four Years Under Graduate Program in Chemistry for B.Sc. (Hons.) as per NEP-2020

Effective from 2021-22

Sem	Type of Course	Theory/ Practical	Instruction hour per week	Total hours of Syllabus / Sem	Duration of Exam	Internal Assessment Marks	Sem End Exam. Marks	Total Marks	Credits
I	DSCC-1T	Theory	04 hrs	56	03 hrs	30	70	100	04
	DSCC-1P	Practical	04 hrs	52	03 hrs	15	35	50	02
	OEC-1	Theory	03 hrs	42	03 hrs	30	70	100	03
	*SEC-1	Practical	02 hrs	22-30	03 hrs	15	35	50	02
II	DSCC-2T	Theory	04 hrs	56	03 hrs	30	70	100	04
	DSCC-2P	Practical	04 hrs	52	03 hrs	15	35	50	02
	OEC-2	Theory	03 hrs	42	03 hrs	30	70	100	03
	Details of the other Semesters will be given later								

***Student can opt digital fluency as SEC or the SEC of his/ her any one DSCC selected it will be evaluated as pr the guidelines issued by the University time to time.**

PROGRAMME OUTCOMES (PO) from B.Sc. (Honors) Chemistry

After studying the Chemistry for 04 years, students will be able to:

PO 1 Demonstrate, solve and an understanding of major concepts in all the disciplines of chemistry.

PO 2 Provide students with broad and balanced knowledge and understanding of key chemical concepts.

PO 3 Understand practical skills so that they can understand and assess risks and work safely and competently in the laboratory.

PO 4 To apply standard methodology to the solutions of problems in chemistry.

PO 5 Provide students with knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas involving chemistry.

PO 6 Provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes.

PO 7 Develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.

PO 8 Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.

PO 9 To prepare students effectively for professional employment or research degrees in chemical sciences.

PO 10 To cater to the demands of chemical industries of well-trained graduates.

PO 11 To build confidence in the candidate to be able to work on his own in industry and institution of higher education.

PO 12 To develop an independent and responsible work ethics.

Chemistry as Discipline Specific Course (DSC)

B.Sc. Semester – I

CHEMISTRY: CHM T-1

Courses	Credits	No. of Classes/Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	04	04	56	3	30	70	100
Practical	02	04	52	3	15	35	50

UNIT-I ATOMIC STRUCTURE & PERIODICITY OF ELEMENTS

Atomic Structure: Review of Rutherford's atomic model, Bohr's theory, Hydrogen atomic spectra.

Derivation of radius and energy of an electron in hydrogen atom, limitations of Bohr's theory, dual behavior of matter and radiation, de Broglie's equations, Heisenberg Uncertainty principle and their related problems. Quantum mechanics. Derivation of Schrodinger's wave equation for hydrogen atom and meanings of various terms in it. Significance of ψ and ψ^2. Radial and angular wave functions (atomic orbitals) and their distribution curves for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Quantum numbers and their significance. Orbital shapes of *s, p, d and f* atomic orbitals, nodal planes. Rules for filling electrons in various orbitals, Electronic configurations of the atoms (atomic number up to 54). Concept of exchange energy. Anomalous electronic configurations. IUPAC nomenclature of elements with atomic number greater than hundred. **(10 Lectures)**

Periodicity of elements: Brief account on the following properties of elements with reference to s and p-block and trends in groups and periods. Effective nuclear charge, screening effect, Slater's rules, atomic and ionic radii, ionization enthalpy, electron gain enthalpy, electronegativity, Pauling/ Allred-Rochow scales**.**

Numerical problems are to be solved wherever applicable. **(04 Lectures)**

UNIT-II FUNDAMENTALS OF ORGANIC CHEMISTRY & STEREOCHEMISTRY

Fundamentals of Organic Chemistry: Review of hybridization, *sigma* and *pi* bonds.

IUPAC Nomenclature of poly functional organic compounds, comparative study of bond lengths, bond angles, bond energies and dihedral angles, bond polarity, dipole moment and illustration with examples of organic compounds, delocalization, electron displacement effects and their applications: inductive effect, electrometric effect, resonance effect, hyperconjugation, and steric effect.

Organic reaction Mechanism: Definition, classification of organic reactions: substitution, addition, elimination, rearrangement, oxidation and reduction reactions with suitable examples. Use of curved arrows, types of bond fission, electrophiles, nucleophiles, nucleophilicity, nucleofugacity and basicity.

Reactive intermediates: Structure, formation and stability and reactions of carbocations, carbanions, free radicals and carbenes. **(7 Lectures)**

Stereochemistry:

Stereoisomersim: Definition of stereoisomerism, conformational isomers and configurational isomers (distinction between conformation and configuration). Newman, Sawhorse and Fischer projection formulae and their interconversions.

Geometrical isomerism: Definition, reason for geometrical isomerism, E and Z notation - CIP rules and examples, determination of configuration of geometric isomers by dipole moment method and anhydride formation method, *syn* and *anti* isomers in compounds containing C=N.

Optical isomerism: Chirality/asymmetry, enantiomerism, diastereomerism and meso compounds. R and S notations (compounds with two asymmetric centers), D and L configurations and *threo* and *erythro* nomenclature, racemic mixture and racemization,

Resolution: Definition, Resolution of racemic mixture by: i) Mechanical separation ii) Formation of diastereomers iii) Biochemical methods. Biological significance of chirality. Problems are to be solved wherever applicable. **(7 Lectures)**

UNIT-III GASES & LIQUIDS

Gaseous state: Review of kinetic theory of gases, van der Waals equation of state Boyle temperature.

Molecular velocity: Maxwell's Boltzmann distribution law of molecular velocities (most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies (derivation not required), law of equipartition of energy.

Collision frequency, collision diameter, Collision cross-section, collision number and mean free path and coefficient of viscosity, calculation of σ and η , variation of viscosity with temperature and pressure.

Critical phenomena: Andrews isotherms of CO_2, critical constants and their determination Relation between critical constants and van der Waals equation (Derivation), continuity of states, law of corresponding states. Numerical problems are to be solved wherever applicable.

(7 Lectures)

Liquid state: Molecular forces and general properties of liquids**.**

Surface tension: surface tension, surface energy, effect of temperature on surface tension, shapes of liquid drops and soap bubbles, capillary action, determination of surface tension by capillary rise method, drop weight and drop number methods using stalagmometer. Effect of temperature on surface tension. Parachor, Additive and constitutive properties: atomic and structural parachor. Elucidation of structure of benzene and benzoquinone.

Viscosity: Definition, viscosity coefficient, fluidity, molecular viscosity, relative viscosity and absolute viscosity, determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces.

Refractive index: Definition, Specific and molar refraction. Determination of refractive index using Abbe's refractometer. Additive and constitutive properties: Elucidation of structure of molecules. Numerical problems are to be solved wherever applicable.

(7 Lectures)

UNIT-IV ANALYTICAL CHEMISTRY

Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Accuracy, precision, selectivity and sensitivity. Method validation. Types and sources of errors in analytical measurements. Presentation of experimental data and results from the point of view of significant figures.

Titrimetric analysis: Principle, classification, normality, molarity, molality, mole fraction, ppm, ppb etc. Standard solutions, preparation and dilution of reagents/solutions using $N_1V_1= N_2V_2$, preparation of ppm level solutions from source materials (salts).

Acid-base titrimetry: Theory, titration curves for all types of acids – base titrations.

Redox titrimetry: Theory, balancing redox equations, titration curves, theory of redox indicators and applications.

Precipitation titrimetry: Theory, titration curves, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences.

Complexometric titrimetry: Theory, titration methods employing EDTA (direct, back, displacement and indirect determinations). Indicators for EDTA titrations - theory of metal ion indicators. Determination of hardness of water.

Numerical problems are to be solved wherever applicable. (**14 Lectures)**

CHEMISTRY LAB: CHM P -1

Inorganic chemistry experiments

Calibration of glasswares (burette, pipette, volumetric flask)

(Primary and Secondary standard solutions, normality, molarity, molality, equivalent mass).

1. Determination of sodium carbonate using standard HCl solution (Standardize HCl solution using standard sodium carbonate solution).
2. Determination of carbonate and hydroxide present together in amixture.
3. Determination of Mohr's salt and oxalic acid using standardized $KMnO_4$ solution.
4. Determination of ferrous (Fe (II)) and ferric (Fe(III)) anions in a solution using standard solution of $K_2Cr_2O_7$ by internal indicator method (diphenylamine or N-phenylanthranilic acid).
5. Determination of Magnesium using standard EDTA solution (Standardization of EDTA is to be carried out using standard zinc sulphate solution).
6. Determination of iodine using sodium thiosulphate (Standardize the sodium thiosulphate using dichromate).

Organic chemistry experiments

7. Determination of phenol by bromination method
8. Determination of aniline by bromination method.
9. Determination of acetamide by hydrolysis method.
10. Determination of ethyl benzoate by hydrolysis method.
11. Determination of aspirin in the tablet by hydrolysis method.
12. Determination of amount of formaldehyde in the given solution by sodium sulphite method.

- Standard solution is to be prepared by the students for both in regular and in practical examination.

Examination

In the practical examination, in a batch of ten students, five students each will be performing inorganic and organic experiments. At least two experiments from inorganic and two experiments from organic may be given. Selection of experiments may be done by the students based on lots. Viva questions may be asked on any of the experiments prescribed in the practical syllabus**.** *Manual is not allowed in the examination.*

Distribution of marks in inorganic experiments

Accuracy - 15 marks, reactions and calculations – 5 marks, technique and presentation-5 marks, Journal-5 marks, viva-voce-5 marks, total=35 marks.

Deduction of marks for accuracy: : ±0.2 CC -15 marks, ± 0.4 CC- 12 marks, ±0.6 CC- 09 marks, ±0.8 CC- 06 marks, ±0.9 CC or above - 03 marks.

Distribution of marks in organic experiments

Accuracy - 15 marks, reactions and calculations – 5 marks, technique and presentation-5 marks, Journal-5 marks, viva-voce-5 marks, total=35 marks.

Deduction of marks for accuracy: : ±0.2 CC -15 marks, ± 0.4 CC- 12 marks, ±0.6 CC- 09 marks, ±0.8 CC- 06 marks, ±0.9 CC or above - 03 marks.

LEARNING OUTCOMES / COURSE OUTCOMES: CHMT-1

Chemistry as Discipline Specific Course (DSC)

B.Sc. Semester – I

CHEMISTRY: CHM T-1

After successful completion of three year degree program in Chemistry a student should be able to;

UNIT-I ATOMIC STRUCTURE & PERIODICITY OF ELEMENTS

1. Describe the dual nature of radiation and matter; dual behavior of matter and radiation, de Broglie's equations, Heisenberg uncertainty principle and their related problems.
2. Quantum mechanics. Derivation of Schrodinger's wave equation. Orbital shapes of *s*, *p*, *d and f* atomic orbitals, nodal planes. Electronic configurations of the atoms.
3. Define periodicity, explain the cause of periodicity in properties, classify the elements into four categories according to their electronic configuration.
4. Define atomic radii, ionisation energy, electron affinity and electronegativity, discuss the factors affecting atomic radii, describe the relationship of atomic radii with ionization energy and electron affinity, describe the periodicity in atomic radii, ionization energy, electron affinity and electronegativity.

UNIT-II FUNDAMENTALS OF ORGANIC CHEMISTRY & STEREOCHEMISTRY

1. Explain bond properties, electron displacement effects (inductive effect, electrometric effect, resonance effect and Hyper conjugation effect). steric effect and their applications in explaining acidic strength of carboxylic acids, basicity of amines.
2. Understand basic concept of organic reaction mechanism, types of organic reactions, structure, stability and reactivity of reactive intermediates.
3. Describe important characteristics of configurational and conformational isomers. Practice and write conformational isomers of ethane, butane and cyclohexane.
4. Understand the various concepts of geometrical isomerism and optical isomerism. Describe CIP rules to assign E,Z notations and R& S notations. Explain D and L configuration and *threo* and *erythro* nomenclature.
5. Explain racemic mixture and racemisation, resolution of racemic mixture through mechanical separation, formation of diastereomers, and biochemical methods, biological significance of chirality.

UNIT-III GASES & LIQUIDS

1. Explain the existence of different states of matter in terms of balance between intermolecular forces and thermal energy of the particles. Explain the laws governing behavior of ideal gases and real gases. Understand cooling effect of gas on adiabatic expansion
2. Describe the conditions required for liquefaction of gases. Realize that there is continuity in gaseous and liquid state.
3. Explain properties of liquids in terms of intermolecular attractions.

UNIT-IV ANALYTICAL CHEMISTRY

1. Understand principles of titrimetric analysis.
2. Understand principles of different type's titrations. Titration curves for all types of acids – base titrations.
3. Gain knowledge about balancing redox equations, titration curves, theory of redox indicators and applications.
4. Understand titration curves, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences.
5. Indicators for EDTA titrations - theory of metal ion indicators. Determination of hardness of water.

CHEMISTRY LAB (Inorganic and Organic Analyses): CHM P-1

After studying this course and performing the experiments set in it student will be able to:

1. Understand and practice the calibration of glasswares (burette, pipette, volumetric flask).
2. Basic concepts involved in titrimetric analysis, primary standard substances, preparation of standard solutions.
3. Explain the principles of acid-base, redox and iodometric titrations.
4. Work out the stoichiometric relations based on the reactions involved in the titrimetric analysis.
5. Based on principles of titrimetric analysis student can perform
6. Describe the significance of organic quantitative analysis.
7. Determine the amount of phenol, aniline, amide, ester and formaldehyde in a given solution by performing blank titration and main titrations.
8. Determine aspirin in the tablet by hydrolysis method.

B.Sc. Semester - II

CHEMISTRY: CHMT-2

Courses	Credits	No. of Classes/Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	04	04	56	3	30	70	100
Practical	02	04	52	3	15	35	50

UNIT-I CHEMICAL BONDING & MOLECULAR STRUCTURE

Ionic Bonding*:* General characteristics of ionic compounds. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Landé equation and calculation of lattice energy. Born-Haber cycle and its applications.

Polarizing power and polarizability: Fajan's rules, ionic character in covalent compounds and percentage of ionic character.

Covalent bonding: General characteristics of covalent compounds. VB approach, shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures of NO_3^-, CO_3^{2-} and SO_4^{2-}.

Molecular Orbital Theory: LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules and ions of 1st and 2nd periods and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.

Numerical problems are to be solved wherever applicable. (**14 Lectures)**

UNIT-II ALIPHATIC HYDROCARBONS

Alkanes: Methods of preparation by catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis and from Grignard reagent. Free radical mechanism of halogenations, relative reactivity and selectivity of halogenation. Conformational analysis of ethane and butane.

Alkenes: Methods of preparation by dehydration of alcohols and dehydrohalogenation of alkyl halides. Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. *cis* Alkenes by partial catalytic hydrogenation and *trans* alkenes by Birch reduction. Reactions: Addition of HX (Markownikov's and anti-Markownikov's addition)

Stereospecificity of halogen addition, regioselectivity and relative rates of addition reaction. Hydrogenation, hydration, hydroxylation and epoxidation of alkenes. Oxidative cleavage of alkenes with $KMnO_4$. Ozonolysis, mechanism of ozonolysis in propene and polymerization.

Alkadienes: Classification, mechanism of addition of halogen and hydrogen halides in 1,3-diene, kinetically and thermodynamically controlled addition of HBr to 1,3-butadiene, polymerization and Diels-Alder reaction.

Alkynes: Preparation: Acetylene from CaC_2 and conversion into higher alkynes by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: Acidity of 1-alkynes and formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$. **(11 Lectures)**

Cycloalkanes: Types of cycloalkanes and their relative stability. Baeyer strain theory and theory of strainless rings. Conformational analysis of cyclohexane with Karplus energy diagram. Axial and equatorial bonds. Relative stability of mono substituted cyclohexanes. **(3 Lectures)**

UNIT-III SOLIDS & CHEMICAL KINETICS

Solids: Types of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl. Defects in crystals.

Liquid Crystals: Explanation, classification with examples- Smetic, nematic, cholesteric, disc shaped and polymeric. Structures of nematic and cholesteric phases-molecular arrangements in nematic and cholesteric liquid crystals. Applications of liquid crystals in LCDs and thermal sensing. Numerical problems are to be solved wherever applicable.

(7 Lectures)

Chemical Kinetics: Review of reaction rates, order and molecularity.

Factors affecting rates of reaction: concentration pressure, temperature, catalyst, etc. Examples for different orders of reactions. Derivation of integrated rate equations for zero and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction (numerical problems). Methods for determination of order of a reaction by half life period and differential equation method. Effect of temperature on reaction rates, temperature coefficient, Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Numerical problems are to be solved wherever required. **(7 Lectures)**

UNIT-IV ANALYTICAL CHEMISTRY

Gravimetric Analysis: Requisites of precipitation, mechanism of precipitation, factors influencing precipitation, co-precipitation and post-precipitation. Structure, specificity, conditions and applications of organic reagents such as salcylaldoxime, oxine, DMG, cupron and cupferron in inorganic analysis. Advantages of organic reagents over inorganic reagents.

(6 Lectures)

Water analysis: Water availability, requirement of water. Quality of surface water and ground water. Impurities in water. Standards of water quality (color, pH, hardness, TDS, sulphate, fluoride, chloride etc.) for potable, domestic, industrial and agricultural purpose. Water treatment technologies – house hold water treatment, municipal water treatment, industrial treatment (primary and secondary treatment of industrial effluent). Softening of water. Disinfection of water. Definition and determinations of DO, BOD and COD, and their significance.

Numerical problems are to be solved wherever required. **(8 Lectures)**

CHEMISTRY LAB CHM P- 2

Analytical chemistry experiments

Explanation regarding errors, types of errors, accuracy, precision, significant figures and standard deviation (students should write in the journal regarding the above).

1. Determination of total alkalinity in antacids.
2. Determination of Vitamin C in lemon juice/formulations.
3. Determination of free alkali present in different soaps/detergents.
4. Analysis of DO in waste water sample / pond water / river water etc.
5. Determination of Ni (II) using DMG by gravimetric method.
6. Determination of Chemical Oxygen Demand (COD) in waste water sample.
7. Determination of temporary, permanent and total hardness of water using standard EDTA solution

Physical chemistry experiments

1. Determination of surface tension and parachor of alcohol series.
2. Determination of surface tension of soap solutions for various concentrations.
3. Determination of the viscosity of liquids (ethylacetate & ethyl alcohol /toluene, & chlorobenzene or any other two non hazardous liquids) using Ostwald's viscometer.
4. Study of the variation of viscosity of sucrose solution with different concentrations.
5. Determination of specific and molar refraction by Abbes refractometer (ethyl acetate, methyl acetate, ethylene chloride)
6. Determination of the composition of liquid mixture by refractometry (toluene & alcohol, water & sucrose solution).

In the practical examination, in a batch of ten students, five students each will be performing analytical and physical experiments. At least two experiments from analytical and two experiments from physical may be given. Selection of experiments may be done by the students based on lots. Viva questions may be asked on any of the experiments prescribed in the practical syllabus. *Manual is not allowed in the examination.*

Distribution of marks in analytical experiments

Accuracy - 15 marks, reactions and calculations – 5 marks, technique and presentation-5 marks, Journal - 5 marks, viva-voce-5 marks, total = 35 marks.

Deduction of marks for accuracy: : ±0.2 CC -15 marks, ± 0.4 CC- 12 marks, ±0.6 CC- 09 marks, ±0.8 CC- 06 marks, ±0.9 CC or above - 03 marks.

Distribution of marks in physical experiments:

Accuracy-15 marks, calculation: 5 marks, technique and presentation-5; marks, journal-5 marks, viva-voce-5 marks, total = 35 marks.

Deduction of marks for accuracy: Error up to 5% - 15 marks, 6 - 10% 12 marks, 11-15% 9 marks, 16 or above 6 marks.

LEARNING OUTCOMES / COURSE OUTCOMES CHMT-2

Chemistry as Discipline Specific Course (DSC)

B.Sc. Semester – II

CHEMISTRY: CHM T-2

After successful completion of three year degree program in Chemistry a student should be able to;

UNIT-I CHEMICAL BONDING & MOLECULAR STRUCTURE

1. Explain ionic bond, Born Lande equation ,Born Haber cycle and Fajan's rules
2. State VSEPR theory, hybridisation and shapes of various molecules.
3. Understand the concept of resonance and write resonating structures of NO_3^-, CO_3^{2-} and SO_4^{2-}.
4. Explain MO Theory and draw the MO diagrams for homonuclear diatomic molecules and ions of 1st and 2nd periods and heteronuclear diatomic molecules such as CO, NO and NO^+.
5. Compare MO and VB theory.

UNIT-II ALIPHATIC HYDROCARBONS

1. Learn preparation and reactions of alkanes, alkenes and alkynes.
2. Clear the concept learning mechanism of Free radical mechanism of halogenations of alkanes.
3. Understand the mechanisms of addition reactions of alkenes and alkynes.
4. Learn the concept of polymerization, ozonolysis in alkenes and alkynes..
5. Learn acidity of alkynes, formation of metal acetylides and their applications.
6. Explain cycloalkanes and their relative stability.
7. Explain conformational analysis of cyclohexane with Karplus energy diagram. Axial and equatorial bonds. Relative stability of mono substituted cycloalkanes.

UNIT-III SOLIDS & CHEMICAL KINETICS

1. Expected to learn symmetry elements, unit cells, crystal systems.
2. Learn Bravais lattice, types and identification of lattice planes.
3. Explain laws of crystallography - law of constancy of interfacial angles, law of rational indices.
4. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and

CsCl (qualitative treatment only).

5. Explain defects in crystals. Learn the applications of liquid crystals.
6. Learn the concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates.
7. Understand the concept of order and molecularity of a reaction and their applications.
8. Define half–life of a reaction.
9. Explain methods for determination of order of a reaction by half life period and differential equation method.
10. Understand the concept of activation energy and its calculation from Arrhenius equation.
11. Explain theories of reaction rates: Collision theory and activated complex theory of bimolecular reactions.

UNIT-IV ANALYTICAL CHEMISTRY

1. Learn principles of gravimetric analysis.
2. Learn the precipitation, mechanism of precipitation, factors influencing precipitation, co-precipitation and post-precipitation.
3. Learn structure, specificity, conditions and applications of organic reagents. Advantages of organic reagents over inorganic reagents.
4. Learn about quality of surface water, ground water. Impurities in water, standards of water quality (color, pH, hardness, TDS, sulphate, fluoride, chloride) for potable, domestic, industrial and agricultural purpose.
5. Learn Water treatment technologies – house hold water treatment, municipal water treatment, industrial treatment (primary and secondary treatment of industrial effluent), softening of water, and disinfection of water. Determinations of DO, BOD and COD, and their significance.

CHEMISTRY LAB (Analytical and Physical experiments) CHM P-2

1. Learn regarding errors, types of errors, accuracy, precision, significant figures and standard deviation.
2. To determine the total alkalinity in antacids, Vitamin C in lemon juice/formulations.
3. To determine free alkali present in different soaps/detergents. Learn analysis of DO in waste water sample.
4. To determine Chemical Oxygen Demand (COD) in waste water sample.

5. To determine temporary, permanent and total hardness of water by collecting different samples of water.
6. Enable to understand the applications of experiments like methods of determination of viscosity, surface tension, refractive index.

Reference Books for Discipline Specific Course

Inorganic Chemistry

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd Ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J. J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
5. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
6. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
7. Rodgers, G. E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.
8. Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012) Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry. John Wiley & Sons, 1974.
9. G.L. Miessler & Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
10. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
11. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., New York (1985).

Organic Chemistry

1. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
2. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi, 2004.
3. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
4. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
5. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
6. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
8. Graham Solomons, T. W., Fryhle, C. B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
9. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
10. Organic Chemistry-F. A. Carey, 4th Edition, McGraw Hill (2000).

11. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983.
12. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998.
13. Organic Chemistry - L. Ferguson, Von Nostrand, 1985.
14. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
15. Organic Chemistry- Mehta and Mehta, PHI Learning Pvt. Ltd, New Delhi,2005.

Physical Chemistry

1. Barrow, G.M. Physical Chemistry, Tata McGraw-Hill, 2007.
2. Castellan, G.W. Physical Chemistry, 4th Ed. Narosa, 2004.
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi, 2009.
4. P.W. Atkins: Physical Chemistry, 2002.
5. W.J. Moore: Physical Chemistry, 1972.
6. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
7. Text Book of Physical Chemistry - S. Glasstone, Mackmillan India Ltd., 1982.
8. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
9. Physical Chemistry - Alberty R. A. and Silbey, R. J. John Wiley and sons, 1992.
10. Physical Chemistry - G. M. Barrow, McGraw Hill, 1986.
11. Physical Chemistry (3^{rd} Edition) - Gilbert W. Castilian, Narosa Publishing House, 1985.
12. Chemical Kinetics by K. J. Laidler, Tata McGraw Hill Publishing Co., New Delhi.
13. Kinetics and Reaction Mechanisms by Frost and Pearson, Wiley, New York, 1981.

Analytical Chemistry

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
2. Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. Instrumental Methods of Analysis, 7^{th} Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. Christian, G.D; Analytical Chemistry, VI Ed. John Wiley & Sons, New York, 2004.
4. Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Skoog, D. A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed, 2017.
6. Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974.

CHEMISTRY: CHM OEC-1
Open Elective Course
B.Sc. Semester – I

Courses	Credits	No. of Classes/Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	3	30	70	100

Chemistry in daily life

Unit- I

Household chemicals: Common chemicals used at home.

Tooth paste – Contents of toothpaste, chemical name, ingredients, flavor and its role.

Cosmetics – Contents and uses of Face powder, snow, lipsticks and perfumes. Toxic household chemicals and their effects (antifreeze, bleach, drain cleaners, carpet cleaners, ammonia, air fresheners).

Soaps and detergents- Types of soaps, synthetic detergents (neutral, anionic and cationic), cleansing action of detergents. Advantages and disadvantages of detergents over soaps.

Biomolecules: Composition and uses of Carbohydrates, proteins, oils and fats minerals and vitamins. Functions of enzymes and hormones in the human body. **(14 Lectures)**

Unit- II

Food additives, adulterants and contaminants: Definition types and applications - Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose and sodium cyclamate. Flavours: Vanillin, alkyl esters (fruit flavours) and monosodium glutamate.

Artificial food colorants: Coal tar dyes and non-permitted colours and metallic salts. Analysis of pesticide residues in food.

Science behind emotions, sunscreen, rust formation, rainbow, motion sickness, salt harvesting, crystallization of sugar and kidney stones.

Chemotherapy: Drugs and their classification. Therapeutic action of different classes of the drugs *viz.* analgesics, antibiotics, antacids, antihistamines, antimicrobials, contraceptives, antipyretics, antiseptics and neurologically active drugs. **(14 Lectures)**

Unit- III

Polymers: Examples of synthetic polymers and their uses (LDPE, HDPE, PVC, Polypropylene, nylon, teflon, polysiloxanes, polyphosphazenes and polybutadiene).

Surface Coatings: Classification and brief introduction to surface coatings. Paints and pigments - formulation, composition and related properties. Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

Fertilizers: Composition of fertilizers, uses of Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, superphosphate of lime.

Insecticides, weedicides and pesticides: Examples, content and uses.

Chemical explosives: Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

(14 Lectures)

COURSE OUTCOMES OEC-1 Chemistry

On completion of the course students will be able to:

- Understand the chemical constituents in various day to day materials using by a common man.
- Understand the chemical constituents in fertilizers, insecticides and pesticides, chemical explosives etc.
- Understand the chemical constituents in polymers, surface coatings etc.

Reference Books

1. Hawley's Condensed Chemical Dictionary by Richard J. Lewis. Call Number: REF 540.3 H31.
2. Van Nostrand's Encyclopedia of Chemistry by Glenn D. Considine, Call Number: REF 540.3 V33C 2005.
3. Macmillan Encyclopedia of Chemistry by Joseph J. Lagowski.
4. NCERT 12^{th} Standard Book and references therein.
5. Chemistry in Daily Life: Third Edition Paperback – 1 January 2012 by Singh K.

CHEMISTRY: CHM OEC-2
Open Elective Course
B.Sc. Semester – II

Courses	Credits	No. of Classes/Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	3	30	70	100

Molecules of Life
UNIT I

Carbohydrates: Sugars, non sugars, reducing and non-reducing sugars. Occurrence and general properties of glucose and fructose. Open chain and Haworth ring structures of glucose and fructose. Epimers, mutarotation and anomers.

Disaccaharides: Occurance of disaacharides (Sucrose, Maltose and Lactose). Glycosidic linkage in disaccharides. Ring structures of sucrose, maltose and lactose. Polysaccharides: Starch – monomer units, glycosidic linkage, components-difference in their structure (explanation only) and solubility in water. Cellulose and glycogen– monosaccharide, glycosidic linkage, structure (explanation only). Biological importance of carbohydrates.

(8 Lecturers)

Amino Acids, Peptides and Proteins :α- amino acids , general formula, zwitter ion form of α-amino acid, general formula. Isoelectric point and its importance. Classification of amino acids as essential and non-essential- examples. Configuration of optically active α-amino acids (found in proteins). Peptide bond. Proteins: classification based molecular shape –fibrous and globular, examples. Structure of protein – qualitative idea about primary, secondary, tertiary, and quaternary structures (diagrams not required). Denaturation of protein.

(6 lectures)

UNIT II

Enzymes and correlation with drug action: Mechanism of enzyme action, factors affecting enzyme action, Co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity),
Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Noncompetitive inhibition including allosteric inhibition). **(6 lectures)**

Drug action- Receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, -NH_2 group, double bond and aromatic ring . **(3 lectures)**

Oils and fats Biological Importance of oils and fats. Fatty acids (saturated, unsaturated fatty acids, formation of triglycerides and general formula of triglycerides. Chemical nature of oils and fats-saponification, acid hydrolysis, rancidity and its prevention methods, refining of oils, hydrogenation of oils, drying of oils. Iodine value. Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol). **(5 lecturers)**

UNIT III

Nucleic Acids : Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation. **(8 lectures)**

Vitamins and Hormones: Classification and biological significance, source and structure of Vitamin A, B1 (thiamine), B2 (riboflavin), B6 (pyridoxine), α-tocopherol, K1 (phylloquinone), C (ascorbic acid). Deficiency diseases of vitamins.

Hormones: definition, classification with examples, functions and deficiency diseases of hormones.
(6 lectures)

Course Outcome / Learning Outcome:

After studying this paper the student would be able to

1. Acquire knowledge about different types of sugars and their chemical structures.
2. Identify different types of amino acids and determine the structure of peptides.
3. Explain the actions of enzymes in our body and interpret enzyme inhibition.
4. Predict action of drugs. Depict the biological importance of oils and fats. Importance of lipids in the metabolism. Differentiate RNA and DNA and their replication. Explain production of energy in our body.

Reference Books:

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

4. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed.,
5. W. H. Freeman. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, 2002.

SKILL ENHANCEMENT COURSE IN CHEMISTRY

CHM SEC-1: Soil Analysis

Courses	Credits	No. of Classes/Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory + Practical	02	03	33	3	15	35	50

Soil Analysis (Theory + Practical = 3 Hour/Week)

Theory

1. Introduction: Definition of Soil, Concept of Lithosphere, Soil as a natural body, Soil Components: Air, Water, inorganic and organic solids, Formation of Soil, Types of Soils & Basic Concepts.
2. Physical properties of Soil: Soil Separates, Texture, Aggregation and Structure, Temperature, Colour, Properties of Soil Mixture, Pore Space, Bulk Density, Particle Density, Aeration and Drainage, Compaction, Surface area, Soil water relationships.
3. Chemical Properties of soil: Morphology of Colloids, Chemistry of Clays, Ionic Exchange, Acidity, Alkalinity, pH, Salinity, Reactions in Liming and Acidification.
4. Biological Properties: Soil Organic Matter, C: N Relationships, N-Transformation, Soil Organisms, Sulfur Transformation.
5. Fertility of soil. Soil deficiency with respect to macro and micro nutrient components, brief study of micronutrient & macronutrient sources & importance

Practical

6. Visit to Soil Testing Laboratory & Report writing. Visit to Farmers Fields for Collection of Soil Samples.
7. Determination of pH of soil sample using pH meter and determination of Electrical Conductivity of Soil Sample using Conductivity meter.
8. Determination of alkalinity and salinity of the soil sample and determination of total organic matter in the given soil Sample.
9. Determination of Ca (II) and Mg(II) ions from soil sample
10. Determination of Fe (II) and Fe (III) ions from soil sample.
11. Determination of Na and K from soil sample by flame photometry.

Objectives:

- To acquire skills for Laboratory management and routine analysis of Soil.
- To improve working ability in analytical laboratory.

Scope / Learning Out Come:

The students after B.Sc. has one of the more exciting and rewarding turning time of life. Course is designed as a new non-conventional alternative for the future. The course can be completed either as full time or as part time along withthe graduation. The certificate obtained will be helpful for obtaining jobs in various fields. The student can start his own business /laboratory or can associate with any kind of laboratory or associated jobs with confidence. There are opportunities in the field of analysis, analytical research, fundamental research, quality control departments, governmental and non-governmental organizations etc. for the technical laboratory personnel.

References

1. Laboratory manual for Environmental Chemistry: Sunita Hooda and Sumanjeet Kaur by S. Chand & Company 1999.
2. Soils and soil fertility, Troch, F.R. And Thompson, L.M. Oxford Press.
3. Fundamentals of soil science, Foth, H.D. Wiley Books.
4. Soil Science and Management, Plaster, Edward J., Delmar Publishers.
5. Principles of Soil Chemistry (2Wed.) Marcel Dekker Inc., New York.
6. Handbook of Agricultural Sciences, S.S. Singh, P. Gupta, A. K. Gupta, Kalyani Publication.
7. Introduction to soil laboratory manual - J. J. Harsett Stipes.
8. Introduction to soil science laboratory manual, Palmer and troch – Iowa State.

Faculty of Science & Technology

04 - Year UG Honors programme:2021-22

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSCC/ OEC

Part-A

1. Question number 1-6 carries 2 marks each. Answer any 05 questions : 10 marks

Part-B

2. Question number 7- 14 carries 05Marks each, Answer any 06 questions : 30 marks

Part-C

3. Question number 15-18 carries 10 Marks each, Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 70 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

PATTERN OF THEORY AND PRACTICAL QUESTION PAPER FOR SEC

(35 marks and duration 3 hrs)

4. Question number 1-4 carries five marks each. Answer any two questions

: 10 marks

5. Question number 5 is an experiment which carries :20 marks
6. Journal and viva-voce exam carries 2+3 = 5 marks

Distribution of marks for the experiment

Accuracy - 15 marks, techniques and calculations -5 marks,

Deduction of marks for accuracy: Error up to 5% - 15 marks, 6 - 10% 12 marks, 11-15% 9 marks, 16-20% 6 marks, above 20% zero (0) marks.

Note for Practical examiners for all the semesters: During the practical examination, internal examiner should provide expert readings of the experiment and key of distribution format. The duly filled format should be submitted along with the answer scripts for every batch.

Karnataka University, Dharwad
Revised syllabus for Under Graduate Course in Chemistry (opt.)

Semester I

CHEMISTRY-DSC 2A: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures
***Section A: Inorganic Chemistry-1* (30 Periods)**
Atomic Structure: *Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.*

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (*ms*). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations. **(14 Lectures)**

Chemical Bonding and Molecular Structure
Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches. **(16 Lectures)**

***Section B: Organic Chemistry-1* (30 Periods)**
Fundamentals of Organic Chemistry
Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.
(8 Lectures)
Stereochemistry
Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration:

Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis* – *trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). **(10 Lectures)**

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4,ozonolysis and oxidation with hot alk. KMnO4. **(12 Lectures)**

Reference Books:

- Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic*
- *Chemistry*, John Wiley & Sons.
- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry:*
- *Principles of Structure and Reactivity*, Pearson Education India, 2006.
- Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John
- Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India
- Edition, 2013.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New
- Delhi (1988).
- Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education,
- 2000.
- Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.

CHEMISTRY LAB: DSC 2A LAB: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS 60 Lectures

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO4.
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.
4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.
5. Estimation of Cu (II) ions iodometrically using Na2S2O3.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
(a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

Semester II

CHEMISTRY-DSC 2B: CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY (Credits: Theory-04, Practicals-02) Theory: 60 Lectures

***Section A: Physical Chemistry-1* (30 Lectures)**

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

(10 Lectures)

Chemical Equilibrium:

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔGo, Le Chatelier's principle. Relationships between *Kp*, *Kc* and *Kx* for reactions involving ideal gases. **(8 Lectures)**

Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

(12 Lectures)

***Section B: Organic Chemistry-2* (30 Lectures)**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions*: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene). **(8 Lectures)**

Alkyl and Aryl Halides

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.

Preparation: from alkenes *and* alcohols. *Reactions:* hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. *Reactions (Chlorobenzene):* Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3 (or NaNH2/NH3). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides. **(8 Lectures)**

Alcohols, Phenols and Ethers (Upto 5 Carbons)
Alcohols: *Preparation:* Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.*Reactions:* With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer- Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.
Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde) *Preparation:* from acid chlorides and from nitriles. *Reactions* – Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction. **(14 Lectures)**

Reference Books:

- Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi (1988).
- Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

CHEMISTRY LAB- DSC 2B LAB: CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY 60 Lectures

Section A: Physical Chemistry
Thermochemistry
1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO3, NH4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria
pH measurements
a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
b) Preparation of buffer solutions:
(i) Sodium acetate-acetic acid
(ii) Ammonium chloride-ammonium hydroxide
Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry
1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed.
Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
(a) Bromination of Phenol/Aniline
(b) Benzoylation of amines/phenols
(c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Reference Books

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).

Semester III

CHEMISTRY-DSC 2C: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures
***Section A: Physical Chemistry-2* (30 Lectures)**
Solutions
Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperaturecomposition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. **(8 Lectures)**

Phase Equilibrium
Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-H_2O and Na-K only).
(8 Lectures)
Conductance
Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of

sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acidbase). **(6 Lectures)**

Electrochemistry

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

(8 Lectures)

Section B: Organic Chemistry-3 **(30 Lectures)**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Carboxylic acids and their derivatives

Carboxylic acids (aliphatic and aromatic) *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. *Reactions:* Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation. **(6 Lectures)**

Amines and Diazonium Salts

Amines (Aliphatic and Aromatic): (Upto 5 carbons) *Preparation*: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Diazonium salts: *Preparation:* from aromatic amines. *Reactions:* conversion to benzene, phenol, dyes.

(6 Lectures)

Amino Acids, Peptides and Proteins:

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. *Reactions of Amino acids*: ester of –COOH group, acetylation of –NH2 group, complexation with Cu2+ ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (Nterminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & Cactivating groups and Merrifield solid-phase synthesis. **(10 Lectures)**

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation. **(8 Lectures)**

Reference Books:

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
- Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

- Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Bioch*emistry *7th Ed.*, W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

CHEMISTRY LAB-DSC 2C LAB: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL ORGANIC CHEMISTRY-II 60 Lectures

Section A: Physical Chemistry

Distribution

Study of the equilibrium of one of the following reactions by the distribution method: I2(aq) + I-(aq) □ I3 -(aq) Cu2+(aq) + *x*NH2(aq) □ [Cu(NH3)*x*]2+

Phase equilibria

a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance

I. Determination of cell constant
II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
III. Perform the following conductometric titrations:
i. Strong acid vs. strong base
ii. Weak acid vs. strong base

Potentiometry

Perform the following potentiometric titrations:
i. Strong acid vs. strong base
ii. Weak acid vs. strong base
iii. Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

I Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

II

1. Separation of amino acids by paper chromatography
2. Determination of the concentration of glycine solution by formylation method.
3. Titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. Differentiation between a reducing and a nonreducing sugar.

Reference Books:

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.

Semester IV

CHEMISTRY-DSC 2D: COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS (Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Transition Elements (3d series)

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

(12 Lectures)

Coordination Chemistry

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature. **(8 Lectures)**

Crystal Field Theory

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for *Oh* and *Td* complexes, Tetragonal distortion of octahedral geometry.
Jahn-Teller distortion, Square planar coordination. **(10 Lectures)**

Section B: Physical Chemistry-3 **(30 Lectures)**

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. Van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO2. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only). **(8 Lectures)**

Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). **(6 Lectures)**

Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals. **(8 Lectures)**

Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). **(8 Lectures)**

Reference Books:

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
- Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.
- Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
- Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
- Rodgers, G.E. *Inorganic & Solid State Chemistry*, Cengage Learning India Ltd., 2008.

CHEMISTRY LAB-DSC 2D LAB: COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS 60 Lectures

Section A: Inorganic Chemistry

Semi-micro qualitative analysis using H2S of mixtures - not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following: Cations: NH4+, Pb2+, Ag+, Bi3+, Cu2+, Cd2+, Sn2+, Fe3+, Al3+, Co2+, Cr3+, Ni2+, Mn2+, Zn2+, Ba2+, Sr2+, Ca2+, K+
Anions : CO3 2– , S2–, SO2–, S2O32–, NO3–, CH3COO–, Cl–, Br–, I–, NO3–,SO42-, PO43-, BO33-,C2O42-, F- *(Spot tests should be carried out wherever feasible)*

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel(II) or aluminium as oximate in a given solution gravimetrically.
2. Draw calibration curve (absorbance at λmax vs. concentration) for various concentrations of a given coloured compound (KMnO4/ CuSO4) and estimate the concentration of the same in a given solution.
3. Determine the composition of the Fe3+-salicylic acid complex solution by Job's method.
4. Estimation of (i) Mg2+ or (ii) Zn2+ by complexometric titrations using EDTA.
5. Estimation of total hardness of a given sample of water by complexometric titration.
6. Determination of concentration of Na+ and K+ using Flame Photometry.

Section B: Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded).
a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
b) Study of the variation of surface tension of a detergent solution with concentration.
(II) Viscosity measurement (use of organic solvents excluded).
a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
b) Study of the variation of viscosity of an aqueous solution with concentration of solute.
(III) Chemical Kinetics .Study the kinetics of the following reactions.
1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
a. Acid hydrolysis of methyl acetate with hydrochloric acid.
b. Saponification of ethyl acetate.
c. Compare the strengths of HCl and H2SO4 by studying kinetics of hydrolysis of methyl acetate

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).

Discipline Specific Electives ,Select two papers

CHEMISTRY-DSE I-IV (ELECTIVES)
CHEMISTRY-DSE: APPLICATIONS OF COMPUTERS IN CHEMISTRY
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures
Basics:
Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.

Numerical methods:
Roots of equations: Numerical methods for roots of equations: Quadratic formula, iterative method, Newton-Raphson method, Binary bisection and Regula-Falsi. *Differential calculus:* Numerical differentiation. *Integral calculus:* Numerical integration (Trapezoidal and Simpson's rule), probability distributions and mean values. *Simultaneous equations:* Matrix manipulation: addition, multiplication. Gauss-Siedal method. *Interpolation, extrapolation and curve fitting:* Handling of experimental data. *Conceptual background of molecular modelling:* Potential energy surfaces. Elementary ideas of molecular mechanics and practical MO methods.

Reference Books:

- Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press (2001) 487 pages.
- Noggle, J. H. *Physical chemistry on a Microcomputer.* Little Brown & Co. (1985).
- Venit, S.M. *Programming in BASIC: Problem solving with structure and style.* Jaico Publishing House: Delhi (1996).

PRACTICAL-DSE LAB: APPLICATIONS OF COMPUTERS IN CHEMISTRY 60 Lectures
Computer programs based on numerical methods for
1. Roots of equations: (e.g. volume of van der Waals gas and comparison with ideal gas, pH of a weak acid).
2. Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations).
3. Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values.
4. Matrix operations. Application of Gauss-Siedel method in colourimetry.
5. Simple exercises using molecular visualization software.

Reference Books:

- McQuarrie, D. A. *Mathematics for Physical Chemistry* University Science Books (2008).
- Mortimer, R. *Mathematics for Physical Chemistry*. 3rd Ed. Elsevier (2005).
- Steiner, E. *The Chemical Maths Book* Oxford University Press (1996).
- Yates, P. *Chemical Calculations.* 2nd Ed. CRC Press (2007).
- Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press (2001) 487 pages.
- Noggle, J. H. *Physical Chemistry on a Microcomputer.* Little Brown & Co. (1985).

➢ Venit, S.M. *Programming in BASIC: Problem solving with structure and style.* Jaico Publishing House: Delhi (1996).

CHEMISTRY-DSE: ANALYTICAL METHODS IN CHEMISTRY
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures
Qualitative and quantitative aspects of analysis:
Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. **(5 Lectures)**
Optical methods of analysis:
Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.
UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;
Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.
Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.
Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.
(25 Lectures)
Thermal methods of analysis:
Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture. **(5 Lectures)**

Electroanalytical methods:
Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values. **(10 Lectures)**

Separation techniques:
Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC. Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC). Role of computers in instrumental methods of analysis. **(15 Lectures)**

Reference Books:
➢ Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.

- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
- Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, International Publisher, 2009.
- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
- Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

PRACTICALS- DSE LAB: ANALYTICAL METHODS IN CHEMISTRY 60 Lectures

I. Separation Techniques

1. Chromatography:

(a) Separation of mixtures

(i) Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions:

(i) To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}- DMG complex in chloroform, and determine its concentration by spectrophotometry.

(ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.

3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

5. Analysis of soil:

(i) Determination of pH of soil.

(ii) Total soluble salt

(iii) Estimation of calcium, magnesium, phosphate, nitrate

6. Ion exchange:

(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.

(ii) Separation of metal ions from their binary mixture.

(iii) Separation of amino acids from organic acids by ion exchange chromatography.

III Spectrophotometry

1. Determination of pKa values of indicator using spectrophotometry.

2 Structural characterization of compounds by infrared spectroscopy.

3 Determination of dissolved oxygen in water.

4 Determination of chemical oxygen demand (COD).

5 Determination of Biological oxygen demand (BOD).

6 Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Reference Books:

- Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

- Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
- Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
- Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

CHEMISTRY-DSE: MOLECULAR MODELLING & DRUG DESIGN
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Introduction to Molecular Modelling:

Introduction. Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces. Molecular Graphics. Surfaces. Computer Hardware and Software. The Molecular Modelling Literature. **(10 Lectures)**

Force Fields:

Fields. Bond Stretching. Angle Bending. Introduction to nonbonded interactions. Electrostatic interactions. van der Waals Interactions. Hydrogen bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water. **(14 Lectures)**

Energy Minimization and Computer Simulation:

Minimization and related methods for exploring the energy surface. Non-derivative method, First and second order minimization methods. Computer simulation methods. Simple thermodynamic properties and Phase Space. Boundaries. Analyzing the results of a simulation and estimating Errors. **(12 Lectures)**

Molecular Dynamics & Monte Carlo Simulation:

Molecular Dynamics Simulation Methods. Molecular Dynamics using simple models. Molecular Dynamics with continuous potentials. Molecular Dynamics at constant temperature and pressure. Metropolis method. Monte Carlo simulation of molecules. Models used in Monte Carlo simulations of polymers. **(12 Lectures)**

Structure Prediction and Drug Design:

Structure prediction - Introduction to comparative Modeling. Sequence alignment. Constructing and evaluating a comparative model. Predicting protein structures by 'Threading', Molecular docking. Structure based de novo ligand design, Drug Discovery – Chemoinformatics – QSAR. **(12 Lectures)**

Reference Books:

- Leach, A.R. *Molecular Modelling Principles and Application*, Longman, 2001.
- Haile, J.M. *Molecular Dynamics Simulation Elementary Methods*, John Wiley and Sons, 1997.
- Gupta, S.P. *QSAR and Molecular Modeling,* Springer - Anamaya Publishers, 2008.

PRACTICAL- DSE LAB: MOLECULA MODELLING & DRUG DESIGN 60 Lectures

i. Compare the optimized C-C bond lengths in ethane, ethene, ethyne and benzene. Visualize the molecular orbitals of the ethane σ bonds and ethene, ethyne, benzene and pyridine π bonds.

ii. (a) Perform a conformational analysis of butane.
(b) Determine the enthalpy of isomerization of *cis* and *trans* 2-butene.

iii. Visualize the electron density and electrostatic potential maps for LiH, HF, N2, NO and CO and comment. Relate to the dipole moments. Animate the vibrations of these molecules.

iv. (a) Relate the charge on the hydrogen atom in hydrogen halides with their acid character.
(b) Compare the basicities of the nitrogen atoms in ammonia, methylamine, dimethylamine and trimethylamine.

v. (a) Compare the shapes of the molecules: 1-butanol, 2-butanol, 2-methyl-1-propanol, and 2-methyl-2-propanol. Note the dipole moment of each molecule.

(b) Show how the shapes affect the trend in boiling points: (118 ºC, 100 ºC, 108 ºC, 82 ºC, respectively).

vi. Build and minimize organic compounds of your choice containing the following functional groups. Note the dipole moment of each compound: (a) alkyl halide (b) aldehyde (c) ketone (d) amine (e) ether (f) nitrile (g) thiol (h) carboxylic acid (i) ester (j) amide.

vii. (a) Determine the heat of hydration of ethylene.

(b) Compute the resonance energy of benzene by comparison of its enthalpy of hydrogenation with that of cyclohexene.

viii. Arrange 1-hexene, 2-methyl-2-pentene, (*E*)-3-methyl-2-pentene, (*Z*)-3-methyl-2-pentene, and 2,3-dimethyl-2-butene in order of increasing stability.

ix. (a) Compare the optimized bond angles H2O, H2S, H2Se.

(b) Compare the HAH bond angles for the second row dihydrides and compare with the results from qualitative MO theory.

Note: Software: ChemSketch, ArgusLab (www.planaria-software.com), TINKER 6.2 (dasher.wustl.edu/ffe), WebLab Viewer, Hyperchem, or any similar software.

Reference Books:

- Leach, A.R. *Molecular Modelling Principles and Application*, Longman, 2001.
- Haile, J.M. *Molecular Dynamics Simulation Elementary Methods*, John Wiley and Sons, 1997.
- Gupta, S.P. *QSAR and Molecular Modeling*, Springer - Anamaya Publishers, 2008.

CHEMISTRY-DSE: NOVEL INORGANIC SOLIDS (Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Synthesis and modification of inorganic solids:

Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods. **(10 Lectures)**

Inorganic solids of technological importance:

Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments. Molecular material and fullerides, molecular materials & chemistry – one-dimensional metals, molecular magnets, inorganic liquid crystals. **(10 Lectures)**

Nanomaterials:

Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites. **(10 Lectures)**

Introduction to engineering materials for mechanical construction:

Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminium and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials. **(10 Lectures)**

Composite materials:

Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites. **(10 Lectures)**

Speciality polymers:

Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ion-exchange resins and their applications. Ceramic &

Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.

(10 Lectures)

Reference Books:

- Shriver & Atkins. *Inorganic Chemistry*, Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012)
- Adam, D.M. *Inorganic Solids: An introduction to concepts in solid-state structural chemistry*. John Wiley & Sons, 1974.
- Poole, C.P. & Owens, F.J. *Introduction to Nanotechnology* John Wiley & Sons, 2003.
- Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.

CHEMISTRY PRACTICAL - DSE LAB: NOVEL INORGANIC SOLIDS 60 Lectures

1. Determination of cation exchange method
2. Determination of total difference of solids.
3. Synthesis of hydrogel by co-precipitation method.
4. Synthesis of silver and gold metal nanoparticles.

Reference Book:

- Fahlman, B.D. *Materials Chemistry*, Springer, 2004.

CHEMISTRY-DSE: POLYMER CHEMISTRY (Credits: Theory-06, Practicals-02)

Theory: 60 Lectures

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. **(4 Lectures)**

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems. **(8 Lectures)**

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques. **(8 lectures)**

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. **(4 Lectures)**

Nature and structure of polymers-Structure Property relationships. **(2 Lectures)**

Determination of molecular weight of polymers (*Mn*, *Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. **(8 Lectures)**

Glass transition temperature (Tg) and determination of Tg, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg). **(8 Lectures)**

Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures. **(8 Lectures)**

Properties of Polymers (Physical, thermal, Flow & Mechanical Properties). Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)]. **(10 Lectures)**

Reference Books:

- Seymour, R.B. & Carraher, C.E. *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc. New York, 1981.
- Odian, G. *Principles of Polymerization*, 4th Ed. Wiley, 2004.
- Billmeyer, F.W. *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
- Ghosh, P. *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991.
- Lenz, R.W. *Organic Chemistry of Synthetic High Polymers.* Interscience Publishers, New York, 1967.

CHEMISTRY PRACTICAL - DSE LAB: POLYMER CHEMISTRY 60 Lectures

Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
a. Purification of monomer
b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN)
2. Preparation of nylon 66/6
1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein
a. Preparation of IPC
b. Purification of IPC
c. Interfacial polymerization
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:
(a) Polyacrylamide-aq.NaNO2 solution
(b) (Poly vinyl proplylidine (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers
4. DSC analysis of polymers
5. Preparation of polyacrylamide and its electrophoresis
*at least 7 experiments to be carried out.

Reference Books:

- M.P. Stevens, *Polymer Chemistry: An Introduction*, 3rd Ed., Oxford University Press, 1999.

- H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*, 3rd ed. Prentice-Hall (2003)
- F.W. Billmeyer, *Textbook of Polymer Science*, 3rd ed. Wiley-Interscience (1984)
- J.R. Fried, *Polymer Science and Technology*, 2nd ed. Prentice-Hall (2003)
- P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2nd ed. John Wiley & Sons (2002)
- L. H. Sperling, *Introduction to Physical Polymer Science*, 4th ed. John Wiley & Sons (2005)
- M.P. Stevens, *Polymer Chemistry: An Introduction* 3rd ed. Oxford University Press (2005).
- Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

CHEMISTRY-DSE: RESEARCH METHODOLOGY FOR CHEMISTRY
(Credits: Theory-05, Tutorials-01) Theory: 75 Lectures
Literature Survey:
Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples.
Digital: Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki- Databases, ChemSpider, Science Direct, SciFinder, Scopus.

Information Technology and Library Resources: The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information. **(20 Lectures)**

Methods of Scientific Research and Writing Scientific Papers:
Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation. Writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics. Avoiding plagiarism. **(20 Lectures)**

Chemical Safety and Ethical Handling of Chemicals:
Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric – safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals. **(12 Lectures)**

Data Analysis
The Investigative Approach: Making and Recording Measurements. SI Units and their use.Scientific method and design of experiments.
Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests. Chemometrics. Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse. Basic aspects of multiple linear regression analysis.
(13 Lectures)

Electronics

Basic fundamentals of electronic circuits and their components used in circuits of common instruments like spectrophotometers, typical circuits involving operational amplifiers for electrochemical instruments. Elementary aspects of digital electronics. **(10 Lectures)**

Reference Books

- Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011) *Practical skills in chemistry*. 2nd Ed. Prentice-Hall, Harlow.
- Hibbert, D. B. & Gooding, J. J. (2006) *Data analysis for chemistry*. Oxford University Press.
- Topping, J. (1984) *Errors of observation and their treatment.* Fourth Ed., Chapman Hall, London.
- Harris, D. C. *Quantitative chemical analysis*. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis.* Cambridge Univ. Press (2001) 487 pages.
- Chemical safety matters – IUPAC – IPCS, Cambridge University Press, 1992.
- OSU safety manual 1.01.

CHEMISTRY-DSE: GREEN CHEMISTRY
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures
Introduction to Green Chemistry
What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry **(4 Lectures)**

Principles of Green Chemistry and Designing a Chemical synthesis
Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following:

- Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.
- Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy.
- Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.
- Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.
- Selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups.
- Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.
- Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.
- Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. **(30 Lectures)**

Examples of Green Synthesis/ Reactions and some real world cases
1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)

2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction
3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)
4 Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.
5 Designing of Environmentally safe marine antifoulant.
6 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.
7 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.
8 Healthier fats and oil by Green Chemistry: Enzymatic interesterification for production of no Trans-Fats and Oils
9 Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting **(16 Lectures)**

Future Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis (C_2S_3); Green chemistry in sustainable development. **(10 Lectures)**

Reference Books:

- Ahluwalia, V.K. & Kidwai, M.R. *New Trends in Green Chemistry*, Anamalaya Publishers (2005).
- Anastas, P.T. & Warner, J.K.: *Green Chemistry - Theory and Practical*, Oxford University Press (1998).
- Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).
- Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).
- Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).
- Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition,2010.

CHEMISTRY PRACTICAL - DSE LAB: GREEN CHEMISTRY 60 Lectures

1. Safer starting materials

- Preparation and characterization of nanoparticles of gold using tea leaves.

2. Using renewable resources

- Preparation of biodiesel from vegetable/ waste cooking oil.

3. Avoiding waste

Principle of atom economy.

- Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
- Preparation of propene by two methods can be studied

(I) Triethylamine ion + OH^- → propene + trimethylpropene + water

(II) 1-propanol H_2SO_4/□ propene + water

- Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

4. Use of enzymes as catalysts

- Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

5. Alternative Green solvents

Extraction of D-limonene from orange peel using liquid CO_2 prepared form dry ice. Mechanochemical solvent free synthesis of azomethines

6. Alternative sources of energy

- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).

 Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Reference Books:

- Anastas, P.T & Warner, J.C. *Green Chemistry: Theory and Practice,* OxfordUniversity Press (1998).
- Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistry experiment*. American Chemical Society, Washington DC (2002).
- Ryan, M.A. *Introduction to Green Chemistry*, Tinnesand; (Ed), American Chemical Society, Washington DC (2002).
- Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi*. Bangalore CISBN 978-93-81141-55-7 (2013).
- Cann, M.C. & Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society (2008).
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- Cann, M. C. & Thomas, P. *Real world cases in Green Chemistry*, American Chemical Society (2008).
- Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition, 2010.
- Pavia, D.L., Lampman, G.M., Kriz, G.S. & Engel, R.G. *Introduction to Organic Laboratory Techniques: A Microscale and Macro Scale Approach,* W.B.Saunders,1995.

CHEMISTRY-DSE: INDUSTRIAL CHEMICALS AND ENVIRONMENT
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures
Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate. **(10 Lectures)**

Industrial Metallurgy:General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic,oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond'sprocess. Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology. **(8 Lectures)**

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur. Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO2, CO2, CO, NOx, H2S and other foul smelling gases. Methods of estimation of CO, NOx, SOx and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water. **(30 Lectures)**

Energy & Environment

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management. **(10 Lectures)**

Biocatalysis

Introduction to biocatalysis: Importance in "Green Chemistry" and Chemical Industry. **(6 Lectures)**

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- J. A. Kent: *Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.*
- *S. S. Dara: A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
- K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
- S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.
- S.E. Manahan, *Environmental Chemistry*, CRC Press (2005).
- G.T. Miller, *Environmental Science* 11th edition. Brooks/ Cole (2006).
- A. Mishra, *Environmental Studies*. Selective and Scientific Books, New Delhi (2005).

CHEMISTRY PRACTICAL - DSE LAB: INDUSTRIAL CHEMICALS & ENVIRONMENT
60 Lectures

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).
6. Estimation of total alkalinity of water samples (CO32-, HCO3
-) using double titration method.
7. Measurement of dissolved CO2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
- K. De, *Environmental Chemistry*: New Age International Pvt. Ltd, New Delhi.
- S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.

CHEMISTRY-DSE: INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures
Recapitulation of *s*- and *p*-Block Elements
Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mulliken, and Alfred-Rochow scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.
(4 Lectures)

Silicate Industries
Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements. **(14 Lectures)**

Fertilizers:
Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate. **(8 Lectures)**

Surface Coatings:
Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing. **(8 Lectures)**

Batteries:
Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.
(8 Lectures)

Alloys:
Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels. **(8 Lectures)**

Catalysis:
General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts. **(6 Lectures)**

Chemical explosives:
Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants. **(4 Lectures)**

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- P. C. Jain & M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
- B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

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PRACTICALS-DSE LAB: INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE
60 Lectures

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of calcium in calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.
5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

CHEMISTRY-DSE: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS
(Credits: Theory-04, Practicals-02)   Theory: 60 Lectures
Introduction to spectroscopic methods of analysis:
Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation. **(4 Lectures)**

Molecular spectroscopy:
Infrared spectroscopy: Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.

UV-Visible/ Near IR – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags). **(16 Lectures)**

Separation techniques

Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis.

Immunoassays and DNA techniques

Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).

(16 Lectures)

Elemental analysis:

Mass spectrometry (electrical discharges).

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences). **(8 Lectures)**

NMR spectroscopy: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spincoupling, Applications. **(4 Lectures)**

Electroanalytical Methods: Potentiometry & Voltammetry **(4 Lectures)**

Radiochemical Methods **(4 Lectures)**

X-ray analysis and electron spectroscopy (surface analysis) **(4 Lectures)**

Reference books:

- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- P.W. Atkins: Physical Chemistry.
- G.W. Castellan: Physical Chemistry.
- C.N. Banwell: Fundamentals of Molecular Spectroscopy.
- Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
- W.J. Moore: Physical Chemistry.

PRACTICALS-DSE LAB: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS 60 Lectures

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)
8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride)
10. Separation of Carbohydrates by HPLC
11. Determination of Caffeine in Beverages by HPLC

12. Potentiometric Titration of a Chloride-Iodide Mixture
13. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple
14. Nuclear Magnetic Resonance
15. Use of fluorescence to do “presumptive tests” to identify blood or other body fluids.
16. Use of “presumptive tests” for anthrax or cocaine
17. Collection, preservation, and control of blood evidence being used for DNA testing
18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome)
19. Use of sequencing for the analysis of mitochondrial DNA
20. Laboratory analysis to confirm anthrax or cocaine
21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives
22. Detection of illegal drugs or steroids in athletes
23. Detection of pollutants or illegal dumping
24. Fibre analysis

At least 10 experiments to be performed.

Reference Books:

- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

DSE: QUANTUM CHEMISTRY, SPECTROSCOPY & PHOTOCHEMISTRY

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Quantum Chemistry: Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and “particle-in-a-box” (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy.Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution. Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH_2, H_2O) molecules. Qualitative MO theory and its application to AH_2 type molecules. **(24 Lectures)**

Molecular Spectroscopy:

Interaction of electromagnetic radiation with molecules and various types of spectra; Born- Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies.

Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

(24 Lectures)

Photochemistry

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence. **(12 Lectures)**

Reference Books:

- Banwell, C. N. & McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).
- Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).
- House, J. E. *Fundamentals of Quantum Chemistry* 2^{nd} Ed. Elsevier: USA (2004).
- Lowe, J. P. & Peterson, K. *Quantum Chemistry*, Academic Press (2005).
- Kakkar, R. *Atomic & Molecular Spectroscopy*: *Concepts & Applications*, Cambridge University Press (2015).

DSE LAB 60 Lectures

UV/Visible spectroscopy

I. Study the 200-500 nm absorbance spectra of KMnO4 and K2Cr2O7 (in 0.1 M H2SO4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule-1, kJ mol-1, cm-1, eV).

II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of K2Cr2O7.

III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry

I. Verify Lambert-Beer's law and determine the concentration of CuSO4/KMnO4/K2Cr2O7 in a solution of unknown concentration

II. Determine the concentrations of KMnO4 and K2Cr2O7 in a mixture.

III. Study the kinetics of iodination of propanone in acidic medium.

IV. Determine the amount of iron present in a sample using 1,10-phenathroline.

V. Determine the dissociation constant of an indicator (phenolphthalein).

VI. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.

VII. Analyse the given vibration-rotation spectrum of HCl(g)

Reference Books

- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).

- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

DSE: ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

***Section A: Inorganic Chemistry-4* (30 Lectures)**

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, K2Cr2O7, KMnO4, K4[Fe(CN)6], sodium nitroprusside, [Co(NH3)6]Cl3, Na3[Co(NO2)6]. **(6 Lectures)**

Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies). **(12 Lectures)**

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na+, K+ and Mg2+ ions: Na/K pump; Role of Mg2+ ions in energy production and chlorophyll. Role of Ca2+ in blood clotting, stabilization of protein structures and structural role (bones).

(12 Lectures)

***Section B: Organic Chemistry-4* (30 Lectures)**

Polynuclear and heteronuclear aromatic compounds:

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine. **(6 Lectures)**

Active methylene compounds:

Preparation: Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon).

(6 Lectures)

Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λmax & εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α,β – unsaturated compounds. Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on>C=O stretching absorptions). **(18 Lectures)**

Reference Books:

 James E. Huheey, Ellen Keiter & Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.

 G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry*, Pearson Publication.

 J.D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S.

 F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley & Sons.

 I.L. Finar: *Organic Chemistry* (Vol. I & II), E.L.B.S.

 John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds*, Prentice Hall.

 R.M. Silverstein, G.C. Bassler & T.C. Morrill*: Spectroscopic Identification of Organic Compounds*, John Wiley & Sons.
 R.T. Morrison & R.N. Boyd: *Organic Chemistry*, Prentice Hall.
 Peter Sykes: *A Guide Book to Mechanism* in *Organic Chemistry*, Orient Longman.
 Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.

DSE LAB 60 Lectures
Section A: Inorganic Chemistry
1. Separation of mixtures by chromatography: Measure the *Rf* value in each case. (Combination of two ions to be given) Paper chromatographic separation of Fe3+, A13+ and Cr3+ or Paper chromatographic separation of Ni2+, Co2+, Mn2+ and Zn2+
2. Preparation of any two of the following complexes and measurement of their conductivity:
(i) tetraamminecarbonatocobalt (III) nitrate
(ii) tetraamminecopper (II) sulphate
(iii) potassium trioxalatoferrate (III) trihydrate
Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl2 and LiCl3.

Section B: Organic Chemistry
Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Reference Books:
- A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

DSE: MOLECULES OF LIFE
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures
Unit 1: Carbohydrates (10 Periods)
Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose.
Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Unit 2: Amino Acids, Peptides and Proteins (12 Periods)
Classification *of Amino Acids,* Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (tbutyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

Unit 3: Enzymes and correlation with drug action (12 Periods)
Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action(Including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Noncompetitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group,-NH2 group, double bond and aromatic ring,

Unit 4: Nucleic Acids **(10 Periods)**

Components of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (**nomenclature**), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA(**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

Unit 5: Lipids **(8 Periods)**

Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

Unit 6: Concept of Energy in Biosystems **(8 Periods)**

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

Recommended Texts:

- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.,* W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

DSE LAB 60 Lectures

1. Separation of amino acids by paper chromatography
2. To determine the concentration of glycine solution by formylation method.
3. Study of titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat
8. Differentiate between a reducing/ nonreducing sugar.
9. Extraction of DNA from onion/cauliflower
10. To synthesise aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

Recommended Texts:

- Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, ELBS.
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.

Skill Enhancement Course (any four) (Credit: 02 each)- SEC1 to SEC4 Chemistry
IT SKILLS FOR CHEMISTS (Credits: 02) 30 Lectures
Mathematics

Fundamentals, mathematical functions, polynomial expressions, logarithms, the exponential function, units of a measurement, interconversion of units, constants and variables, equation of a straight line, plotting graphs. Uncertainty in experimental techniques: Displaying uncertainties, measurements in chemistry, decimal places, significant figures, combining quantities. Uncertainty in measurement: types of uncertainties, combining uncertainties. Statistical treatment. Mean, standard deviation, relative error. Data reduction and the propagation of errors. Graphical and numerical data reduction. Numerical curve fitting: the method of least squares (regression).

Algebraic operations on real scalar variables (e.g. manipulation of van der Waals equation in different forms).Roots of quadratic equations analytically and iteratively (e.g. pH of a weak acid). Numerical methods of finding roots (Newton-Raphson, binary –bisection, e.g. pH of a weak acid not ignoring the ionization of water, volume of a van der Waals gas, equilibrium constant expressions).

Differential calculus: The tangent line and the derivative of a function, numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations). Numerical integration (Trapezoidal and Simpson's rule, e.g. entropy/enthalpy change from heat capacity data).

Computer programming: Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis. BASIC programs for curve fitting, numerical differentiation and integration (Trapezoidal rule, Simpson's rule), finding roots (quadratic formula, iterative, Newton-Raphson method).

HANDS ON

Introductory writing activities: Introduction to word processor and structure drawing (ChemSketch) software. Incorporating chemical structures, chemical equations, expressions from chemistry (e.g. Maxwell-Boltzmann distribution law, Bragg's law, van der Waals equation, etc.) into word processing documents.

Handling numeric data: Spreadsheet software (Excel), creating a spreadsheet, entering and formatting information, basic functions and formulae, creating charts, tables and graphs. Incorporating tables and graphs into word processing documents. Simple calculations, plotting graphs using a spreadsheet (Planck's distribution law, radial distribution curves for hydrogenic orbitals, gas kinetic theory- Maxwell-Boltzmann distribution curves as function of temperature and molecular weight), spectral data, pressure-volume curves of van der Waals gas (van der Waals isotherms), data from phase equilibria studies. Graphical solution of equations.

Numeric modelling: Simulation of pH metric titration curves. Excel functions LINEST and Least Squares. Numerical curve fitting, linear regression (rate constants from concentrationtime data, molar extinction coefficients from absorbance data), numerical differentiation (e.g. handling data from potentiometric and pH metric titrations, pKa of weak acid), integration (e.g. entropy/enthalpy change from heat capacity data).

Statistical analysis: Gaussian distribution and Errors in measurements and their effect on data sets. Descriptive statistics using Excel. Statistical significance testing: The *t* test. The *F* test.

Presentation: Presentation graphics

Reference Books:

- McQuarrie, D. A. Mathematics for Physical Chemistry University Science Books (2008).
- Mortimer, R. Mathematics for Physical Chemistry. 3rdEd. Elsevier (2005).
- Steiner, E. The Chemical Maths Book Oxford University Press (1996).
- Yates, P. Chemical calculations. 2ndEd. CRC Press (2007).
- Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press (2001) 487 pages.
- Noggle, J. H. *Physical chemistry on a Microcomputer.* Little Brown & Co. (1985).
- Venit, S.M. *Programming in BASIC: Problem solving with structure and style*. Jaico Publishing House: Delhi (1996).

BASIC ANALYTICAL CHEMISTRY (Credits: 02) 30 Lectures

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators

a. Determination of pH of soil samples.

b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

a. Determination of pH, acidity and alkalinity of a water sample.

b. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.

b. Analysis of preservatives and colouring matter.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

a. Paper chromatographic separation of mixture of metal ion (Fe3+ and Al3+).

b. To compare paint samples by TLC method.

Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Analysis of cosmetics: Major and minor constituents and their function

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.

b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Suggested Applications (Any one):

a. To study the use of phenolphthalein in trap cases.

b. To analyze arson accelerants.

c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.

b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.

c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.

Reference Books:

- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry 6th Ed.*, Saunders College Publishing, Fort Worth (1992).
- Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman.

- Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.
- Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.
- Freifelder, D. *Physical Biochemistry 2nd Ed.*, W.H. Freeman and Co., N.Y. USA (1982).
- Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (1977).
- Vogel, A. I. *Vogel's Qualitative Inorganic Analysis 7th Ed.*, Prentice Hall.
- Vogel, A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.*, Prentice Hall.
- Robinson, J.W. *Undergraduate Instrumental Analysis 5th Ed.*, Marcel Dekker, Inc., New York (1995).

CHEMICAL TECHNOLOGY & SOCIETY (Credits: 02) Theory: 30 Lectures

Chemical Technology

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.

Society

Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues, proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs.

Reference Book:

John W. Hill, Terry W. McCreary & Doris K. Kolb, *Chemistry for changing times* 13th Ed.59

CHEMOINFORMATICS (Credits: 02)Theory: 30 Lectures

Introduction to Chemoinformatics: History and evolution of chemoinformatics, Use of chemoinformatics, Prospects of chemoinformatics, Molecular Modelling and Structure elucidation.

Representation of molecules and chemical reactions: Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Molfiles and Sdfiles, Libraries and toolkits, Different electronic effects, Reaction classification.

Searching chemical structures: Full structure search, sub-structure search, basic ideas, similarity search, three dimensional search methods, basics of computation of physical and chemical data and structure descriptors, data visualization.

Applications: Prediction of Properties of Compounds; Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling Toxicity; Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra; Computer Assisted Structure elucidations; Computer Assisted Synthesis Design, Introduction to drug design; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand-Based and Structure Based Drug design; Application of Chemoinformatics in Drug Design.

Hands-on Exercises

Reference Books:

- Andrew R. Leach & Valerie, J. Gillet (2007) *An introduction to Chemoinformatics.* Springer: The Netherlands.

- Gasteiger, J. & Engel, T. (2003) *Chemoinformatics: A text-book.* Wiley-VCH.
- Gupta, S. P. (2011) *QSAR & Molecular Modeling.* Anamaya Pub.: New Delhi.

BUSINESS SKILLS FOR CHEMISTS (Credits: 02) Theory: 30 Lectures

Business Basics: Key business concepts: Business plans, market need, project management and routes to market.

Chemistry in Industry: Current challenges and opportunities for the chemistry-using industries, role of chemistry in India and global economies.

Making money: Financial aspects of business with case studies

Intellectual property: Concept of intellectual property, patents.

Reference

www.rsc.org

INTELLECTUAL PROPERTY RIGHTS (IPR)

(Credits: 02) Theory: 30 Lectures

In this era of liberalization and globalization, the perception about science and its practices has undergone dramatic change. The importance of protecting the scientific discoveries, with commercial potential or the intellectual property rights is being discussed at all levels – statutory, administrative, and judicial. With India ratifying the WTO agreement, it has become obligatory on its part to follow a minimum acceptable standard for protection and enforcement of intellectual property rights. The purpose of this course is to apprise the students about the multifaceted dimensions of this issue.

Introduction to Intellectual Property:

Historical Perspective, Different Types of IP, Importance of protecting IP.

Copyrights :

Introduction, How to obtain, Differences from Patents.

Trade Marks:

Introduction, How to obtain, Different types of marks – Collective marks, certification marks, service marks, Trade names, etc. Differences from Designs.

Patents:

Historical Perspective, Basic and associated right, WIPO, PCT system, TraditionalKnowledge, Patents and Healthcare – balancing promoting innovation with public health,Software patents and their importance for India.

Geographical Indications

Definition, rules for registration, prevention of illegal exploitation, importance to India.

Industrial Designs

Definition, How to obtain, features, International design registration.

Layout design of integrated circuits

Circuit Boards, Integrated Chips, Importance for electronic industry.

Trade Secrets

Introduction and Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade Secret Protection.

Different International agreements

(a) Word Trade Organization (WTO):

(i) General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement

(ii) General Agreement on Trade related Services (GATS)

(iii) Madrid Protocol

(iv) Berne Convention

(v) Budapest Treaty

(b) Paris Convention

WIPO and **TRIPS, IPR** and Plant Breeders Rights, IPR and Biodiversity

IP Infringement issue and enforcement – Role of Judiciary, Role of law enforcement agencies – Police, Customs etc. Economic Value of Intellectual Property – Intangible assets and their valuation, Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

Reference Books:

 N.K. Acharya: *Textbook on intellectual property rights*, Asia Law House (2001).

 Manjula Guru & M.B. Rao, *Understanding Trips: Managing Knowledge in Developing Countries*, Sage Publications (2003).

 P. Ganguli, Intellectual Property Rights: *Unleashing the Knowledge Economy*, Tata McGraw-Hill (2001).

 Arthur Raphael Miller, Micheal H.Davis; *Intellectual Property: Patents, Trademarks and Copyright in a Nutshell,* West Group Publishers (2000).

 Jayashree Watal, *Intellectual property rights in the WTO and developing countries,* Oxford University Press, Oxford

ANALYTICAL CLINICAL BIOCHEMISTRY (Credits: 02) THEORY: 30 Lectures

Basic understanding of the structures, properties and functions of carbohydrates, lipids and proteins:

Review of concepts studied in the core course:

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle. Isolation and characterization of polysachharides.

Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β- pleated sheets, Isolation, characterization, denaturation of proteins.

Enzymes: Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and

Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications. Lipoproteins. Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones.

Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy.

Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

Biochemistry of disease: A diagnostic approach by blood/ urine analysis.

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.

Urine: Collection and preservation of samples. 6. Formation of urine. Composition and estimation of constituents of normal and pathological urine.

Practicals

Identification and estimation of the following:

1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Burchard reaction.
6. Proteins – qualitative.
7. Isolation of protein.
8. Determination of protein by the Biuret reaction.

9. Determination of nucleic acids

Reference Books:

- T.G. Cooper: Tool of Biochemistry.
- Keith Wilson and John Walker: Practical Biochemistry.
- Alan H Gowenlock: Varley's Practical Clinical Biochemistry.
- Thomas M. Devlin: Textbook of Biochemistry.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.
- Talwar, G.P. & Srivastava, M. *Textbook of Biochemistry and Human Biology*, 3rd Ed. PHI Learning.
- Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Bioch*emistry *7th Ed.*, W. H. Freeman.
- Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.

GREEN METHODS IN CHEMISTRY (Credits: 02) Theory: 30 Lectures

Theory and Hand-on Experiments

Introduction: Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability

The following Real world Cases in Green Chemistry should be discussed:

1. Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO2 for precision cleaning and dry cleaning of garments.
2. Designing of environmentally safe marine antifoulant.
3. Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments.
4. An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.

Practicals

1. Preparation and characterization of biodiesel from vegetable oil.
2. Extraction of D-limonene from orange peel using liquid CO2 prepared from dry ice.
3. Mechano chemical solvent free synthesis of azomethine.
4. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).

Reference Books:

- Anastas, P.T. & Warner, J.K. *Green Chemistry- Theory and Practical*, Oxford University Press (1998).
- Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).
- Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).
- Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).
- Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. *Green Chemistry Experiments: A monograph* I.K. International Publishing House Pvt Ltd. New Delhi, Bangalore.
- Lancaster, M. *Green Chemistry: An introductory text* RSC publishing, 2nd Edition.
- Sidhwani, I.T., Saini, G., Chowdhury, S., Garg, D., Malovika, Garg, N. Wealth from waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated *"A Social Awareness Project", Delhi University Journal of Undergraduate Research and Innovation*, **1(1)**: 2015.

PHARMACEUTICAL CHEMISTRY (Credits: 02) Theory: 30 Lectures

Drugs & Pharmaceuticals

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Practicals

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).

Reference Books:

- G.L. Patrick: Introduction to *Medicinal Chemistry, Oxford University* Press, UK.
- Hakishan, V.K. Kapoor: *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New Delhi.
- William O. Foye, Thomas L., Lemke , David A. William: *Principles of Medicinal Chemistry*, B.I. Waverly Pvt. Ltd. New Delhi.

CHEMISTRY OF COSMETICS & PERFUMES (Credits: 02) 30 Lectures

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Practicals

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

Reference Books:

- E. Stocchi: *Industrial Chemistry,* Vol -I, Ellis Horwood Ltd. UK.
- P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

PESTICIDE CHEMISTRY (Credits: 02) 30 Lectures

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Practicals

1. To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.
2. Preparation of simple organophosphates, phosphonates and thiophosphates

Reference Book:

 Cremlyn, R. *Pesticides. Preparation and Modes of Action*, John Wiley & Sons, New York, 1978.

FUEL CHEMISTRY (Credits: 02) 30 Lectures

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.
Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal.Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.
Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels.
Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its
derivatives Xylene.
Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Reference Books:

 Stocchi, E. *Industrial Chemistry,* Vol-I, Ellis Horwood Ltd. UK (1990).
 Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
 Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut(1996).

B.Sc. –I Semester Chemistry

Total hours :60 **Theory :80 Marks**

INORGANIC CHEMISTRY

1)**Atomic structure**: Bohr's model of hydrogen atom, derivation of Bohr's equation for the energy of an electron in hydrogen atom ,Somerfield's extension of Bohr's theory and it's short comings,de-Broglies equation, uncertainty principle, Schrodinger wave equation for hydrogen atom (derivation not expected), eigen values, Eigen functions ,probability density, significance of ψ and ψ^2, shapes of s,p,and d orbitals based on radial probability distribution curves, quantum numbers and their significance rules governing the electronic configuration. Aufbau principle, Hund's rule (n+1)rule , Pauli's exclusion principle, electronic configuration of elements upto atomic no.36.

07 hours

2) Periodic properties: Review of modern periodic table, atomic ,covalent , vander Waals and ionic radii and their calculations, periodic trends in atomic radii, ionization energy , electron affinity and electro negativity in predicting and explaning chemical behaviours, general characteristics for s-block(group 1 and 2)and p –block(group16 and 17)elements ,unique characteristics of litium and fluorine.

04 hours

3)Oxidation Number: Computation of oxidation number, balancing of redox reactions,calculation of equivalent masses of oxidizing and reducing agents .

02 hours

4)Principles of volumetric analysis: Concentration terms :normality , molarity, mole fraction and percentage , primary standard , acid –base precipitation , redox iodimetric ,iodometric and complexometric titrations, and choice of indicators in these titrations.

05 hour

5) Acids and bases : lux –flood and Lewis concepts of acids and bases, hard and soft acids and bases Pearson's concept of HSAB .

02 hours

ORGANIC CHEMISTRY

6)Classification and IUPAC Nomenclature of organic compounds: Functional group and classification of organic compounds, IUPAC rules to name mono and bi –functional aliphatic and aromatic compounds ,bicycles and 3-7member hetero cyclic compounds with one hetero atom and benzo derivatives .

04 hours

7)STRUCTURE AND BONDING OF ORGANIC COMPOUNDS : Hybridization,sigma and pi-bonds, comparative bond lengths , bond angles , bond energies and dihedral angles , bond polarity ,dipole moment and illustrate with examples of organic compounds, delocalization , electronic displacement and their applications ,inductive effect , electromeric effect, resonance effect ,hyperconjugation and steric effect.

05 hours

8)BASICS OF ORGANIC REACTION MECHANISM: Meaning of the term reaction mechanism, classification of organic reactions ; substitution ,addition ,elimination ,rearrangement , oxidation and reduction reaction with suitable examples. Curly arrow rules , types of bond fission, electrophiles and nucleophiles ,nucleophilicity and basicity,reactive intermediates , structure,formation and stability of carbocation,carbanion,free radicals and carbenes.

07 hours

9)STEREOISOMERISM-I: Meaning of stereoisomerism,conformational isomers and configurational isomers(distinction between conformation and configuration),geometrical isomerism-definition ,reason for geometrical isomerism,E and Z notation-CIP rules and examples, determination of configuration of geometric isomers by dipole moment method, syn and anti isomers in compounds containing C=N.

04 hours

Physical chemistry

10)Gaseous state:

Distribution of molecular speed:Maxwell's Boltzmann law of distribution of molecular velocieties,calculation of molecular velocities of gaseous molecules,average,most probable and RMS velocities,collision diameter,mean free path,collision number,critical phenomenon:critical constants,Andrew's isotherms,vander Waal's equation and critical constants,measurement of critical constants(Tc,Pc and Vc),law of corresponding state and reduced equation of states.

08 hours

11)Liquid state:

Intermolecular forces,structure of liquids(qualitative description).Structural differencs between solids,liquids and gases.Physical properties of liquids.

i)Vapour pressure and enthalpy of vapourisation.

ii)Surface tension, surface energy,effect of temperature on surface tension,shapes of liquid drops and soap bubbles,capillary action,determination of surface tension of liquids by drop number method.Parachor and its applications.

iii)Viscosity,effect of temperature on viscosity,determination of viscosity of liquids by using Ostwald's viscometer.

iv)Refractive index,specific and molar refractions and their applications.Determination of refractive index of liquid using Abbe refractometer.

08 hours

12)Nernst distribution law:

Distribution law:thermodynamics derivation of distribution law,calculation of partition coefficient,deviation from distribution law due to molecular complexity(association and dissociation),applications of distribution law-extraction of substance from solution with derivation and numerical problems.

04 hours

B.SC. II SEMESTER CHEMISTRY SYLLABUS

INORGANIC CHEMISTRY

1.CHEMICAL BONDING –I

Ionic bond: factors favoring the formation of ionic bond, lattice energy and solvation energy, born-haber cycle for the formation of NaCl and problems on calculation of lattice energy, Born-lande equation. covalent bond: factors favoring the formation of covalent bond, valence bond theory with respect of F_2, O_2 and N_2 molecules, concept of resonance in CO_2^{2-} and NO_3^- ion. Hybridization: Hybridization in $BeCl_2$, BCl_3, $SiCl_4$, PCl_5 and SF_6 molecules, VSEPR theory to explain the structures of NH_3, H_2O and Cl_2O molecules. (**08 Hours)**

2. CHEMICAL BONDING – II

Molecular orbitals theory: Bonding and antibonding molecular orbitals, linear combination atomic orbitals, conditions for the combinations and bond order. Electronic configuration, energy level diagram and predicting the magnetic property for H_2, He_2, N_2, O_2, O_2^+, O_2^- species. comparison of valence bond and molecular orbital theory. Metallic bond: Band theory, electrical properties of metals, nonmetals and semiconductors and super conductors. Hydrogen bonding in HF, H_2O and nitrophenols . Vander waal s forces in noble gases. **(08 HOURS)**

3. CHEMISTRY OF d and f-BLOCK ELEMENTS:

General characteristics of d-block elements (viz. oxidation states, metallic, colour , magnetic, catalytic and complex forming properties), general characteristics of lanthanides and consequences of lanthanide contraction, comparison of d and f-block elements, general features of actinides, transuranic elements. **(04 HOURS)**

ORGANIC CHEMISTRY

4.CHEMISTRY OF ALIPHATIC HYDROCARBONS :

Hydrocarbons as source of energy, relationship between dihedral angle and conformation, conformation analysis of ethane and butane.

ALKENES: Mechanism of addition of hydrogen halides and bromine. Markovnikoffs rule, peroxide effect , acid catalyzed hydration of alkenes(mechanism), oxymercuration –reduction (markovnikoff addition), hydroboaration and oxidation (anti-markovnikoffs addition), oxidative cleavage of alkenes with $KMnO_4$ and ozone, polymerization.

ALKADIENES: Classification, mechanism of addition of halogen and hydrogen halides in 1,3-diene, polymerizationa and Diels-alder reaction.

ALKYNES: Mechanism of addition of halogen and halogen halides, hydration of alkynes, oxidative cleavages of alkynes with $KMnO_4$ and ozone, polymerization. **(07 HOURS)**

5. CYCLOALKANES:

Relative stability and conformational analysis of cyclopropane, cyclobutane, cyclopentane and cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane. **(03 HOURS)**

6. BASIC CONCEPTS IN AROMATICITY :

Criteria for aromaticity : Heat of hydrogenation,resonance and resonance energy. Huckels rule –explanation using examples of benzene, furan, thiophene, pyridine, naphthalene and antracene. Ions: cyclopropane cation, cyclopentadiene anion, cycloheptatriene cation, molecular orbital theory using examples of benzene pyrrole and pyridine.**(04 HOURS)**

7.AROMATIC HYDROCARBONS:

A general mechanism for electroplilic aromatic substitution: Arenium ion path way. Examples of halogenations, nitration, sulphonation and friedal-crafts reaction. Orientation and reactivity in monosubstituted benzene. Theory of orientation : explanation of one electrom withdrawing group and one electron donating group. Polynuclear hydrocarbons : classification and constitution of naphthalene and its synthesis by Howarths method. **(06 HOURS)**

PHYSICAL CHEMISTRY

8. CHEMICAL KINETICS –I:

Rate of reaction,second order reaction : derivationof second order velocity constants,when a=b and a#b,relation between half life period and order of reaction, determination of order of reaction by differential equation method and half life period method, numerical problems. Complex reactions: derivation of rate constant for first order parallel, reversible and consecutive reactions **(06 HOURS)**

9. SOLUTIONS:

Raoults law : relation between mole fractions and vapour pressure of the components in the liquid and vapour phases, non-ideal solutions, activity co-efficients, thermodynamics of ideal solution, Gibbs duhem-morgules equation and its applications, theory of fractional distillation: fractional azeotropic distillations , the nature of azeotropic immiscible liquids, solutions of solid in liquids, solid solutions **(10 HOURS)**

10. PHYSICAL PROPERTIES AND CHEMICAL CONSTITUTIONS :

Polarisation –orientation of dipoles in electric field, claussius-mossatti equation, dipole moment and its measurement by temperature variation and refractivity method, induced dipole moment, dipole moment and structure of molecules, magnetic properties, para,dia and ferro magnetism, optical activity and chemical constitutions **(04 HOURS)** .

III Semester

1.Chemistry of nonmetals:

Preparation, structure, properties of diborane and borazole. Classification of silicates, preparation and structure of NF_3,N_2F_3,$SOCl_2$, & S_4N_4 , preparation, structures, and properties of inter halogen compounds, structure and bonding in Xenon compounds, Xenon difluoride, xenon difluoride,& Xenon trioxide. (**6 hours).**

2. Metallurgy:

Review of the steps involved in metallurgical process, thermodynamic concept of selection of reducing agent. Ellingham diagram, extraction of Ni mond's process,, lead by carbon reduction process, uranium from pitchblende and plutonium from spent nuclear fuel, advantages and applications of powder metallurgy, techniques in the production of metal powder and production of tungsten powder from wolframite. (**8 hours).**

3. Solids:

Space lattice, unit cell, calculation of particles per unit cell, laws of crystallography, symmetry elements in crystal, derivation of Bragg's equation, determination of structure of sodium chloride by rotating crystal method, defects in stoichiometric crystal non stoichiometric crystal. (**6 hours).**

4. stereochemistry-II:

Molecular representation, Fischer's projection formula, Newman's formula, Saw horse formula. Optical isomerism, optical activity, specific rotation and optical purity, chirality, asymmetric centers, enantiomer. R and S notations. CIP rules with examples, molecules with two or more asymmetric centers, diastereomer, meso compounds, R and S notations , D and L configuration and threo and erythro nomenclature, racemic mixture and resolution of racemic mixture through mechanical separation, formation of diastereomer and biochemical method biological significance of chirality. (**6 hours).**

5. Halogen compounds:

Reactivity of halogens in alkyl halides, vinyl halides, allyl halides, aryl halides alkyl-aryle halide. nucleophilic aliphatic substitution, stereochemistry and comparison between SN_2 & SN_2 reactions, elimination reactions: mechanism ,stereochemistry and comparison between E1 and E2 reactions saytzeff's rule, Hoffman rule ,aromatic nucleophilic substitution and elimination-addition mechanism addition. (**6 hours).**

6. Polyhydric alcohols and ethers

Preparation of glycol from ethane and glycerol from propene and use of nitroglycerin. Ethers: mechanism of William ether synthesis, mechanism of synthesis of ether by intermolecular dehydration of alcohols, mechanism of ether cleavage by strong acids Epoxides synthesis from alkene using peroxides acid and base catalyzed ring opening of epoxides with mechanism and poly ether formation. (**04 hours).**

7. phenols

Acidic character :acidic strength of alcohols and phenols ,mechanism of Kolbe's reaction, Claosen rearrangement ,Fries rearrangement, Gattermann synthesis , Ledrer-Mannase reaction, Reimer-Tiemann reaction. (**4 hours).**

Ionic Equilibria:
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. (**8 hours).**

Photochemistry
Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching. Role of photochemical reactions in biochemical processes, photo stationary states, chemiluminescence. **(12 Lectures)**

B.SC. IV SEMESTER

1.NUCLEAR CHEMISTRY:

Nuclear particles (positron, neutrino, mesons, pions, and quarks) nuclear instability, problems. n : mass defect, binding energy, decay constant and half-life period, Nuclear reactions [(α, n), (α, p), (p, α), (p, n), (n, α) and (n, p)] liquid drop model of nuclear fission, nuclear reactor and types of nuclear reactors in India, nuclear fusion, uses of radio isotopes in tracer techniques, agriculture, medicine, food preservation and carbon dating, problems on carbon dating. (08 hours)

2. INORGANIC POLYMERS:

General properties and types of inorganic polymers, comparison with organic polymers, classification, preparation, structures, properties and applications of silicones. Preparation, structures, properties and application of phosphazines. (04 hours)

3. ENVIRONMENTAL CHEMISTRY:

Air pollutants: Sources and control measures of CO_x, SO_x, NO_x, H_2S, hydrocarbons, CFC'"s and particulates. Water pollutants: Sources and adverse effects of sewage. Infectious agents,organic chemicals, inorganic minerals, sediments, oil and detergents. Definition and determinations of D.O., B.O.D. and C.O.D. preliminary, primary and secondary treatment of sewage or industrial effluents. Pesticides and their adverse effects. (07 hours)

ORGANIC CHEMISTRY

4. CARBONYL COMPOUNDS- 1:

Structure of carbonyl compound, synthesis of aldehydes and ketones by oxidation of alcohol, aldehydes by reduction of acyl chloride, esters, nitriles and ketones from Gillmann's reagent, general mechanism of nucleophilic addition to the carbonyl compounds, mechanism of addition of hydrogen cynide and hydroxyl amine, addition of alcohol, anines and phosphorous ylids (No mechanism required). (04 hours)

5. CARBONYL COMPOUNDS- 2:

Acidity of α-hydrogens, mechanism of aldol condensation, Perkin's condensation, Claisen's condensation, Dieckman's condensation and Darzen's condensation, reactions of compounds with no α-hydrogens mechanism of benzoin condensation and Cannizaro's reaction, crossed Aldol, Claisen's condensation, crossed Cannizaro's reaction. (04 hours)

6. CARBOXYLIC ACIDS AND THEIR DERIVATIVES :

Acidity of carboxylic acid, effect of substituents on acidity of aliphatic and aromatic acids. Preparation of carboxylic acid from nitriles and Grignard's synthesis of acylchlorides from PCL_5 , amides from acylchlorides, esterification and hydrolysis of esters, $A_{AC}2$, $B_{AC}2$ reaction mechanism, definition and examples keto-enol tautomerism using example of ethyl acetoacetate (EAA), use of EAA in preparation of alkyl acetic acid, dicarboxylic acid and alkyl ketones, Knoevenagel's reaction and Michel's addition (mechanism not required). (06 hours)

7. AMINES :

Structure of amines, basicity of aliphatic amines, aryl amines and heterocyclic amines, effect of substituents on basicity of aliphatic and aromatic amine, basicity of amines versus amides, preparation of amines by Gabriel's phthalimide synthesis, through reduction of nitro compound by Halfmann and Curtius reaction (Mechanism required), reactions of aliphatic and aromatic amines with nitrous acid, replacement reaction of arenediazonium salt (replacement by -Cl/-Br, -CN, -I, -F, -OH, -H), coupling reaction of arenediazonium salt. (04 hours)

8. ORGANO METALLIC COMPOUNDS :

Definition and examples of organo metallic compounds, synthesis and application of Grignards reagent in preparation of alkanes, alcohols, aldehydes and ketones, esters, ethers and thiols. (02 hours)

PHYSICAL CHEMISTRY

9. ADSORPTION AND CATALYSIS:

Adsorption : Adsorption isotherms (all five types) Freundlich's and Langmuir's adsorption isotherms (derivation) and their limitations, multilayer theory : BET adsorption isotherm (equation only), measurement of surface area of adsorbent. Gibbs adsorption equation and its applications, theories of catalysis: intermediate compound and adsorption theory. Kinetics of acid-base catalyst: general and specific. Enzyme catalysis: micheals-mention equation, bio enzymes and industrial applications.

10. PHASE RULE :

Statement and explanation of the terms with examples: phase components,degree of freedom, gibbs phase rule application of phase equilibria for one component system, reduced phase rule ,two component systems(Zn-Cd, KI-H_2C-CH_3,Ag-Pb), pattinsons process of desilverization, eutectic and freezing mixtures and their applications.

11.MICELLES :

Emulsions, micro emulsions, electro kinetic effects, colloidal or association colloids, surface active agents or surfactants, solubilization of surface solutions.

CH: 5.1-CHEMISTRY- V (Sem-V, Paper-I)

1. Coordination chemistry –I:

Review of terms: double salts, complex compounds, central metal ion, ligand, coordination number and complex ion, classification of ligands, Werner's theory of coordination compounds with reference to cobalt ammine complexes, IUPAC nomenclature of coordination compounds, calculation of effective atomic number (EAN) in different complexes, stereochemistry and examples of coordination compounds with coordination numbers 2,3,4,5 and 6. Ionization, hydrate, linkage, geometrical and optical isomerism incoordination compounds with respect to coordination numbers 4 and 6. **(07 Hours)**

2. Bioinorganic chemistry

Elements of life: essential and beneficial elements, major, trace and ultra-trace elements. Basic chemical reactions in the biological systems and the role of metal ions (specially Na^+, K^+, Mg^{2+}, Ca^{2+}, $Fe^{3+/2+}$, $Cu^{2+/+}$ and Zn^{2+}). Metal ion transport across biological membrane Na^+/ K^+ion pump. Dioxygen molecule in life. Dioxygen management proteins: Haemoglobin, Myoglobin, chelation therapy (examplesonly), Pt and Au complexes as drugs (examples only).

(06 Hours)

UNIT – II

3. Heterocyclic compounds:

5 and 6membered rings with one heteroatom, reactivity, orientation and Important reactions of furan, pyrrole, thiophene and pyridine (with mechanism), synthesis of pyrrole by Knorr, Paal-Knorr, Hantzsch synthesis, furan by Paal- Knorr, Feist-Benary synthesisand its variation, thiophenes by Paal-Knorr, Hinsberg synthesis, pyridine byHantzsch synthesis, benzo-fused 5-and 6- membered rings with one heteroatom:reactivity, orientation,Indole,quinolone and isoquinoline: indole by Fischer, quinolone bySkraup,isoquinoline by Bischler-Napieralski synthesis. Biological importance of heterocycles of above. **(06 Hours)**

4. Alkaloids:

Classification, extraction, general properties, Hoffman's exhaustive methylation, constitution of hygrine, coniine and nicotine. (Synthesis expected) **(04 Hours)**

5. Pericyclic reaction:

Types of pericyclic reaction, molecular orbital theory(MOT), symmetry properties ofreactant and product orbitals, cyclo addition reaction-[2+2] and [4+2] cycloadditionreactions. Electro cyclic reaction: cyclisation of 4n and $[4n+2]\pi$ systems, sigmatropic rearrangements.**(04 Hours)**

UNIT – III

6. Electrochemistry

Arrhenius theory of ionization and its limitations. Theory of strong electrolytes: Debye-Huckel theory of strong electrolytes, Debye-HuckelOnsagar equation (no derivation), relaxation effect, electrophoretic effect, viscous effect, interionic attraction theory, activity coefficients of electrolytes, mean ionic activity coefficients of electrolyte, ionic strength of electrolyte solution. Theory of electrolyte dissociation: Migration of ions: Ionic mobility, transport number, Hittorf's method and Moving boundary method with problems, conductometric titrations.

(08 Hours)

7. Chemical kinetics –II

Theories of reaction rates: collision theory, Lindemann's theory of unimolecular reactions. Theory of absolute reaction rates: thermodynamic treatment to activated complex, comparison between collision theory and theory of absolute reaction rates, chemical kinetics in solutions, influence of ionic strength on reaction rates, salt effects (primary and secondary). **(05 Hours)**

CH: 5.2 -CHEMISTRY- VI (Sem-V, Paper- II)

UNIT – I

1. Organometallic Chemistry

Definition and classification of organometallic compounds on the basis of bondtype. Concept of hapticity of organic ligands.18-electron and 16-electron rules (pictorial MO approach). Applications of 18-electron rule to metal carbonyls, nitrosyls, cyanides.General methods of preparation of mono and binuclear carbonyls of 3d series.Structures of mononuclear and binuclear carbonyls.π-acceptorbehaviour of CO,synergic effect and use of IR data to explain extent of back bonding. Zeise's salt. **(06 Hours)**

2. Environmental Chemistry:
Air pollutants: sources and control measures of COx, SOx, NOx, H2S, hydrocarbons, CFC's and particulates.Water pollutants: sources and adverse effects of sewage, infectious agents, organic chemicals, inorganic minerals, sediments, oil and detergents. Definition and determinations of DO, BOD and COD. Preliminary, primary and secondary treatment ofsewage or industrial effluents.Pesticides and their adverse effects. **(07 Hours)**

UNIT – II
3. Ultraviolet Spectroscopy:
Types of electronic transitions, λmax, chromophores and auxochromes, bathochromic and hypsochromic shifts, intensity of absorption, Woodward rules for calculating λmax ofα,β-unsaturated aldehydes, ketones, carboxylic acids, esters. Conjugated dienes: alicyclic, homoannular and heteroannular, *cis-trans* isomerism, applications of UV spectroscopy. **(05 Hours)**

4. Infrared spectroscopy:
Introduction to infrared spectroscopy, intensity of absorption band, position of Absorption bands, C-H, >C=O, O-H, N-Hstretching frequencies (for every functional group reason for variation in band values must beexplained), effect of hydrogen bonding. **(04 Hours)**

5. Art of organic synthesis:
Retrosynthetic analysis: Strategy of organic synthesis – Terminology: Target molecule, Synthons, Synthetic equivalents, Disconnection approach and Functional Group Interconversions (FGI). Applications to simple organic molecules – Acetone cyanohydrin, *p*-Methoxyacetophenone, Benzocaine, Pirindol, 6-Methyl quinolone and Saccharin. **(05 Hours)**

UNIT – III
Molecular spectroscopy:
Interaction of electromagnetic radiation with matter, electromagnetic spectrum.
(a). Rotational spectroscopy:(Microwave Spectroscopy)
Rotation of molecules, diatomic rigid rotator, selection rule, derivation for expression of energy and bond length (HCl), polyatomic molecules: linear, symmetric top, asymmetric top molecules(qualitative approach).
(03 Hours)
(b). Vibrational spectroscopy:(IR Spectroscopy)
Vibrating diatomic molecules - energy of diatomic molecules, force constant, vibrational spectra: harmonically vibrating diatomic molecules (HCl) and anhormonic case, Morse potentials function and dissociation energy (problem), vibration and rotational spectra of diatomic molecules (only CO), Raman spectra: rotational-vibration spectra of Raman (elementary approach) complementary of Raman and IR.
(07 Hours)
(c). Electronic spectroscopy:(UV-Visible Spectroscopy)
Diatomic molecules: Born-Oppenheimer approximation, vibrational course structure of electronic transition and intensity, Franck -Condon principle, predissociation, application of UV- Visible spectroscopy. **(03Hours)**

B.Sc. VI SEMESTER CHEMISTRY SYLLABUS PAPER-1

1.coordination chemistry-II:

valence bond theory of coordination compounds with reference to $[Fe(CN)_6]^{4+}$, $[Fe(CN)_6]^{3-}$, $[FeF_6]^{3-}$, $[Zn(NH_3)_4]^{2-}$, $[NiCl_4]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Ni(H_2O)_6]^{2+}$ and its limitations, crystal field theory with reference to octahedral, tetrahedral and square planar complexes, calculation of crystal field stabilization energy, explanation of color and magnetic properties of metal complexes, determination of magnetic susceptibility by

Guoy method, stability constant, stepwise and overall formation constants, trends in stepwise constants, factor affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelates: definition, characteristics, factors influencing the stability of metal chelates and importance of chelates. (08 Hours)

2. Bioinorganic Chemistry:

Essential and trace elements in biological processes, role of Na, K, Ca, Mg, Fe and Zn in biological system, toxic effect of Hg, Cd, Pb and As role of hemoglobin, myoglobin and chlorophyll in biological systems. (03 Hours)

3. Non aqueous solvents:

Solvent properties and typical reactions studied in liquid ammonia and liquid sulphurdioxide. (03 Hours)

4. Carbohydrates:

Definition, classification, osazone formation, epimers and epimerization, inter conversation of fructose and glucose, Kiliani synthesis and Ruff degradation, ring structure of D-glucose, mutarotation and determination of ring size of D-glucose by Haworth-Hirst method, perspective formula of D-glucose. Disaccharides: structure of sucrose and lactose (mention hydrolysis product, glycoside linkage and reducing properties). Polysaccharides: partial structure of starch and cellulose. (05 Hours)

5. Amino acids and proteins:

Classification of amino acids, stereochemistry of amino acids, Zwitter ion and explanation to isoelectric point, synthesis of amino acids from Gabriel phthalimide synthesis, Streckers synthesis, Ninhydrin reaction. Peptides: definition and Bergman's synthesis of simple dipeptide. Proteins: biological importance, primary, secondary structure of proteins (α-helical, β-sheet) (04 Hours)

6. Vitamins and Hormones:

Classification and biological significance, source and structure of Vitamin A, B1 (thiamine), B2 (Pyridoxine), tocopherol, K1 (phylloquinone), C (ascorbic acid), Van Drop's synthesis of Vitamin A, synthesis of Vitamin C from D-glucose. Hormones: Definition, classification with examples, functions and deficiency diseases of hormones, synthesis of adrenaline and thyroxine. (04 Hours)

7. Electro Motive Force (EMF):

Reversible and irreversible cells, EMF of a chemical cell and its measurement by potentiometer, standard cell (Western standard cell), types of electrodes, reference electrodes, calomel electrode, sign conversions, Nernts equation, electrochemical series and its applications, determination of p H of solution by hydrogen electrode, quinhydrone and glass electrode methods, concentration cell with and without transference, liquid junction potential, salt bridge and its applications. Application of concentration cells, determination of solubility, potentiometric titration: acid-base, calculation of Ka and redox titration, determination of redox potential and numerical problems. (09 Hours)

8. Battery technology:

Primary and secondary cells, lead storage battery and its applications, Ni-Cd cells, Lithium battery, fuel cells and their applications. Corrosion: types and factors influencing corrosion, theory of corrosion and methods of prevention. (04 Hours)

B.Sc. VI SEMESTER CHEMISTRY SYLLABUS PAPER-2

1. ANALYTICAL CHEMISTRY:

Chromatography : definition,and classification , coloumn chromatography : principle and applications, paper chromatography: principle and types, applications anf significance of rf value, ion exchange chromatography: types of ion exchange resins, basic requirements of useful resin,principle, applications,separation of lanthanides and determination of chloorides, high performance liquid chromatography ; principle, instrumentation and applications, gas chromatography advantages, principl e, instrumentation and applications.

Flame Photometry: principle, instrumentation and applications and determination of Na & K. (2 HOURS)

Atomic Adsorption Spectroscopy: principle, instrumentation, advantages over flame emission spectroscopy and applications.

Thermogravimetry: principle and applications of TG &DTA . (2 HOURS)

2. NUCLEAR MAGNETIC RESONANCE (NMR) : Basic principles of PMR , nuclear shielding and deshielding , chemical shift and molecular structure, spin-spin coupling constant, areas of signals, interpretation of PMR structure of simple organic molecules such as ethylbromide ,ethanol, acetaldehyde, ethyl acetate, toluene, acetophenone and acetanilide.

3. DRUGS : Definition and classification , requirement of an ideal drug, synthesis and therapeutic use of a).analgesic and antipyretic b).antibacterial: sulphadiazine and sulphathiazole c). antimalarial : chloroquine d). antibiotic: chlorrphenicol e). tranquilizers: mysoline and pentothal sodium f). local anesthetics: novacaine g). antihistamines: chlorpheniramine maleate (**6 hours).**

4. TERPENES : Classification , isoprene rule, special isoprene rule , constitution and synthesis of citral and @-terpinol.

5. MACROMOLECULES : Types of Polymers,natural and synthetic , types of poly reactions: chain reactions, polyethylene,polystyrene,pvc and polymethylacralate, mechanism of addition, polymerization reaction and condensation reaction , mol weight of polymers: number average and weight average mol mass , determination of mol mass of macromolecules by osmotic pressure method and by viscosity method.

6. QUANTUM CHEMISTRY : Black body radiation , planks theory, Einsteins theory, photoelectric effect,Compton effect, bohrs theory of hydrogen atom, sommerfeld theory, wave particle duality , de-broglies theory, heisenbergs uncertainity principle, wave nature of electron, wave function and its interpretation, eigen function values, normalization and orthogonality. (8 HOURS)

Annexure "A"

KARNATAK UNIVERSITY, DHARWAD

PROPOSED SYLLABUS OF

MATHEMATICS

FOR B.Sc. DEGREE COURSE

UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

WITH EFFECT FROM 2020-21 AND ONWARDS

Karnatak University, Dharwad

B. Sc. Mathematics Syllabus under Choice Based Credit System(CBCS)

Karnatak University is proposed to introdused to Choice Based Credit System(CBCS) for B. Sc. Programme from the academic year 2020-21. Proposed syllabus has been prepared as per the guidelines. The Board of Studies in Mathematics has prepared this syllabus.

B. Sc. Mathematics Programme Course Matrix for Semester I-IV

Discipline Specific Course(DSC)

Sem	Title of the Course	Type of instruction & hours per week/course 4=(3L+1T)	Credits	Hours of Exam(SEE) Per Course /Sem.	Max. Marks For LA per Course/Sem.	Max. Marks For SEE per Course/Sem.	Max. Marks per Course/Sem.
I	BMDSC Paper 1.1 Differential Calculus-I	4	3	3	15	60	150
	BMDSC Paper 1.2 Algebra	4	3	3	15	60	
II	BMDSC Paper 2.1 Differential Calculus-II	4	3	3	15	60	150
	BMDSC Paper 2.2 Integral Calculus And Geometry	4	3	3	15	60	
III	BMDSC Paper 3.1 Number Theory and Group Theory	4	3	3	15	60	150
	BMDSC Paper 3.2 Analysis and Trigonometry	4	3	3	15	60	
IV	BMDSC Paper 4.1 Sequences and Series	4	3	3	15	60	150
	BMDSC Paper 4.2 Vector Calculus and Differential Equations	4	3	3	15	60	

SEE : Semester end exam

B. Sc. Mathematics Programme Course Matrix for Semester V-VI

Discipline Specific Electives (DSE)

(Choose any One Group for each Semester)

Sem	Group	Title of the Course	Type of instruction & hours per week/course 4=(3L+1T)	Credits	Horse of Exam(SEE) Per Course/Sem.	Max. Marks For LA per Course/Sem.	Max. Marks For SEE per Course/Sem.	Max. Marks per Course /Sem.
V	Group 1	BMDSE Paper 5.1A Real Analysis	4	3	3	15	60	150
		BMDSE Paper 5.1B Numerical Analysis	4	3	3	15	60	
	Group 2	BMDSE Paper 5.2A Laplace Transforms and Fourier Analysis	4	3	3	15	60	
		BMDSE Paper 5.2B Finite difference based Numerical Methods	4	3	3	15	60	
VI	Group 1	BMDSE Paper 6.1A Differential Equations	4	3	3	15	60	150
		BMDSE Paper 6.1B Modern Algebra	4	3	3	15	60	
	Group 2	BMDSE Paper 6.2A Topology And Complex Analysis	4	3	3	15	60	
		BMDSE Paper 6.2B Linear Algebra	4	3	3	15	60	

B. Sc. Mathematics Programme Course Matrix for Semester V-VI

Skill Enhancement Course (SEC)

(Choose any One Group for each Semester)

Sem	Group	Title of the Course	Type of instruction & hours per week/course 2=2L	Credits	Horse of Exam(SEE) Per Course/Sem.	Max. Marks For I.A per Course/Sem.	Max. Marks For SEE per Course/Sem.	Max. Marks per Course /Sem.
V	Group 1	BMSEC-Paper 5.1A Difference equation	2	2	1.5	10	40	50+50
		BMSEC-Paper 5.1B Applications of Calculus	2	2	1.5	10	40	
	Group 2	BMSEC-Paper 5.2A Statics	2	2	1.5	10	40	
		BMSEC-Paper 5.2B Dynamics	2	2	1.5	10	40	
VI	Group 1	BMSEC-Paper 6.1A Calculus of variations	2	2	1.5	10	40	50+50
		BMSEC-Paper 6.1B Linear Programming Problems	2	2	1.5	10	40	
	Group 2	BMSEC-Paper 6.2A Graph Theory	2	2	1.5	10	40	
		BMSEC-Paper 6.2B Lattice and Boolean Algebra	2	2	1.5	10	40	

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B.Sc – I Semester, Proposed new syllabus: 2020-21 onwards
[BMDSC] Paper 1.1: Differential Calculus-I

Unit 1 :

Real Numbers : Intervals, Absolute Values, Bounded and unbounded sets, Supremum and infimum of a set, Archimedean properties of real numbers. Neighbourhoods and limit points of a set.

Limits and Continuity: Definition of limit and continuity of a function in $\varepsilon - \delta$ form. Algebra of limits (with proof) and continuity (without proof). Boundedness of continuous function. Properties of continuous function. Intermediate value theorem. Uniform continuity – Defiuition. Theorems i) Uniform coutinuity implies continuity and ii) contiuuity oo closed interval implies Uniform continuity. Differentiability: Definition and problems on continuity as well Differeotiability of a function. **(25 hrs)**

Unit 2 : Indeterminate forms: L- Hospital rule (Statement only). Evaluation of Limits using L-Hospital rule.

Higher Order Derivatives : The n^{th}derivative of $(ax+b)^m$, $\log(ax+b)$, e^{ax}, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$. Leibnitz Theorem on n^{th} derivative of a product of functions and its application.

Mean Value Theorems : (*Recap of Rolle's and Lagrange's theorems*) Cauchy's mean value theorem. Monotonic functions: its applications in asteblishing some inequalities, Taylor's theorem (with Schlomtichand Rocheform of remainder), Maclaurin's theorem (without proof) Maclaurio's expansion of some standard functions. **(20 hrs)**

Reference Books:

1. **Differential Calculus** : Shanthi Narayan & P.K Mittal (S. Chand & Co.), 2010.
2. **Advanced Calculus:** B.R.Takur, G.P.Shrivastva & Bhanu Tripati Prasad and sons,
3. **Advanced Calculus** : Murry R. Spiegal (Schaum Series), 2010.
4. **Mathematical Analysis** : S. C. Malik (Wiley Eastern), 1992.
5. **Text book of B.Sc. Mathematics** : G.K. Ranganath and others, 2015.
6. **Real Analysis** : P.N. Chatterji, A Pragati edition, 2019
7. **Real Analysis** : Shanthi Narayan (S. Chand & Co.), 2005.
8. **Real Analysis:** Sharma and Vasishta, Krishna publications, 2014
9. **A Course in B.Sc. Mathematics:** Prof. Bhoosnurmath, C S Salimath & V S Shetiya
10. **College Mathematics for B.Sc.:** Dr. N. Rudraiah

[BMDSC] Paper 1.2 : Algebra

Unit 1 :

Set Theory : (*Recap of operations on sets, equivalence relation*) Indexed sets, Arbitrary union and intersection of sets, Generalized De'Morgan's Laws. Images , inverse images of functions, Set functions, properties of set functions, Properties of composite functions, Countable and uncountable sets.

Matrices: Row and column transformations in matrices, Rank of a matrix, Reduction to normal forms, Inverse of a matrix by elementary operations. Solution of system of linear equations, Necessary condition for a system of equation to be consistent, Solution of system of linear equations by Gauss Elimination and Gauss-Jordan methods. **(30 hrs)**

Unit 2.

Theory of equations: (*Recap of Quadratic equation: sum & products of roots and relation between the roots and coefficients*), Factor theorem and remainder theorem. Cubic and Bi-quadratic equations, solution of the equations when Roots are in A.P, G.P and H.P. Irrational and complex roots, Solotions of equatious by synthetic division. **(15 hrs)**

Reference Books:

1. **Matrices :** Shanthi Narayan (S. Chand & Co.), 2010.
2. **Elements of Modern Algebra and Topology :** Sampathkumar & K. S. Amur.
3. **Matrices :** M. Pille
4. **Matrices:** M.D. Raisighania, H.C, Sexena and H.K Das
5. **Matrices:** P.N. Chatterji
6. **Theory of Equations :** M.L. Kanna
7. **Set Theory and related topics :** Lipschotz:. -Schaum Series, 1998.
8. **Elementary Set Theory:** M.L Khanna, 1998.
9. **A Course in B.Sc. Mathematics :** Prof. Bhoosnurmath, C S Salimath & V S Shetiya
10. **College Mathematics for B.Sc.:** Dr. N. Rudraiah
11. **A Text Book of B.Sc.Mathematics :** G K Ranganath

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B. Sc – II Semester, Proposed new syllabus: 2020-21 onwards

[BMDSC] Paper 2.1: Differential Calculus-II

Unit 1. Differentiation in polar Co-ordinates. Plane curves in Polar and pedal forms. Angle between the radius vector and the tangent. Angle of intersection of curves (polar form). Length of Polar tangent, normal, sub-tangent and sub-normal at any point on the curve. Length of perpendicular from pole to the tangent. Pedal equations. Derivative of an arc length of a plane curve. **(15 hrs)**

Unit 2. (*Recapitulation of Maximum and Minimum of a function*)
Concavity, Convexity and Points of inflexion of curves. Curvature of plane curves. Derivation of Radius of curvature in Cartesian, parametric and polar forms. Center of curvature. Evolutes & Involutes, Envelopes of a plane curves. Asymptotes of a plane curves: Asymptotes parallel to coordinate axes and oblique asymptotes, theorems and problems.
Tracing of curves: Definitions, Singular points, multiple points, Node, Cusp and isolated points. General rules for tracing of curves in Cartesian, polar forms. Examples on tracing of simple curves. **(30 hrs)**

Reference Books:

1. **Advanced Calculus:** B.R.Takur, G.P.Shrivastva & Bhanu Tripati, Prasad and sons, 2005.
2. **Differential Calculus** by Shanthi Narayan & P.K Mittal (S. Chand & Co.), 2010.
3. **Differential Calculus** by N. P. Bali (Golden series), 2015.
4. **A Course in B.Sc. Mathematics :** Prof. Bhoosnurmath, C S Salimath & V S Shetiya
5. **College Mathematics for B.Sc.**:Dr. N. Rudraiah
6. **A Text Book of B.Sc.Mathematics** :G K Ranganath

[BMDSC] Paper- 2.2: Integral Calculus and Geometry

Unit 1. Integral Calculus: Reduction formulae for evaluating $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int Cosec^n x$, $\int \cot^n x\,dx$, $\int x^n e^m dx$ anfl $\int x^m (\log x)^n dx$ with definito limits. Application of definite integrals to area under a curve (only polar curves), volumes and surfaces of the solid generated by the revolution. Length of plane curves. **(20 hrs)**

Unit 2. Analytical Geometry of three dimensions:

Sphere: Equation of a Sphere. Section of a sphere by a plane. Equation of a Sphere through a circle. Equation of a sphere with two given points as the ends of diameter, Tangent planes. Orthogonal spheres.

Cone: Equation of a cone. Qoadric cone. Enveloping cone of a sphere. Right circular cone.

Cylinder: Equation of a cylinder. Enveloping cylinder of a sphere. Right circular cylinder.

Coordinate geometry: Polar equation of the conic. Polar Equation of the directrix and tangent to the conic. Equation of asymptotes to the conic.

(25 hrs)

Reference Books:

1. **Integral Calculus** : Shanthi Narayan & P.K. Mittal, (S.Chand), 2005.
2. **Integral Calculus** : Vasishta , Sharma & N.P Bali, Krishna Publication, 2014.
3. **Coordinate Geometry** : M. L. Khanna
4. **The elements of Coordinate Geometry** : S.L.Loney, 2016.
5. **A Course in B.Sc. Mathematics** : Prof. Bhoosnurmath, C S Salimath & V S Shetiya
6. **College Mathematics for B.Sc.**:Dr. N. Rudraiah
7. **A Text Book of B.Sc.Mathematics** :G K Ranganath

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B.Sc – III Semester- Proposed new syllabus: 2021-22 onwards
[BMDSC] Paper- 3.1: Number Theory and Group Theory

Unit 1. Number theory: Divisibility. Properties of divisibility. Division algorithm. GCD. Euclid's algorithm. Relatively prime numbers. Fundamental theorem of arithmetic. The number of positive divisors and sum of all the positive divisors of a number. The theory of Congruences. Basic Properties of congruences. Linear Congruences. The Chinese remainder theorem. Euler's phi-functions, Euler's theorem, Fermat's theorem. Wilson's Theorem. **(20 hrs)**

Unit 2. Group Theory: Groups. Abelian Group. Standard examples of Groups.

Properties of Groups. Sub-Groups and its properties. Permutation Groups.

Cyclic Groups, Cosets. Lagrange's theorem. Normal sub-Groups. Quotient Groups. Homomorphism and Isomorphism of Groups. Kernel of homomorphism. Fundamental theorem of homomorphism. **(25 hrs)**

Reference Books:

1. **Theory of Numbers:** Prakash Om, Golden series, 2005.
2. **Higher Algebra :** Ray & Sharma (S. Chand & co.)
3. **Modern Algebra :** P.N Chatterjee
4. **Higher Algebra:** Hall and Knight, Arihant, 2016.
5. **Modern Algebra:** M.L. Khanna
6. **Modern Algebra :** B. S. Vatsa & others(New Age International), 2009
7. **A Course in B.Sc. Mathematics :** Prof. Bhoosnurmath, C S Salimath & V S Shetiya
8. **College Mathematics for B.Sc.:**Dr. N. Rudraiah
9. **A Text Book of B.Sc.Mathematics :**G K Ranganath

[BMDSC] Paper-3.2: Analysis and Trigonometry

Unit 1: Real Analysis:

Real valued functions of more than one variable. Limits and continuity definitions. Partial derivatives. Homogeneous functions- Euler's theorems and its extension. Total differentials –composite function and Implicit function. Jacobians: Chain rule, Inverse rulo, Jacobian of Implicit function and functional dependence. Taylor's theorem (Genoralized mean vaioe theorem) and Maclaurin's form for functions of two variables. Maxima and Minima of functions of two and three variables. Lagrange's method of undetermined multipliers.

(25 hrs)

Unit 2 : Trigonometry

Complex numbers in terms of polar form, D'Moivre's theorem. (statement only). n^{th} roots of a complex number. Expansion of $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ in terms of $\sin\theta$, $\cos\theta$ and $\tan\theta$ respectively. Expansion of $\sin^n\theta$, $\cos^n\theta$ and $\sin^m\theta\ \cos^n\theta$ in a series of sines or cosines multiple of θ. Exponential and circular function of complex variable. Hyperbolic function and its identities. Problems on real and imaginary parts of circular and Hyperbolic function. Logarithm of complex numbers. Summatiun of trigonometric series in 'C+iS' form.

(20 hrs)

Reference Books:

1. **Advanced Calculus**: B.R.Takur, G.P.Shrivastva & Bhanu Tripati.
2. **Real Analysis** :Hari Kishan, Pragati Publication.
3. **Real Analysis:** M. L. Khanna.
4. **Differentisl Calculus** : Shanti Narayan , & P.K. Mittal,(S.Chaed & Co.).
5. **Higher Trigonometry** : M. K. Singal & Asha Rani Singal.
6. **Trigonometry** : M.D. Raisighania, H.C, Sexena and H.K Das.
7. **Plane Trigonometry II** : S.L . Loney, Arihant, 2016.
8. **Trigonometry** ; M.L Khanna.
9. **A Course in B.Sc. Mathematics** : Prof. Bhoosnurmath, C S Saiimath & V S Shetiya.
10. **College Mathematics for B.Sc.**: Dr. N. Rudraiah.
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Graduate Programme, B.Sc. (CBCS)

B.Sc – IV Semester, Proposed new syllabus: 2021-22 onwards

[BMDSC] Paper-4.1: Sequences and Series

1. **Unit I: Sequences:** Seqnences. Bounded and unbounded sequences. Monotonic Sequences. Limit points of a sequence. Convergent, divergent and oscillatory sequences. Algebra of convergent sequencos. Limit superior and limit inferior uf sequences. Cauchy's first and second theorem on limits. Cauchy's general principle for convergence of a sequenco. Snbsequence. **(20hrs)**

2. **Unit II: infinite Series:** Partial sums and behavior of an infinite series. Convergence and divergenco of series. Cauchy's general principle of convergence. Series of nou-negative terms. Necessary and sufficient condition for convergence. Geometric series.
   P-series(Harmonic series). Comparison tests for positive term series. D'Alembert's ratio test. Raabe's ratio test. Cauchy's Root test and Integral test. Logarithmic test. DeMorgan's & Bertrand's test. Alternating series. Leibnitz's theorem. Absolute convergence and conditional convergence of a series. **(25 hrs)**

Reference Books:

1. **First Course io Real Analysis:** M.K. Singal and Asha Rani
2. **Advanced Calculus**: B.R.Takur, G.P.Shrivastva & Bhanu Tripati
3. **First Course in Real Analysis** : S.L. Gupta and Nisha Rani:
4. **Principles of Real Analysis** : S.L. Gupta and N.R. Gupta: - Pearson Educatien
5. **Real Analysis** : Hari Kishan, Pragati Publication.
6. **A Caurse in B.Sc. Mathematics** : Prof. Bhoosnurmath, C S Saliraiah & V S Shetiya
7. **College Mathematics for B.Sc.**:Dr. N. Rudraiah
8. **A Text Book of B.Sc.Mathematics** :G K Ranganath
9. **Fundamental Real Analysis**: S.L. Gupta and Nisha Rani, Vikash Publishers, 2004.

[BMDSC] Paper 4.2: Vector Calculus and Differential Equations

Unit 1: Vector Calculus:

(Recapitulation of Dot and cross product of vectors). Ordinary derivatives of vectors. Condition for a vector function to be constant, to have constant magnitude and constant direction. Derivatives of sum, dot product, cross product and triple products of vectors. Vector differential operator del. Gradient of scalar point function, divergenco and curl of vector point function. Solenoidal and irrotational vectors. **(15 hrs)**

Unit 2: Differential Equations:

(Recapitulation of Linear and Homogeneous Differential equations). Non-homogeneous , exact equations, Integrating factors found by inspection, the determination of integrating factor, equations reducible fo exact and Bernoulli's equations. Simple equations of the first order and higher degree. Equations solvable for p, x, y. Clairaut's equations. Linear differendal equations of the nth order with constant coefficients. Particular Integrals when the RHS is of the from e^{ax+b}, sin(ax+b), cos(ax+b), x^n, $e^{ax}\cdot V$, $x\cdot V$, where V is a function of x. Reduction of homogeneous equations. Linear equations with variable coefficient, Exact differential equations of n^{th} order. **(30 hrs)**

Reference Books:

1. **Vector Calculus** : Shanti Narayan and J.N Kapur, S. Chand, 1987.
2. **Vector Calculus** : J N Sharma A R Vasishta, Krishna's Series, 2015.
3. **Vector Calculus** : M. L. Khanna, Krishna's Series.
4. **Differential equations** : D.A. Murray
5. **Introductory Course on Differential equations** : H.T.H. Piaggio, 2018.
6. **Differential Equations** : Ayres- Schaum Series.
7. **Differential Equations** : A.R.Vasishtha & Dr. S.K. Sharma
8. **Differential Equations** : M.L. Khanna
9. **A Course in B.Sc. Mathematics** : Prof. Bhoosnurmath, C S Salimath & L V S Shetiya
10. **College Mathematics for B.Sc.**:Dr. N. Rudraiah
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B.Sc – V Semester, Proposed new syllabus: 2022-23 onwards

Group 1

[BMDSE] Paper- 5.1A : Real Analysis

Unit 1: The Riemann Integration: The upper and lower Darboux sums. Riemann integral. Necessary and sufficient conditions for integrability. Algebra of integrable functions. integral as the limit of a sum. Integrability of continuous and monotonic functions. Fundamental theorem of Integral calculus. The first and second mean value theorems of integral calculus. **(20 hrs)**

Unit 2: Improper integrals. Improper integrals of the first, second and third kind. Improper integral as the limit of a proper Integral. Comparison tests. Abel's test and Dirichlet's test for the convergence of the integral of a product of two functions.

Double Integrals and Triple Integrals: Double integrals with change of order, change of variables, changing into polar coordinates and Triple integrals. Applications to find area and volumes.

Differentiation under integral sign. Leibnitz's rule and problems. Beta and Gamma functions: Properties, transformations, relation between Beta and Gamma functions. Duplication formula. **(25 hrs)**

Reference Books:

1. **A course of Mathematical Analysis**: Shantinarayan (S. Chand & Co.)
2. **Fundamental Real Analysis** : S. L. Gupta and Nisha Rani
3. **Advanced Calculus**: B.R.Takur, G.P.Shrivastva & Bhanu Tripati
4. **Real Analysis** : Sharma & Vasishta
5. **Real Analysis** : Hari Kishan, Pragati Publication.
6. **Higher Engineering Mathematics**: Dr.B.S.Grewal, Khanna Publisher, 2019.
7. **A Course in B.Sc. Mathematics** : Prof. Bhoosnurmath, C S Salimath & V S Shetiya
8. **College Mathematics for B.Sc.**:Dr. N. Rudraiah
9. **A Text Book of B.Sc.Mathematics** :G K Ranganath

[BMDSE] Paper-5.1B: Numerical Analysis

Unit 1 : Solution of algebraic and transcendental equations: Absolute error, Relative error, Percentage error. Interval halving method, Regula-falsi method, Secant method and Newton's method. Fixed point iteration method, Rate of convergence. Error analysis for these Iterative methods.

(25 hrs)

Unit 2: Numerical solution of system of linear equations: Gauss elimination method, Gauss-Jordan elimination, Jacobi's method, Gauss-Seidel method.

Numerical solution of initial value problems: Taylor's series method, Euler's method, Modified Euler's method and Runge-Kutta method.

(20 hrs)

Reference Books:

1. 1. **Introductory methods of Numerical Analysis:** S. S Shastry Prentice Hall of India, 2012.
2. **Numerical methods for Sc. & Eng :** M. K. Jain,New Age International, 2007.
3. 3. **Finite Differences & Numerical Analysis :** H. C. Saxena, S. Chand & Co., 1988.
4. **A Course in B.Sc. Mathematics :** Prof. Bhoosnurmath, C S Salimath & V S Shetiya
5. **College Mathematics for B.Sc.:**Dr. N. Rudraiah
6. **A Text Book of B.Sc. Mathematics :**G K Ranganath
7. **Numerical Analysis:** Richard L. Burden, Douglas J. Faires, Annette M. Burden, Cengage Learning, 10 Edition.

Group 2

[BMDSE] Paper-5.2A : Laplace Transforms and Fourier Analysis

Unit 1: Laplace Transforms: Basic Properties. Laplace transforms of some common functions. Laplace transform of Periodic functions. Laplace transform of derivative and Integral of a function. Heaviside function. Dirac-delta function. Convolution theorem. Inverse Laplace transforms and its properties. Method of solving differential equatiou of first and second order with constant coefficients using Laplace transforms.

(25 hrs)

Unit 2: Fourier series and Transforms: Periodic functious. Fourier Coefficients. Fourier series of functions with period 2π and period 2L. Fourier series of even and odd functions. Half range Cosine and Sine series. Finite Pourier transforms. Finite Fourier Cosine and Sine transforms of some commoo functions. Transforms of derivates.

(20 hrs)

Reference Books:

1. **Fourier Series and Fourier Transform:** Murry P & Spiegal, Schaum's, 2011.
2. **Fourier Series & Boundary value problem:** Churchill R.V & Brown I.W, McGraw-Hill, 1978.
3. **Higher Engineering Mathematics:** B.S.Grewal, Khanna Publisher, 2019.
4. **Laplace and Fourier Transforms:** J K Goyal & K P Gupta, Pragati Edition, 2016.
5. **Laplace Transform Theory:** M. G. Smith, (Van Nostrand), New University Mathematics, 1966.
6. **A Course in B.Sc. Mathematics:** Prof. Bhoosnurmath, C S Salimath & V S Shetiya
7. **College Mathematics for B.Sc.:** Dr. N. Rudraiah
8. **A Text Book of B.Sc.Mathematics :** G K Rangnath

[BMDSE] Paper-5.2B: Finite difference based Numerical Methods

Unit 1: Finite Differences: Definition and properties of forward difference operator Δ, backward difference operator ∇, shift operator E and central difference operator δ.Relations among them. The n^{th} forward difference of a polynomial. Factorial notations. Separation of symbols. Interpolation. Newton-Gregory forward and backward interpolation formulae. Lagrange's interpolation formula for onequal intervals.

(25 hrs)

Unit 2: Numerical differentiation of first and second order using Newton's forward and Newton's backward interpolation formulae. Numerical integration. Newton-Cote's Quadrature formula, Trapezoidal Rule, Simpson's one-third rule and Simpson's three-eighth rule.

(20 hrs)

Reference Books:

1. **Introductory methods of Numerical Analysis:** S. S. Shastry Prentice Hall of India, 2012.
2. **Numerical methods for Sc. & Eng :** M. K. Jain,New Age International, 2007.
3. **Finite Differences & Numerical Analysis :** H. C. Saxena, S. Chand & Co., 1988.
4. **A Course in B.Sc. Mathematics :** Prof. Bhoosnurmath, C S Salimath & V S Shetiya
5. **College Mathematics for B.Sc.:**Dr. N. Rudraiah
6. **A Text Book of B.Sc. Mathematics :**G K Ranganath
7. 7. **Numerical Analysis:** Richard L. Burden, Douglas J. Faires, Annette M. Burden, Cengage Learning, 10 Edition.

Karnatak University Dharwad

Graduate Programme, B.Sc. (CBCS)

B. Sc – VI Semester Proposed new syllabus: 2022-23 onwards

Group 1

[BMDSE] PAPER-6.1A: Differential Equations

Unit 1 : Simultaneous differential equations with two and more than two variables. Condition of integrability of Pdx+Qdy+Rdz=0. Partial differential equations of the first order and classifications of first order. Integral of the linear equation Pp+Qq=R. Special methods of solution applicable to standard forms. Charpit's metbod. Partial differential equations of the second order. **(25 hrs)**

Unit 2 : Series solution of differential equation: Ordinary differential equation with variable coefficients, Ordinary point, Regular-Singular points, Power Series salution, Frobenius Series solution. Legendre and Bessel equations and thair properties. **(20 hrs)**

Reference Books:

1. **Differential Equations.:** D. A. Murray
2. **Differential Equations :** J. N. Sharma and R. K. Gupta
3. **Differential Equations. :** P. N. Chatterjee
4. **Ordinary and partial Differential equations :** Raisinghania M.D. (S. Chand & Co.), 2016.
5. **Higher Engineering Mathematics:** B.S.Grewal, Khanna Publisher, 2019.
6. **Ordinary Differential equation :**Theory and Applications, Charlton, (Von-Norstand), 1965.
7. **A Course in B.Sc. Mathematics :** Prof. Bhoosnurmath, C S Salimath & V S Shetiya
8. **College Mathematics for B.Sc.:**Dr. N. Rudraiah
9. **A Text Book of B.Sc.Mathematics :** G K Ranganath.

[BMDSE] Paper-6.1B: Modern Algebra

Unit 1 : Rings and Fields: Definition, examples. Abelian Ring. Ring with unity and without unity. Finite and infinite rings(Only definitions).Units in a ring. Zero divisors in a ring. Ring without zero divisor. Properties of ring. Division ring. Integral domain and field definitions. Theorems (i) A finite integral domain is a field (ii) Every field is an integral domain.

(20 hrs)

Unit 2: Polynomial rings, Divisibility, Irreducible polynomials, Eisensten's Criterion of irreducibility, Quotient rings, homomorphism. ideals: Definition, theorems, examples. Maximal ideal, Prime ideal.

(25 hrs)

Reference Books:

1. **Topics in Algebra** : I. N. Herstein, Wiley, 2006.
2. **A First course in Abstract Algebra** : Fraleigh J.B, Pearson, 2013.
3. **Elements of Modern Algebra and Topology** : Sampathkumar & K. S. Amur.
4. **Modern Algebra** : P.N Chatterjee, Anu Books, 2019.
5. **Introduction of Mathematical Analysis-**: Shanti Narayan (S.Chand & Co.)
6. **A Course in Abstract Algebra** : Vijay K Khanna and Bambari, Vikash Publisher, 2017.
7. **Modern Algebra** ; M. L Khanna, Jai Prakash Nath and Co., 2012;
8. **A Course in B.Sc. Mathematics** : Prof. Bhoosnurmath, C S Salimath & V S Shetiya
9. **College Mathematics for B.Sc.**:Dr. N. Rudraiah
10. **A Text Book of B.Sc.Mathematics** :G K Ranganath

Group 2

[BMDSE] PAPER-6.2A : Topology and Complex Analysis

Unit 1: Topology: Topological Spaces. Open sets. Closed sets. Usual topology, Closure, Neighborhood, Limit points and derived sets. Interior, exterior and boundary of a topological space. Bases and Sub bases of a topological space. Subspaces. T_0, T_1 and T_2 spaces.

(15 hrs)

Unit 2 : Complex Analysis: Limits , continuity and differentiability of complex valued function. Analytical functions. Canchy - Riemann Equations. Necessary and sufficient condition for a function to be analytic. Harmonic functions. Construction of analytic functions. Complex Integration. Cauchy theorem. Cauchy integral formula. Morera's theorem. Cauchy's inequality. Liouville's theorem. Taylor's theorem. Laurent's theorem. Singularities. Poles. Residues. Cauchy residoe theorem. Contour integration. Evaluation of

(i) $\int_0^{2\pi} f(sin\theta, cos\theta)d\theta$ or $\int_{-\pi}^{\pi} f(sin\theta, cos\theta)d\theta$

(ii) $\int_{\pi}^{\infty} \frac{P(x)}{Q(x)}dx$, where (x) , $Q(x)$ are polynomials , $Q(x) \neq 0$ for any real x and deg(Q(x))≥ deg(P(x))+2

(iii) $\int_{-\infty}^{\infty} \frac{P(x)}{Q(x)} sinaxdx$ or $\int_{-\infty}^{\infty} \frac{P(x)}{Q(x)} cosaxdx$

where (x) , $Q(x)$ are polynomials , $Q(x) \neq 0$ for any real x , and deg(Q(x))≥ deg(P(x))+1 using contour integration

(30 hrs)

Reference Books:

1. **Elements of Modern Algebra and Topology** : Sampathkumar & K. S. Amur.
2. **Topology** : J. N. Sharma - Krishna Prakashan, Meerut, 2019.
3. **General Topology**-: S. Lipschutz (Schaum's Series), 2011.
4. **Complex Variables** : J. N. Sharma - Krishna Prakashan, 1991.
5. **Complex Variables** : Spiegel (Schaum's Series), 2017.
6. **A Course in B.Sc. Mathematics** : Prof. Bhoosnurmath, C S Salimath & V S Shetiya
7. **College Mathematics for B.Sc.**:Dr. N. Rudraiah
8. **A Text Book of B.Sc.Mathematics** :G K Ranganath
9. **General Topology**: S. R. Malaghan, Serial Publications

[BMDSE] Paper-6.2B: Linea Algebra

Unit 1 : Vector Space: Definition with examples, properties, Vector Subspace. Linear independence and dependence of vectors. Linear span of a set. Base for vector space and dimension.

(20 hrs)

Unit 2: Linear transformation: properties, range, null space, rank and nullity theorem. Linear maps as matrices-change of basic and effect of associated matrices, eigenvalues and eigenvectors of a linear transformation. **(25 hrs)**

Reference Books:

1. **Topics in Algebra** : I. N. Herstein, Wiley, 2006.
2. **A First course in Abstract Algebra** : Fraleigh J.B, Pearson, 2013.
3. **Linear Algebra** : Lipsclitz S, Schaum's, 2017.
4. **Elements of Modern Algebra and Topology** : Sampathkumar & K. S. Amur.
5. **Modern Algebra** : P.N Chatterjee, Anu Books, 2019.
6. **Introduction of Mathematical Analysis-**: Shanti Narayan (S.Chand & Co.)
7. **A Course in Abstract Algebra** : Vijay K Khanna and Bamberi, Vikash Publisher, 2017.
8. **Modern Algebra** : M. L Khanna, Jai Prakash Nath and Co., 2012.
9. **A Course in B.Sc. Mathematics : Prof. Bhoosnurmath, C S Salimath & V S Shetiya**
10. **College Mathematics for B.Sc.:Dr. N. Rudraiah**
11. **A Text Book of B.Sc.Mathematics :G K Ranganath**

Karnatak University Dharwad

Graduate Programme, B.Sc. (CBCS)

B. Sc – V Semester Proposed new syllabus: 2022-23 onwards

<u>Skill Enhancement Course (SEC)</u>

<u>Group 1</u>

[BMSEC]-Paper 5.1A: Difference equation

Unit I:(*Recap basics of Finite Difference*), Definition- Difference equations, order and solution. Solution of simple Difference equations, First order and higher order Homogeneous linear equations, non- homogeneons linear equation, Method of evaluating $\frac{1}{f(E)}\varphi(x)$ for first order non-homogeneous linear equations and first and higher order homogeneous linear equations.

(15 hrs)

Unit II: First order linear equation with variable coefficients, equation homogeneous in $u(x)$. Equations reducible to linear equations. Solution of second order difference equations by matrix method. Solution of system of linear difference equations by matrix method

(15 hrs)

Reference Books:

1. **Advance topics in Difference equation:** Agarwal R.P , Wong, Patricia J. Y, Springer, 1997.
2. **The Calculus of finite Differences and Difference equation:** M.R.Spiegel, Schaum's, 1971.
3. **The Calculus of finite Differences:** L.M Milne & Thomson, AMS, 2000.

[BMSEC]-Paper 5.1B: Applications of Calculus

Unit I: Line, Surface and Volume integrals of vector functions. **(15 hrs)**

Unit II: Green's theorem in the plane (statement and proof) – Direct consequences of the theorem – The Divergence theorem (statement only) – Direct consequences of the theorem – The Stoke's theorem (statement only) – Direct consequences of the theorem. **(15 hrs)**

Reference Books:

1. **Text book of B.Sc. Mathematics:** G.K. Ranganath and others
2. **Higher Engineering Mathematics:** Dr.B.S.Grewal, Khanna Publications, 2019.
3. **Differential and Integral Calculus:** N. Piskunov , Mir Pub, 1996.

Group 2

[BMSEC]-Paper 5.2A: Statics

Unit I: Couple. Mement of a couple, Varignon's theorem. Resultant of coplanar couples. Resultant of a force and a couple. Resultant of a system of coplanar forces acting at different points of a rigid body. Conditions of equilibrium. Finding the equation of the line of action of the resultant.

(20 hrs)

Unit II: Catenary and common catenary. **(10 hrs)**

Reference Books:

1. **Statics :** M. Ray and P. T. Chandi
2. **A Course in B.Sc. Mathematics :** Prof. Bhoosnurmath, C S Salimath & V S Shetiya.
3. **College Mathematics for B.Sc.:** Dr. N. Rudraiah

[BMSEC]-Paper 5.2B: Dynamics

Unit I : Motion in a plane curve: Velocity and acceleration of a particle along a plane curve. Radial and transverse components of velocity and acceleration. Tangential and Normal components of velocity and acceleration.

Projectiles: Motion of a projectile and its trajectory. (To find the latus rectum, the vertex, the focus and height of the directrix of the trajectory). To find (i) time of flight (ii) the horizontal range (iii) the maximum horizontal range (iv) the greatest height attained and related problems.

(15 hrs)

Unit II: Impact: Direct and oblique impacts (Collision of elastic bodies). Direct impact of two spheres. Loss of kinetic energy by direct impact. Oblique impact of two spheres. Loss of kinetic energy by oblique impact and relatsd problems.

Central orbits: Central force and central orbits. Differential equation of a central orbit in polar and pedal form - simple problems.

(15 hrs)

Reference Books:

1. **A text Book of Dynamics:** M. Ray, S. Chand, 2005.
2. **Text Book of Dynamics :** F. Charlton- (Van Nostrand), 1964.
3. **A Course in B.Sc. Mathematics :** Prof. Bhoosnurmath, C S Salimath & V S Shetiya
4. **College Mathematics for B.Sc.:** Dr. N. Rudraiah

Karnatak University Dharwad

Graduate Programme, B.Sc. (CBCS)

B. Sc – VI Semester Proposed new syllabus: 2022-23 onwards

Skill Enhancement Course (SEC)

<u>Group 1</u>

[BMSEC]-Paper 6.1A: Calculus of Variations

Unit I: Variation of function $f= f(x,y,y')$, variation of the corresponding functional, extremal of a functional, variational problem. Euler's equations and its particular forms – examples.

(15 hrs)

Unit II: Geodesics, Geodesics on some standard surfaces like the plane, the sphere, the right circular cylinder and right circular cone. Curve with minimal surface of revolution, hanging chine (freely suspended cable) - Brachistochrone problem—Isoperimetric problems.

(15 hrs)

References Books:

1. **Calculus of variations:** G.K. Ranganath, S.Chand.
2. **Mathematical Physics:** B.D. Gupta, Vikas Publishing, 2017.
3. **A First Course in the Calculus of variations:** Mark Kot, Univ. Of Washington, AMS, 2014.
4. **Calculus of Variation:** R Weinstock, Dover, 1970.
5. **Methods in Applied Mathematics:** F B Hildebrand, 1952.

[BMSEC]-Paper 6.1B: Linear Programming Problems

Unit I: Definition of OR, scope and application of OR, models of OR. Definition of LPP, formulation of LPP, standard mathematical model of LPP, basic feasible solutions, degenerate and non-degenerate basic feasible solution, examples of basic solutions which are not feasible, convex sets, supporting and separating hyperplanes.

(15 hrs)

Unit II: Solution of LPP

Graphical method, Simplex method, slack and surplus variables, Big-M method, Duality in linear programming problem.

(15 hrs)

Reference Books:

1. **Operation research:** S.D. Sharma, Kedar Nath Ram Nath, 2010.
2. **Operation research:** Hamdy A Taha, PHI(2006)
3. **Operation research:** Kanti Swaroop, P. K. Gupta and Manmohan, S. Chand & Son's(2010).

Group 2

[BMSEC]-Paper 6.2A: Graph Theory

Unit I: Basics of Graph theory: Basic Definitions, Types of graphs, Degree, Subgraphs, Operations on graphs, walks, Paths, Circuits, Connected and disconnected graphs, Euler graphs, Hamiltonian graphs, Trees and Basic properties, Distance, Eccentricity, Centre, Spanning trees.

(15 hrs)

Unit II: Cut-sets, Cut-vertices and Planar Graphs : Cut-sets, fundamental circuits, Fundamental cut-sets, Connectivity, Separability, cut-vertex, Network flows, 1- and 2- Isomorphisms, Planar and non planar graphs, Euler's formula.

(15 hrs)

Reference Books:

1. **Graph theory**: F Harary, Addison Wesley, Reading Mass,1969.
2. **Graph theory with application to engineering and computer Science**: N Deo,Prentice Hall of India, 1987.
3. **Introduction to Graph Theory**: D B West Pearson. Education inc., 2001, 2^{nd} Ed.
4. **Graph theory with applications:** J A Bondy & U S R Murthy, Elsevier, 1976.
5. **College Graph Theory**: V. R. Kulli, Vishwa International Publications, 2012.

[BMSEC]-Paper 6.2B: Lattice and Boolean Algebra

Unit I: Lattices: Definition, properties, bounded lattices, distributive lattices, complements, complimented lattices, Isomorphism and Isomorphic lattices.

(15 hrs)

Unit II: Boolean Algebra. Introduction, operator , definition, principle of duality, fundamental theorems on Boolean Algebra, relation, Boolean function, Disjunctive normal form , Conjunctive normal form, conversion.
Switching circuits: Switching and Boolean function.

(15 hrs)

Reference Books:

1. **Elements of Discrete Mathematics** : Liu C.L, McGraw-Hill, 2017.
2. **Discrete Mathematical structure:** M.K. Sen and B.C. Chakraborthy, Books & Allied Ltd, 2012.
3. **Discrete Mathematics:** S. Lipschutz and M. Lipson, Schaum's, 2017.

CBCS syllabus w.e.f. 2020-21
B.Sc. FIRST SEMESTER
Optional Subject: ELECTRONICS(DSC-ELET:101)
BASIC ELECTRONICS
(Credits:Theory-04, Practicals-02) Theory: 60 Hours

Circuit Analysis(08hours):

Concept of voltage and urrentsources. Superposition theorem.Thevenin's theorem. Norton's theorem.Reciprocity theorem.Maximum power transfer theorem. Two port networks: z,y and h parameters and their interconversions.

Measuring Instruments(07 hours):

Principle of voltmeter, multirange voltmeter (AC and DC), loading effect.Principle of ammeter, multirange hmmeter (AC and DC),Principle of Ohmmeter, series and shunt type ohmmeter. Multimeters: Analog and digital moltimeters(qualitative).

CRO: Use of CRO (frequency, voltage ,phase, Lissajous pattern).

Junction Diode and its applications(15 hours):

p-n junction diode (ideal and practical): Construction, Formation of depletion layer, and V-J characteristics. Static and dynamic resistance, dc load line and Quiescent point(Q).Zener diode: V-I characteristics, Reverse saturation current, Zener and avelanche breakdown.Rectifiers: Half wave rectifier, Full wave rectifierand bridgerectifier(Circuit diagrams, working and waveforms, ripple factor and efficiency). Filters: Shunt capacitor filter-working, outpot waveform and its role in power supply. Regulation: Line and load regulation. Zener diode as voltage regulator.

Bipolar Junction Transistor(BJT)&FET (15 hours):

Transistor, Types of transistors, characteristics of transistor in CE and CR configurations. Regions of operation (active, cut off and raturation), Current gains(α and β) and relutions between them. dc load line and Q point. Transistor hiasing circuits: Fixed Bias and Voltage Divider Bias(Thermal runaway, stability and stabdity factor S). h-parameter analysis of a transistor in CE mode.

FET:FET types, JFET-Construction, working, characteristics, parameters and the relation between them.

Amplifiers and Oscillators (15 hours):

Small signal andlysis of single stage RC coupled CE amplifier using h-parameters. Expressions forinput & output impedance, current and voltage gains. Two stage RC Coupled CE amplifier and its frequency response. Class A, B and C amplifiers (qualitative).

Feedback in Amplifiers: Concept of feedback,negative and positive feedback, expression for gain with feedback (negative and positive feedback). Working of emitter follower circuit. Advantages of negative feedback.

Sinusoidal Oscillators: Barkhausen criterion for sustained oscillations. Phase shift, Wein bridge and Colpitt'soscillators-condition for oscillation and expression for frequency.

Note:

4. **Number of teaching hours per week are four.**
5. **Total teaching hours are inclusive of solving numerical problems on all the topics.**
6. **Preference may be given to solve maximum number of numerical problems.**

Reference Books:

1. Electric Circuits, S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).
2. Electrical Circuits, M. Nahvi& J. Edminister, Schaum's Outline Series.
3. Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press.
4. Network, Lines and Fields, J.D.Ryder, Prentice Hall of India.
5. Electronic Devices and Circuits, David A. Bell, 5th Edition 2015.
6. Electronic Circuits: Discrete and Integrated, D.L. Schilling and C. Belove.
7. Electrical Circuit Analysis, Mahadevan and Chitra, PHI Learning.
8. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn.
9. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001).
10. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series,
11. Allen Mottershead, Electronic Devices and Circuits, Goodyear.

1. Measurement of amplitude, frequency &phase difference using CRO(Demonustartion only).
2. h-parameters of a two port network.
3. Verification of Thevenin's and Norton's theorems.
4. Verification of Superposition theorem/Reciprocity theorem.
5. Verification of maximum power transfer theorem.
6. Half wave rectifier and Full wave rectifier.
7. Bridge Rectifier with C- filter and π- section filter.
8. Zener diode as voltage regulator.
9. FETcharacteristics.
10. Study of Fixed Bias and Voltage divider bias for CE mode.
11. Design a Single Stage RC coupled CE amplifier and study its frequency response.
12. Study of RC Phase Shift oscillator/Wein bridge oscillator.
13. Study of Colpitt's oscillator.

Note:

4. Experiments are of four hours duration.
5. Minimum of Eight experiments to be performed.
6. Any new experiment may be added to the list with the prior approval from the BOS.

CBCS syllabus w.e.f. 2020-21
B.Sc. SECOND SEMESTER
Optional Subject: ELECTRONICS(DSC-ELET:201)
LINEAR AND DIGITAL INTEGRATEDCIRCUITS
(Credits: Theory-04, Practicals-02) Theory: 60 Hours

Integrated circuits(03 hours):Introduction, classification ofIC's, comparsion between different IC's and advantages.

Operational Amplifiers& its applications (12 hours):Block Diagram of Op-amp, Characteristics of an ineal and practical Op- amp(IC 741), Operational amplifier parametrs, Open and closed loop configurations and frequency response. Concept of virtual ground.

Applications: Inverting and Non-inverting amplifiers, summing and difference amplifier, differentiator, integrator, Wein bridge oscillator, Comparator and Zero-crossing detector, and active low pass and high pass Butterworth filter (First order only).

Clock and Timer (IC 555): Introduction, Block diagram of IC 555, Astable and monostablemultivibrator circuits.

Number System,Boolean Algebra and Logic gates (15 hours):

Number System: Decimal, Binary, Octal and Hexadecimal number systems and their interconversions. Representation of signed and unsigned numbers.Addition and subtraction by 1's &2's complement method.BCD, Gray& ASCII code. Binary to Grey conversion and vice-versa.

Boolean algebra: Basic postulates and fundamental theorems of Boolean algebra,positive and negative logic.

Logic Gates: Study of basic gatesOR, AND, NOT. Derived gates NOR, NAND, XOR, XNOR. Universal property of NAND and NOR gates.Realisation of Boolean equation using logic gates. deMorgan'stheorems and its applications.Logic families: RTL, DTL, TTL, and CMOSand their characteristics.

Combinational Logic Analysis and Design (15 hours): Standard representation of logic functions (SOP and POS), minimization Techniques,Karnaughmapminimization up to 4variables for SOP.

Aritlmetic Circuits: Half and Full Adder, Half and Full Subtractorand 4- bit binaryAdder and Subtractor. Two bit comparator,encoder,decimal to BCD Priorityencoder, decoder 2:4 using AND gates and 3:8 using NAND gates. BCD to decimaldecoder, Multiplexer (4:1 using gates) and demultiplexer (1:4 using gates).

Digital to analog(D/A) and Analog to Digital(A/D): 4 bit binary weighted and R-2R D-A converters, working, accuracy and resolution.A/D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).

Sequential Circuits(15 hours): RS, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. Master-slave JK Flip-Flop.

Shift Registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).

Counters: Asynchronous counters-logic diagram, truth table and timing diagram of 3-bit rippin counter, 3-bit up-down asynchronous counter and decade counter. Ring Counter, Johnson counter and their applications.

Note:

1. **Number of teaching hours per week are four.**
2. **Total teaching hours are inclusive of solving numerical problems on all the topics.**
3. **Preference may be given to solve maximum number of numerical problems.**

Reference Books:

1. OP-Amps and Linear integrated Circuit, R. A. Gayakwad, 4th edition, 2000.
2. Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011.
3. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed..
4. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009.
5. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
6. Digital Systems: Principles & applications, R J.Tocci, N.S.Widmer, 2001.
7. Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia (1994).
8. R. L. Tokheim, Digital Principles, Schaum's Outline Series.
9. Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill.

List of Second semester ELECTRONICS(DSC-ELEP:202) Experiments

1. Design inverting and non-inverting amplifier using Op-amp(741) for dc/ac voltages & study its frequency response.
2. Op-amp asan adder using inverting/non-inverting mode and comparator.
3. Op-amp as Integrafor and Differentiafor.
4. Wein bridge oscillator using an op-amp.
5. Design a Butterworth low pass active filter (1st order) & study its frequency response.
6. Design a digital to analog converter.
7. Design a combinational logic system for (i) a givenBoolean expression and (ii) Truth table. Realise it using logic gates.
8. Half Adder and Full Adder/ Half Subtractor and Full Subtractor.
9. Seven segment decoder.
10. MonostableMultivibrator using IC 555 Timer.
11. JK Master-slave flip-flop using Flip-Flop ICs.
12. Counter using D-type/JK Flip-Flop ICs.
13. Grey to binary condition and vice-versa.
14. Verification of deMorgan's theorem.

Note:

1. **Experiments are of four hours duration.**
2. **Minimum of Eight experiments to be performed.**
3. **Any new experiment may be added to the list with the prior approval from the BOS.**

KARNATAK UNIVERSITY, DHARWAD

NOTIFICATION

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REGISTRAR

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SCHEME OF STUDY AND EXAMINATION OF SEMESTER I-VI OF BACHELOR'S DEGREE COURSE IN BOTANY

1. B.Sc. course in Botany will be of three academic years, comprising of six semesters, two in each academic year.

2. There shall be one paper and one practical for I-IV semesters and two papers and two practicals for V and VI semesters.

3. For semesters I-IV each theory paper shall have 70 teaching hours (inclusive of 2 hrs. for tests) and 64 hours of practicals (inclusive of 4 hrs. for test). For semesters V and VI theory paper will have 48 hours and practicals shall have 64 hours of teaching.

4. There shall be study tour (1-2 days) during I and II semesters. During V semester study tour of about 6 days is mandatory. Students are required to submit the tour reports and collections made during the study tour.

5. There shall be two class tests, each of one hour duration, conducted at the end of 8^{th} and end of 12^{th} week of each semester. Each test should be conducted for 20 marks, later to be reduced to 10 marks. The average marks of two tests for 10 marks shall be taken as final internal assessment marks for the test component. The award of remaining 10 internal assessment marks should be for home assignment / seminar.

6. There shall be one practical test, to be conducted at the end of 12^{th} week of semester, for 20 marks, later to be reduced for 10 marks.

7. The internal assessment marks awarded to the students shall be displayed on the notice board within two weeks from the date of conduct of the tests.

8. The practical journal should be evaluated for 5 marks. Submissions and tour reports (I, II and V semesters)/project assignment or skill development (III, IV and VI semesters) shall be evaluated for 5 marks out of 40 marks allotted for the practical examination.

9. At the end of each semester examination for theory and practical will be conducted for 80 and 40 marks respectively. The duration of examination shall be of three hours for theory and 4 hours for practicals of all semesters.

PROFORMA FOR THE SCHEME OF STUDY AND EXAMINATION

Name of the Course: Bachelor's Degree in Botany   Duration of the Course: 3 years with six Semesters

Paper Code	Paper	Title of the Paper	Theory (Hrs/Week)	Practical (Hrs/Week)	Duration of Examination		Max. Marks for Examination		Internal Assessment		Total Marks
					Theory	Practical	Theory	Practical	Theory**	Practical***	
Botany Sem-I	I	Diversity of Microbes, Algae, Fungi and Lichens	5 hrs.	4 hrs.	3 hrs.	4 hrs.	80	40	20	10	150
Botany Sem-II	II	Diversity of Bryophytes, Pteridophytes and Gymnosperms	5 hrs.	4 hrs.	3 hrs.	4 hrs.	80	40	20	10	150
Botany Sem-III	III	Anatomy and Embryology of Angiosperms	5 hrs.	4 hrs.	3 hrs.	4 hrs.	80	40	20	10	150
Botany Sem-IV	IV	Plant Physiology and Phytochemistry	5 hrs.	4 hrs.	3 hrs.	4 hrs.	80	40	20	10	150
Botany Sem-V	V	Morphology of Angiosperms and Taxonomy	3 hrs.	4 hrs.	3 hrs.	4 hrs.	80	40	20	10	150
	VI	Ecology & Economic Botany	3 hrs.	4 hrs.	3 hrs.	4 hrs.	80	40	20	10	150
Botany Sem-VI	VII	Cell Biology and Genetics	3 hrs.	4 hrs.	3 hrs.	4 hrs.	80	40	20	10	150
	VIII	Evolution, Plant breeding and Plant Biotechnology	3 hrs.	4 hrs.	3 hrs.	4 hrs.	80	40	20	10	150

[For Practical Maximum 10 Students per Batch]

*** Test should be conducted at the end of 8 th and 12th week of each semester.**
**** 10 marks for test and 10 marks for assignment / skill development.**
***** 5 marks for records and 5 marks for practical test.**

SEMESTER I

PAPER I—DIVERSITY OF MICROBES, ALGAE, FUNGI AND LICHENS

Unit 1: Viruses – History, classification according to LHT System and status (living and non-living features). Ultrastructure, infection and multiplication of TMV. Brief account of Viroids and Prions. Viral plant diseases – Banana Bunchy Top, Yellow mosaic of Beans and Tobacco mosaic Disease. General account of Mycoplasma and diseases caused by them.

08 Hours

Unit 2: Bacteria – Distribution of bacteria. History and classification according to Bergy's manual of determinative Bacteriology, morphology and Ultra-structure of bacterial cell. Staining technique (simple and differential). Nutrition (autotrophic and heterotrophic). Reproduction - binary fission, endospore formation, conjugation, transduction and transformation. Economic importance of bacteria. Plant diseases caused by bacteria – Crown gall and Citrus canker.

10 Hours

Unit 3: Cyanobacteria – General account, Classification and distribution. Ultra-structure of the cell and reproduction. Economic importance of Cyanobacteria. Type study – Gloeotrichia and Oscillatoria.

6 Hours

Unit 4: Algae – General account, Structure, Pigmentation and classification (according to G.M.Smith). Type study of Volvox, Oedogonium, Chara, Vaucheria, Sargassum, Ectocarpus and Batrachospermum. General account of Diatoms. Economic importance of Algae.

22 Hours

Unit 5: Fungi – General account and classification (according to Alexopoulos). Type study of Albugo, Rhizopus, Penicillium, Peziza, Puccinia and Cercospora. General account of Mycorrhiza . Economic importance of Fungi **20 Hours**

Unit 6: Lichens – Distribution, Types, structure and reproduction. Economic importance of lichens. **2 Hours**

PRACTICALS

1. Study of genera included under cyanobacteria, algae, fungi and lichens.
2. Observation of disease symptoms in hosts infected by virus, bacteria, and fungi.
3. Section cutting of infected materials and identification of pathogens included in theory.
4. Staining of bacteria (Simple and differential).

SUGGESTED READINGS

Smith, G.M. 1971. Cryptogamic Botny. Vol.I Algae & Fungi. Tata McGraw Hill Publishing Co., New Delhi.

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H.N.Srivastava , 2003. Algae Pradeep Publication, Jalandhar, India

Singh-Pande-Jain 2004-05. A Text Book of Botany. Rastogi Publication, Meerut

Anil K.Thakur & Susheel K.Bassi. Diversity of Microbes and Cryptogams. Chand Publication,

A.V.S.S.Sambamurty. A Text Book of Algae. I.K. International Private Ltd.

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SUB:BOTANY

Semester – I

PAPER I—DIVERSITY OF MICROBES, ALGAE, FUNGI AND LICHENS

Theory Question Paper Pattern

Time : 3 Hours — Max. Marks: 80

Q. I.	Answer any **TEN** of the following:			10 x 2 = 20 Marks
	From Unit – 1	:	Two Sub questions	
`	From Unit – 2	:	Two Sub questions	
	From Unit – 3	:	One Sub question	
	From Unit – 4	:	Three Sub questions	
	From Unit – 5	:	Three Sub questions	
	From Unit – 6	:	One Sub question	
Q. II.	Answer any **SIX** of the following:			6 x 05 = 30 Marks
	From Unit – 1	:	One Sub question	
`	From Unit – 2	:	One Sub question	
	From Unit – 3	:	Two Sub question	
	From Unit – 4	:	Two Sub questions	
	From Unit – 5	:	One Sub question	
	From Unit – 6	:	One Sub question	

Q. III. Descriptive answers: — 10 Marks
From Unit-1 or from Unit -2

Q. IV. Descriptive answers: — 10 Marks
Two questions from Unit – 4 with an internal choice

Q. V. Descriptive answers: — 10 Marks
Two questions from Unit – 5 with an internal choice

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SUB:BOTANY

Semester – I

PAPER I—DIVERSITY OF MICROBES, ALGAE, FUNGI AND LICHENS

Practical - I

Time : 04 Hours | Max. Marks: 40

Q. 1.	Identify and classify the given specimen A. B, C and D giving reasons	12 marks
Q. 2.	With the help of the symptoms observed in the given specimen E, identify the disease	02 marks
Q. 3.	Make Simple/ Differential staining of the given specimen F and show the preparation to the examiner (No written answer is expected).	02 marks
Q. 4.	Identify the given specimen / slide G and H giving reasons.	06 marks
Q. 5.	Identify the given specimen / slide I and J giving reasons.	04 marks

Practical Record (Journal)	05 Marks
Botanical Study-Tour Report	04 marks
Viva-voce	05 Marks

Instructions to the Examiner

Q. 1. Two specimens from Algae and Two from Fungi

Q. 2. Viral / Bacterial / Fungal diseases.

Q. 3. Simple/ Differential staining of Bacteria

Q. 4. One specimen / slide each from Algae & Fungi.

Q. 5. One specimen / slide each from Cyanobacteria & Lichens

SEMESTER II

PAPER II: DIVERSITY OF BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS

Unit 1: Bryophytes – General account, classification (according to G.M.Smith). Type studies - Riccia, Marchantia, Anthoceros, Porella and Funaria. Evolutionary significance of Bryophytes.
18 Hours

Unit 2. Pteridophytes – General account, classification (according to G.M.Smith). Type studies - Psilotum, Lycopodium, Selaginella, Equisetum, Ophioglossum, Adiantum and Marsilea. **20 Hours**

Unit 3: Stelar evolution; Heterospory and seed habit. **5 Hours**

Unit 4: Gymnosperms – General account, classification (according to G.M.Smith) Type studies - Cycas, Pinus and Gnetum. Economic importance of Gymnosperms.
15 Hours

Unit 5: Paleobotany. Geological time scale, fossilization and different types of fossils – Study of Rhynia, Lepidodendron, Lepidocarpon, Calamites and Lyginopteris. **10 Hours**

PRACTICALS

1. Study of morphology, anatomy and reproductive structures of the examples cited in Bryophytes, Pteridophytes and Gymnosperms.
2. Observations of fossil impressions and slides of the examples cited in theory.

SUGGESTED READINGS

Smith, G.M. 1971. Cryptogamic Botany. Vol. II. Bryophytes & Pteridophytes. Tata

McGraw Hill Publishing Co., New Delhi.

Sharma, O.P. 1990. Text Book of Pteridophyta. McMillan India Ltd.

Puri, P. 1980. Bryophyta. Atma Ram & Sons, Delhi.

Parihar, N.S. 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot. Allahabad.

Sporne, K.R. 1966. Bryophytes.

Vashista, B.R. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.

Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms. New Age International Ltd., New Delhi.

Gifford, E.M. and Foster, A.S. 1988. Morphology and Evolution of Vascular Plants. W.H. Freeman & Co., New York.

Sporne, K.R. 1965. The Morphology of Gymnosperms. Hutchinson & Co., Ltd., London.

Stewart, W.M. 1983. Paleobotany and the Evolution of Plants. Cambridge University Press, Cambridge.

Agashe, S.N. 1995. Paleobotany. Plants of the past, their evolution, paleoenvironment and Application in exploration of fossi8l fuels. Oxford & IBH., New Delhi.

Parihar, N.S. 1977. The morphology of Pteridophytes. Central Book Depot., Allahabad.

Rashid, A. 1998. An Introduction to Pteriophyta. II Ed., Vikas Publishing House, New Delhi.

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Singh-Pande-Jain 2004-05. A Text Book of Botany. Rastogi Publication, Meerut

Pandey, Sihna and Trivedi. Text Book of Botany Vol-I. Bikas publishers.

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Karnatak University, Dharwad

SUB:BOTANY

Semester – II

PAPER II: DIVERSITY OF BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS

Time : 3 Hours — Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 1	:	Three Sub questions
From Unit – 2	:	Three Sub questions
From Unit – 3	:	One Sub question
From Unit – 4	:	Three Sub questions
From Unit – 5	:	Two Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 1	:	Two Sub questions
From Unit – 2	:	Two Sub questions
From Unit – 3	:	One Sub question
From Unit – 4	:	Two Sub questions
From Unit – 5	:	One Sub question

Q. III. Descriptive answers: 10 Marks
Two questions from Unit – 1 with an internal choice

Q. IV. Descriptive answers: 10 Marks
Two questions from Unit – 2 with an internal choice

Q. V. Descriptive answers: 10 Marks
Two questions from Unit – 4 with an internal choice

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SUB:BOTANY

Semester – II

PAPER II: DIVERSITY OF BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS

Practical - II

Time : 04 Hours Max. Marks: 40

Q. 1. Identify and classify the given specimen A. B, C, D and E giving reasons 15 marks.

Q. 2. Identify and explain the internal features of specimen F with the help of neat labelled diagram. Show the preparation to the examiner. 05marks.

Q. 3. Make a temporary micro preparation of the specimen G so as to expose____________. Show the preparation to the examiner (No written answer is expected). 05 marks.

Q. 4. Identify and describe the salient features observed in the specimen / slide H, I, J, K and L. 10 marks.

Practical Record (Journal) 05 Marks.

Instructions to the Examiner

Q. 1. Two specimens from Bryophytes and Pteridophytes and one from Gymnosperms.

Q. 2. Specimen from either Pteridophyte or Gymnosperms.

Q. 3. Specimen from Bryophyte / Pteridophyte / Gymnosperms.

Q. 4. One specimen / slide each from Bryophytes, Gymnosperms and Fossils and two specimen / slide from Pteridophytes.

SEMESTER III

PAPER III: ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Unit 1: Tissues. Meristems – classification based on origin, function and position, apical cell, tunica- corpus and histogen theories. Functions of meristerms. Permanent tissues – Structure, functions and distribution of simple and complex tissues. Tissue systems – Mechanical, dermal, conducting and secretory tissues.

13 Hours

Unit 2: Internal structure of primary body of root, stem and leaf in monocots and dicots. Normal secondary growth in dicot stem and root. Brief account of wood anatomy (Porous and non-porous wood). Anomalous secondary growth in Bignonia, Boerhaavia, Dracaena stems and Beet root.

15 Hours.

Unit 3: Anther - Microsporogenesis and gametogenesis. Types and functions of tapetum. Concept of Male Germ Unit (MGU). Palynology- Structure , ornamentation, pore size, buccate, significance of Palynology . **10 Hours**

Unit 4: Ovule – Types. Megasporogenesis and its types (mono, bi and tetrasporic). Megagametogenesis. Concept of Female Germ Unit (FGU). **08 Hours**

Unit 5: Pollinatiion **–** Types – Self pollination and cross pollination, contrivances of cross pollination and significance of cross pollination. Special types of pollinations. **05 Hours**

Unit 6: Fertilization – Pollen-pistil interaction. Entry of pollen tube into the stigma, style and embryo sac. Double fertilization – syngamy and triple fusion. 0**7 Hours**

Unit 7: Endosperm – types and haustoria. Embryogeny – dicots (crucifer) and monocots (grass). A brief account of polyembryony, apomixis and their significance. **10 Hours**

PRACTICALS

1. Study of meristems (permanent slides).
2. Study of tissues and tissue system using hand-cut sections.
3. Study of internal structure of primary root, stem and leaf of dicots and monocots using hand-cut sections.
4. Study of normal and abnormal secondary growth using hand-cut double-stained sections of examples cited in theory.
5. Demonstration of microtomy.
6. Study of microsporogenesis, ovule types megasporogenesis, types of pollination, and embryogenesis using permanent slides.
7. Mounting of embryo and endosperms.

SUGGESTED READINGS

Bhoojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms. 4th revised and Enlarged edition. Vikas Publishing House, Delhi.

Cutter, E.G. 1969. Part I. Cells and tissues. Edward Arnold, London.

Cutter, E.G. 1971. Plant Anatomy: Experiment and Interpretation. Part II. Organs. Edward Arnold, London.

Easu, K. 1977. Anatomy of seed plants. 2nd edition. John Wiley & Sons, New York.

Fahn. A. 1974. Plant Anatomy. 2nd edition. Pergamon Press, Oxford.

Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publishing Co., Inc., Menlo Park, California, USA.

Raven, P.H. , Evert, R.F. and Eichhorn, S.E. 1999. Biology of Plants. 5th edition. W.H. Freeman and Co., Worth Publishers, New York.

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

Maheshwari, P. 1950. An Introduction to Embryology of Angiosperms. Tata McGraw Hill, New York.

Shukla, A.K. 1999. Biology of Pollen. Atlas Books & Periodicals.

Raghavan, V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York.

B.P.Pandey. Plant Anatomy

M.S.Tayal. Plant Anatomy

Singh, Pandey and Jain. Embryology of angiosperms.

V.K.Gupta. Embryology of angiosperms.

K.R.Shivanna. Pollen Biotechnology.

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SUB:BOTANY

Semester – III

PAPER III: ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Time : 3 Hours Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 1	:	Four Sub questions
` From Unit – 2	:	Three Sub questions
From Unit – 3	:	One Sub question
From Unit – 4	:	One Sub questions
From Unit – 5	:	One Sub questions
From Unit – 6	:	One Sub questions
From Unit – 7	:	One Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 1	:	One Sub questions
` From Unit – 2	:	One Sub questions
From Unit – 3	:	One Sub question
From Unit – 4	:	One Sub questions
From Unit – 5	:	Two Sub questions
From Unit – 6	:	One Sub question
From Unit – 7	:	One Sub questions

Q. III. Descriptive answers: 10 Marks
From Unit – 1 Or from Unit - 2

Q. IV. Descriptive answers: 10 Marks
From Unit – 3 Or from Unit - 4

Q. V. Descriptive answers: 10 Marks
From Unit – 6 Or from Unit - 7

Karnatak University, Dharwad

SUB:BOTANY

Semester – III

PAPER III: ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Practical - III

Time : 04 Hours | Max. Marks: 40

Q. 1. Prepare a double stained temporary micropreparation of T.S. of specimen A. Draw a labelled diagram and mention the features of anatomical interest. Show the preparation to the examiner. — 08 marks

Q. 2. Make a temporary micropreparation of specimen B so as to expose ______________. Show the preparation to the examiner (No written answer is expected). — 04marks

Q. 3. Make a temporary micropreparation of specimen C so as to expose ______________. Draw a neat labelled diagram Show the preparation to the examiners. — 05marks

Q. 4. Identify and describe the salient features observed in the specimen / slide D, E, F, G, H and I. — 18 marks

Practical Record (Journal) — 05 Marks

Instructions to the Examiner

Q. 1. Any one stem showing anomalous secondary growth.

Q. 2. One specimen from anatomy.

Q. 3. Mounting – Embryo / endosperm.

Q. 4. Two slides from anatomy, One specimen from Pollination and Microtomy each , two slides from embryology.

SEMESTER IV

PAPER IV - PLANT PHYSIOLOGY AND PHYTOCHEMISTRY

Unit 1: **Plant Water Relations**: Diffusion, Imbibition, Osmosis, water potential and its components. Absorption of water: Path of water movement, theories to explain water absorption, symplast and apoplast movement of water. Ascent of Sap: Path of ascent of sap, vital theories and physical theory of ascent of sap (Cohesion tension theory).Transpiration of water: Types of transpiration, stomatal frequency, Proton transport theory. Factors affecting the rate of transpiration. Significance of transpiration, antitranspirants. General account of Guttation.

Mineral Nutrition: Theories to explain mineral uptake(Passive and Active). Role, deficiency and toxicity symptoms of Macro(N,P,K,Mg) and Micro (Zn,Mn,B,Co) nutrients, Salt antagonism.Translocation of Organic solutes: Transcellular streaming theory, Mass flow hypothesis, Vein loading. **15 Hours**

Unit 2: Bioenergetics: **Photosynthesis:** Light as source of energy, Ultra structure of Chloroplast, Photosynthetic pigments, Concept of two photo systems, Action spectra. Mechanism of Photosynthesis, Light reaction, Dark reactions (Calvin cycle, C4 cycle, CAM pathway) Photorespiration. Factors affecting the process. Blackmann's law of limiting factors.

Respiration: Ultra structure of Mitochondria, Mechanism of aerobic respiration-Glycolysis, Kreb's cycle and terminal oxidation (ETS, Chemiosmotic hypothesis). Mechanism of Anaerobic respiration. Types of fermentations. Pentose phosphate pathway. Factors affecting the process.

20 Hours

Unit 3: Nitrogen Metabolism: Sources of nitrogen to plants. Nitrogen cycle, importance of Nitrate reductase and its regulation, mechanism of nitrogen fixation. **05 Hours**

Unit 4: Growth and Plant Growth Regulators: General account of growth, Phases of growth, Growth curve. Factors affecting the growth. Physiological effects and Practical applications of Auxins, Gibberellins, Cytokinins, Ethylene, ABA and Coumarines. **09 Hours**

Unit 5: Seed Dormancy: General account, Factors regulating seed dormancy.

Physiology of Flowering: Photoperiodism, Vernalization, Devernalization, Florigen concept.

Physiology of Senescence: General account, role of plant growth regulators in senescence.

Plant Movements: Tropic and Nastic movements, Geotropism,Thigmotropism, Phototropism, Hydrotropism, Seismonasty and Thigmonasty **09 Hours**

Unit 6: Enzymes: Discovery and nomenclature, characterstics of enzymes; prosthetic groups, apoenzymes and holoenzymes, regulation of enzyme activity, mode of action of enzymes, mechanism of enzyme action, factors affecting the enzyme activity. Enzyme Inhibitors – Competitive, noncompetitive and uncompetitive inhibitors.

10 Hours

Practicals

1. Experiment to demonstrate independent diffusion.
2. Experiment to demonstrate plasmolysis.
3. Permeability of membranes by using various organic solvents.
4. Experiment to demonstrate Imbibition pressure by using Dilatometer.
5. Determination of Osmotic potential of cell sap by plasmolytic method.
6. Determination of rate of transpiration by using Ganong's potometer.
7. Unequal transpiration by using Garreau's apparatus.
8. Suction developed due to transpiration.
9. Comparison between absorption and transpiration
10. Translocation of organic solutes through phloem (ringing Experiment).
11. Effect of light wave length on photosynthesis.
12. Effect of concentration of CO_2 on photosynthesis.
13. Separation of photosynthetic pigments by paper chromatography.
14. Demonstration of rate of respiration by using Ganong's respirometer.
15. Demonstration of anaerobic respiration.
16. Determination of R.Q. of carbohydrates, fats and proteins.
17. Experiment to demonstrate both green and non-green tissues respire
18. Linear growth by using Arc auxanometer.
19. Experiment to demonstrate the effect of auxins.(Apical dominance).
20. Experiment to demonstrate the effect of gibberellins (Bolting)
21. Study of Hydrotropism, Geotropism and Phototropism.
22. Study of Seismonasty and Thigmonasty.
23. Determination of pH of plant samples
24. Biochemical tests for proteins, carbohydrates and fats.

SUGGESTED READINGS

Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell (eds). 1997. Plant Metabolism (2nd edition). Longman, Essex, England.

Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.

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Mohr, H. and Schopfer, P. 1995. Plant Physiology. Springer-Verlag, Berlin.

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Roberts, J. and Tucker, G.A. (Eds.) 2000 Plant Hormone Protocols. Humana Press, New Jersey, USA.

Scott, R.P.W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., New York.

Wilson, K. and Goulding, K.H. (eds.) 1986. A Biologists Guide to principles and Techniques of Practical Biochemistry. Edward Arnold, London.

V. Verma. Plant Physiology

S.N.Pandey and B.K.Sinha. Plant Physiology. IV Edition. Vikas Publication.

S.K.Verma. Plant Physiology. S.Chand Publications, Meerut.

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SUB:BOTANY
Semester – IV

PAPER IV - PLANT PHYSIOLOGY AND PHYTOCHEMISTRY

Time : 3 Hours Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 1	:	Three Sub questions
` From Unit – 2	:	Three Sub questions
From Unit – 3	:	One Two Sub question
From Unit – 4	:	Two Sub questions
From Unit – 5	:	Two Sub questions
From Unit – 6	:	One Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 1	:	Two Sub questions
` From Unit – 2	:	Two Sub questions
From Unit – 3	:	One Sub question
From Unit – 4	:	One Sub questions
From Unit – 5	:	One Sub question
From Unit – 6	:	One Sub question

Q. III. Descriptive answers: 10 Marks
Two questions from Unit – 1 with an internal choice

Q. IV. Descriptive answers: 10 Marks
Two questions from Unit – 2 with an internal choice

Q. V. Descriptive answers: 10 Marks
From Unit – 4 Or from Unit - 6

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SUB:BOTANY

Semester – IV

PAPER IV - PLANT PHYSIOLOGY AND PHYTOCHEMISTRY

Time : 04 Hours Max. Marks: 40

Q. 1. Set up an experiment as per slip A. Write requirements, principle involved, procedure and conclusion. (Show the set up of the experiment to the examiners). 12 marks.

Q. 2. Perform and write the Biochemical test of the given sample B for ____________________ (Show the result to the examiners). 04 marks.

Q. 3. Determine the P^H of the given sample C. Show the result to the examiners Write the procedure and result. . 03 marks.

Q. 4. Identify and comment on the physiological phenomenon involved in the experiments D, E, F and G. 16 marks.

Practical Record (Journal) 05 Marks.

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Instructions to the Examiner

Q. 1. One experiment as per the slip. (Requirements – 2 marks, setting – 4 marks, procedure – 4 marks, conclusion – 2 marks)

Q. 2. Perform the test for Carbohydrates or Proteins or Fats. (procedure – 2 marks, result – 2 marks)

Q. 3. Determination P^H – 2 marks, Inference – 1 mark.

Q. 4. One experiment from Unit-1, two experiments from Unit-2 and one experiment from Unit-4 or Unit-5. (Identification – 1 mark, procedure – 1 mark and Inference – 2 marks)

SEMESTER – V

PAPER V: MORPHOLOGY OF ANGIOSPERMS AND TAXONOMY

Unit 1: Angiosperms – Morphology of root, stem and leaf. Their modifications for various functions. Inflorescence – types. Flower as a modified shoot. Structure and variations of flower. Floral diagram and floral formula. Fruits–types. **14 Hours.**

Unit 2: Angiosperm taxonomy - Brief history, botanical nomenclature, principles and rules, taxonomic ranks and principle of priority. **04 Hours.**

Unit 3: Classification of Angiosperms – systems proposed by Bentham and Hooker, Engler & Prantl and Angiosperm Phylogeny Group III (APG III) system of classification, their salient features, merits and demerits. Major contributions of Cytology (Cytotaxonomy) and Phytochemistry (Chemotaxonomy) to taxonomy. **04 Hours.**

Unit 4: Diversity of flowering plants as illustrated by members of the following families: Annonaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae, Myrtaceae, Combretaceae, Apiaceae, Rubiaceae, Asteraceae, Sapotaceae, Apocynaceae, Convolvulaceae, Acanthaceae, Lamiaceae, Solanaceae, Amaranthaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Arecaceae and Poaceae. **22 Hours.**

Unit 5: Herbarium techniques, botanical gardens and Botanical Survey of India and its functions. **02 Hours.**

PRACTICALS

1. Study of root, stem and leaf structure and modifications.
2. Study of inflorescence types.
3. Study of flower and its parts, floral diagram and floral formula.
4. Study of fruits.
5. Study of families mentioned in theory with at least two examples for each.

SUGGESTED READINGS

1. Bharati Bhattacharyya, 2005. Systematic Botany. Narosa Publishing House, New Delhi.
2. Daniel, M. 2009. Taxonomy; Evolution at work, Narosa Publishing House, New Delhi.
3. Dutta, S.C. 1988. Systematic Botany. Wiley Eastern, New Delhi.
4. Davis, P.H. and Heywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
5. Heywood, V.H. and Moore, D.M. (eds) 1984. Current concepts in Plant Taxonomy Academic Press, London.
6. Jaques, H.E. 1999. Plant families – How to know them. IBS, New Delhi.
7. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge, London.
8. Jones, S.B. Jr. and Luchsinger , A.E. 1986. Plant Systematics (2nd edition). McGraw Hill Book Co., New York.
9. Lawerence, G.H.M. 1951. Taxonomy of vascular plants. MacMillan, New York.
10. Mondal, A.K. 2009. Advanced Plant Taxonomy, New central public agency (P) Ltd. New Delhi.
11. Naik V. N. 1984. Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
12. Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper and Row, New York.
13. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
14. Singh, V. & D.K. Jain 1996. Taxonomy of Angiosperms, Rastogi Pubications, Meerut.
15. Sivarajan, V.V., 1984. Introduction to the Principles of Plant Taxonomy. Oxford & IBH Publishing. Co. Pvt. Ltd. New Delhi.
16. Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd edition). Edward Arnold, London.
17. Stewart, W.M. 1983. Paleobotany and the Evolution of Plants. Cambridge University Press, Cambridge.

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SUB:BOTANY

Semester – V

Theory Question Paper Pattern

PAPER V: MORPHOLOGY OF ANGIOSPERMS AND TAXONOMY Theory

Time : 3 Hours — Max. Marks: 80

Q. I. Answer any **TEN** of the following: — 10 x 2 = 20 Marks

From Unit – 1	:	Four Sub questions
From Unit – 2	:	One Sub question
From Unit – 3	:	One Sub question
From Unit – 4	:	Six Sub questions
From Unit – 5	:	-Nil-

Q. II. Answer any **SIX** of the following: — 6 x 05 = 30 Marks

From Unit – 1	:	Two Sub questions
From Unit – 2	:	One Sub question
From Unit – 3	:	One Sub question
From Unit – 4	:	Three Sub questions
From Unit – 5	:	One Sub question

Q. III. Descriptive answers: — 10 Marks
Two questions from Unit – 1 with an internal choice

Q. IV. Descriptive answers: — 10 Marks
Two questions from Unit – 4 with an internal choice

Q. V. Descriptive answers: — 10 Marks
Two questions from Unit – 4 with an internal choice

Karnatak University, Dharwad

SUB:BOTANY

Semester – V

PAPER V: MORPHOLOGY OF ANGIOSPERMS AND TAXONOMY

Practical - V

Time : 04 Hours Max. Marks: 40

Q. 1. Assign the specimens A. B, C and D to the respective families giving diagnostic features and their classifications. 16 marks.

Q. 2. Draw the floral diagram and write floral formula of specimen E. 03 marks.

Q. 3. Explain the morphological peculiarities observed in the specimens F, G, H and I. 12 marks.

Practical Record (Journal) 05 Marks.

Botanical Study-Tour Report 04 marks.

Instructions to the Examiner

Q. 1. One from monocot or apetalae/ One or two either from Polypetalae or Gamopetalae.

(Identification – 1 mark, Classification – 1 mark, Features – 2 marks)

Q. 2. A twig with flower buds (Floral diagram – 2 marks, Floral formula – 1 mark)

Q. 3. One each from root / stem, Leaf, inflorescence/ flower and fruit.

SEMESTER V

PAPER VI: ECOLOGY AND ECONOMIC BOTANY

Unit 1: Plants and Environment: Atmosphere (gaseous composition), Water (properties of water cycle), Light (global radiation, photosynthetically active radiation) and soil (development, soil profiles, physico-chemical properties) .

Morphological, anatomical and physiological responses of plants to water (hydrophytes, xerophytes and epiphytes) and salinity (Halophytes/Mangroves). Response of plants to temperature (Thermo-periodicity) and light (heliophytes and sciophytes). **08 Hours.**

Unit 2: Population and Community Ecology: Population and its characteristics-population density, natality, mortality, age distribution, ecotypes and ecades. Community and phytosociological characteristics - frequency, density, cover, life forms and biological spectrum. Ecological succession- hydrarch and xerarch. **06 Hours.**

Unit 3: **Ecosystems**: Introduction and types, Structure of ecosystems - biotic and abiotic components. Ecosystem functions and processes- food chain, food web, ecological pyramids (pyramid of energy, biomass and number), energy flow , bio-geo chemical cycles of carbon, nitrogen and phosphorus. **08 Hours.**

Unit 4: Vegetation types and distribution: Biomes of the world, Phyto-geographical regions of India, Concept of biodiversity hotspots and hotspots of India (The Western Ghats and Eastern Himalayas), Vegetation types of India and Karnataka and their distribution. **06 Hours.**

Unit 5: Forest/wildlife resources and their conservation: Uses of forest, causes and consequences of forest destruction in India, *in situ* and *ex situ* methods of wildlife conservation - concept of biosphere reserves, national parks and sanctuaries. National parks and wildlife sanctuaries of Karnataka. **06 Hours.**

Unit 6: Pollution and Global climatic Changes: A brief account of causes, consequences and control of air, water and soil pollution. Green house effect, ozone depletion and international efforts to control them. Global climatic change and it's consequences. **06 Hours.**

Unit 7: Utilisation of Plants: Origin, distribution, botany and uses of the following: **06 Hours.**

a. Food plants: rice, wheat, maize, pulses (pigeon pea and soya bean), potato and sugarcane
b. Fibres: Cotton and jute.
c. Vegetable oils: Groundnut, sunflower and coconut.
d. Timber – Teak, sissoo
e. Paper and Pulp: Bamboo and Eucalyptus
f. Beverages: Tea and coffee
g. Spices and condiments: Black pepper, Cinnamomum, clove, Cardamom,
h. Medicinal Plants: *Rauvolfia serpentina, Tinospora cordifolia, Withania somnifera, Justicia adhatoda and Digitalis purpurea*.
i. A brief account of Ethnobotany- definition, branches and significance.

PRACTICALS

1. Study of frequency and density of herbaceous plants by quadrat method.
2. To determine moisture content and water holding capacity of sandy and clayey soils.
3. To estimate transparency, pH and temperature of different water bodies.
4. To estimate the salinity of water samples.
5. Ecological instruments.
6. Morphology and anatomical adaptations in three hydrophytes, one succulent and one non-succulent xerophyte, one epiphyte and one halophyte.
7. Simple microchemical tests to demonstrate carbohydrates, fats, and proteins in food plants. Test for cellulose in cotton fibres.
8. Field visits: To study the sources of firewood, timber-yielding trees and bamboos. A list to be prepared mentioning special features.
9. Spices: Examine black pepper, cloves, cinnamon (Hand sections) and describe them briefly.
10. Preparation of an illustrated inventory of ten medicinal plants used in indigenous systems of medicine or allopathy: write their botanical and common names, parts used and diseases/ disorders for which they are prescribed.
11. Beverages: Coffee beans and tea leaves.
12. Rubber: Collect illustrative materials of ***Hevea brasiliensis***; morphology of the plant and tapping practices, history of rubber. List the many uses of rubber.

SUGGESTED READINGS

Odum, E.P. 1983. Basic Ecology, Saunders, Philadelphia.

Kormondy, E.J. 1996. Concepts of Ecology. Prentice-Hall of India Pvt. Ltd. Delhi.

Mackenzie, A et al. 1999. Instant Notes in Ecology. Viva Books Pvt. New Delhi.

Kocchar, S.L. 1998. Economic Botany in Tropics. 2nd edition, Macmillian India Ltd., New Delhi.

Sambamurthy, A.V.S.S. and Subramanyam, N.S. 1989. A Text Book of Economic Botany, Wiley Eastern Ltd. New Delhi.

Sharma, O.P. 1996. Hill's Economic Botany. Tata McGraw Hill Co., Ltd., New Delhi.

Simpson, B.B. and Conner-Ogorzaly, M. 1986. Economic Botany-Plants in our world. McGraw Hill, New York.

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Karnatak University, Dharwad

SUB:BOTANY

Semester – V

Theory Question Paper Pattern

PAPER VI: ECOLOGY AND ECONOMIC BOTANY

Time : 3 Hours Max. Marks: 80

Q. I.	Answer any **TEN** of the following:			10 x 2 = 20 Marks
	From Unit – 1	:	Three Sub questions	
`	From Unit – 2	:	Two Sub questions	
	From Unit – 3	:	Two Sub questions	
	From Unit – 4	:	One Sub question	
	From Unit – 5	:	One Sub question	
	From Unit – 6	:	Two Sub questions	
	From Unit – 7	:	One Sub question	

Q. II.	Answer any **SIX** of the following:			6 x 05 = 30 Marks
	From Unit – 1	:	One Sub question	
	` From Unit – 2	:	One Sub question	
	From Unit – 3	:	One Sub question	
	From Unit – 4	:	One Sub question	
	From Unit – 5	:	One Sub question	
	From Unit – 6	:	One Sub question	
	From Unit – 7	:	Two Sub questions	

Q. III. Descriptive answers: 10 Marks
One Question from Unit-1 Or Unit-2

Q. IV. Descriptive answers: 10 Marks
One Question from Unit-3 Or Unit-4

Q. V. Descriptive answers: 10 Marks
One Question from Unit-5 Or Unit-6

Karnatak University, Dharwad

SUB:BOTANY

Semester – V

PAPER VI: ECOLOGY AND ECONOMIC BOTANY

Practical - VI

Time : 04 Hours Max. Marks: 40

Q. 1.	Give an account of external and internal features of ecological adaptations of specimen A and mention the habitat to which it belongs.	06 marks
Q. 2.	Conduct the microchemical test for specimen B and write the inference	04 marks
Q. 3.	Estimate the salinity / P^H of given water sample C. Write the procedure and inference	05 marks
Q. 4.	a. Identify and describe the slide D	03 marks
	b. Describe the use and working mechanism of the instrument E	03 marks
Q. 5.	Identify by giving the Botanical names and family of the specimen F and G. Mention the parts used and their uses.	06 marks

Practical Record (Journal)	05 Marks
Submission of Economic products (Any Five)	04 marks
Viva-voce (On ecology / Vegetation types)	04 Marks

Instructions to the Examiner

Q. 1. One ecological specimen (External adaptation – 1 mark, Internal adaptation – 2 marks, diagram (T.S.) – 2 marks, mentioning habitat – 1 mark)

Q. 2. Microchemical test for protein/ Carbohydrates/ fat/ cellulose.
(conducting the test – 2 marks, writing the test - 1 mark, result - 1 mark)

Q. 3. For P^H (Setting instrument – 2 marks, record of reading – 2 marks, conclusion & result – 1 mark)
For salinity of water (conducting the test – 2 marks, tabulation of readings – 1 mark, calculation and result – 2 marks)

Q. 4. a. Slide / specimen of ecological interest (Identification – 1 mark, description – 2 marks)
b. Ecological instrument (Identification – 1 mark, working mechanism and use – 2 marks)

Q. 5. Utilization of plants
(Identification – 1 mark, Botanical names – 1 mark, economic importance – 1 mark)

SEMESTER VI

PAPER VII: CELL BIOLOGY, GENETICS AND MOLECULAR BIOLOGY

Unit 1: Cells: Ultra-structure of prokaryotic and eukaryotic cell (plant cell), ultra-structure and functions of cell wall, membranes(fluid-mosaic model), endoplasmic reticulum, golgi bodies, lysosomes, peroxisomes, ribosomes, mitochondria, plastids, vacuole and nucleus. Non-living cell inclusions. **10 Hours.**

Unit 2: **Chromosomes:** Morphology and ultrastructure of chromosome (nucleosome model). Chromosome types based on centromere, autosomes and allosomes. Chromosomal aberrations- deletion, duplication, translocation and inversion. Variation in chromosome number- aneuploidy and euploidy. Mitosis and meiosis, their significance. **10 Hours.**

Unit 3: Nucleic acids: Chemical composition, structure and types of DNA and RNA, DNA replication (semi-conservative), concept of gene – prokaryotic and eukaryotic, genetic code. Gene expression – transcription and translation. Regulation of gene expression in prokaryotes (Lac operon model) and eukaryotes. **08 Hours.**

Unit 4. **Genetic inheritance** : Introduction to Genetics, Mendel's life and work - monohybrid cross and law of inheritance, dihybrid cross and law of independent assortment, in-complete dominance (eg: *Mirabilis jalapa*), Interaction of genes with plant examples– dominant epistasis (12:3:1 ratio), supplementary genes (9:3:4 ratio) and complememtary genes (9:7 ratio), multiple alleles (eg. Self sterility in tobacco). Genetic problems related to above topics. Linkage(eg. Maize), Sex determination in plants (eg. *Melandrium*) **12 Hours.**

Unit 5. **Genetic variations:** mutations - spontaneous and induced. Transposable genetic elements, DNA damage and repair. Extra nuclear genome - presence and function of mitochondrial and plastid DNA, Plasmids**.** **06 Hours.**

PRACTICALS

1. Study of Cell structure from onion peels, study of cyclosis in Tradescantia staminal hairs and Hydrilla leaf.
2. Comparative study of bacterial and cynobacterial cells using electron micrographs.
3. Study of ultrastructure of plant cell and its organelles using electron micrographs,
4. Study of cell incusions – cystolith, raphides & inulin
5. Measurement of length and breadth of cells by micrometry.
6. Study of mitosis in onion root cells.
7. Study of meiosis in onion/ Rheo flower buds.
8. Observation of permanent slides of cell division
9. Genetic problems related to laws of Mendelism and incomplete dominance (min-5 Problems)
10. Genetic problems related to interaction of genes (minimum 5 Problems).

SUGGESTED READINGS

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Atherly, A.G., Girton, J.R. and McDonald, J.F. 1999. The Science of Genetics. Saunders College Publishing, Fort Worth, USA.

Gupta, P.K. 1999. A Text-Book of Cell and Molecular Biology. Rastogi Publications Meerut.

Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York.

Lodish, H., Berk,A., Zipursky, S.L.,Matsudaira, P.,Baltimoe, D. and Darne;;. J. 2000. Molecular Cell Biology. W.H. Freeman & Co., New York.

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Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics. John Wiley & Sons, Inc. USA.

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Wolfe, S.L. 1993. Molecular and Cell Biology. Wadsworth Publishing Co., California, USA.

Stickburger, M. 1990. Genetics. (3rd edition). MacMillan Publishing Co.

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Fukui, K and Nakayama, S. 1996. Plant Chromosomes: Laboratory Methods. CRC Press, Boca Raton, Florida.

Gunning, B.E.S. and Steer, M.B. 1996. Plant Cell Biology: Structure and Function. Jones and Bartlett Publishers, Boston, Massachusetts.

Harris, N. and Oparka, K.J. 1994. Plant Cell Biology: A Practical Approach. IRL Press, at Oxford University Press, Oxford, UK.

Sharma, A.K. and Sharma, A. 1999. Plant Chromosomes: Analysis, Manipulation and Engineering. Harwood Academic Publishers, Australia.

Karnatak University, Dharwad

SUB:BOTANY

Semester – VI

Theory Question Paper Pattern

PAPER VII: CELL BIOLOGY, GENETICS AND MOLECULAR BIOLOGY

Time : 3 Hours | Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 1	:	Three Sub questions
From Unit – 2	:	Two Sub questions
From Unit – 3	:	Two Sub questions
From Unit – 4	:	One Sub question
From Unit – 5	:	One Sub question
From Unit – 6	:	Two Sub questions
From Unit – 7	:	One Sub question

Q. II Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 1	:	One Sub question
From Unit – 2	:	One Sub question
From Unit – 3	:	One Sub question
From Unit – 4	:	One Sub question
From Unit – 5	:	One Sub question
From Unit – 6	:	One Sub question
From Unit – 7	:	Two Sub questions

Q. III. Descriptive answers: 10 Marks
One Question from Unit-1 Or Unit-2

Q. IV. Descriptive answers: 10 Marks
One Question from Unit-3 Or Unit-5

Q. V. Descriptive answers: 10 Marks
Two questions from Unit – 4 with an internal choice.

Karnatak University, Dharwad

SUB:BOTANY

Semester – VI

PAPER VI: CELL BIOLOGY, GENETICS AND MOLECULAR BIOLOGY

Practical - VII

Time : 04 Hours   Max. Marks: 40

Q. 1.	Make a temporary micropreparation of the squash/ smear of the material A. Draw labeled diagram of any two stages of cell division seen in your preparation and show to the examiners	08 marks.
Q. 2.	Determine the length and breadth of the given material B by micrometric method.	05 marks.
Q. 3.	Solve the genetic problem C and D.	08 marks.
Q. 4.	Identify and describe the cytological stage in the slides F, G and H	09 marks.
	Practical Record (Journal)	05 marks.
	Submission of slides (2 meiosis slides and 3 mitosis slides)	05 marks.

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Instructions to the Examiner

Q. 1. Squash - *Allium* root tips.
Smear - *Allium , Tradescantia, Aloe vera* – flower buds may be given.
(preparation - 5 mark, drawing – 3 marks)

Q. 2. Onion peels
(calibration – 2 marks, drawing – 1 mark, measurement – 2 marks)

Q. 3. Any two genetic problems (04 marks each)

Q. 4. One slide from mitosis and two slides from meiosis
(identification – 1 mark, description – 1 mark, labelled diagram – 1 mark)

SEMESTER VI

PAPER VIII: EVOLUTION, PLANT BREEDING AND PLANT BIOTECHNOLOGY

Unit 1. **Origin and evolution of life-** Theory of chemical origin, Lamarkism, Darwinism, Mutational theory and Neo-darwinism concepts. **5 Hours.**

Unit 2. **Plant propagation and breeding**: Methods of Plant propagation - cutting, grafting, layering and their types. History and objectives of plant breeding, methods of plant breeding – Introduction, Selection and types, Polyploidy breeding, mutation breeding and Hybridisation (Types - interspecific and intergeneric, techniques - emasculation, artificial pollination, bagging), Male sterility – types, production and significance in plant breeding. Quarantine methods, germ-plasm conservation, pollen banks. **13 Hours**.

Unit 3. **Plant tissue culture**: History, scope and significance, concept of cellular totipotency , tissue culture laboratory and equipments. Basic aspects – sterilization techniques, culture media and its preparation, role of growth hormones in tissue culture. Types of cultures – callus culture and organogenesis, somatic embryogenesis and synthetic seeds, anther culture and haploid plants, protoplast culture and somatic hybridisation. Application of tissue culture in agriculture, forestry, industries and plant conservation. **12 Hours.**

Unit 4. **Plant Genetic Engineering and transgenic plant production**: Introduction to GE and transgenic plants, tools and techniques of direct gene transfer and vector-mediated gene transfer (Ti plasmid) to plant cells. Steps involved in the production of golden rice. Applications and threats of transgenic plants with examples. **10 Hours.**

Unit 5. **PCR** and its applications in plant genome analysis, ELISA and its applications in plant pathogen detection, Immuno-fluorescence and its application in plant tissue culture. **06 Hours.**

PRACTICALS

1. Study of organic evolution using charts
2. Study of plant propagation methods – cutting, layering and grafting.
3. Techniques of emasculation, artificial pollination and bagging.
4. In-vitro germination of pollens and estimation of percentage of pollen viability by hanging drop method.
5. Study of morphology and anatomy of wet and dry stigma, solid and hollow styles.
6. Study of Tissue culture Lab equipments: Laminar Air Flow, Autoclave, Incubator, Oven, etc.
7. Preparation of issue culture media and its composition (MS), surface sterilization of explants/inoculation/callus induction
8. Preparation of synthetic seeds by alginate encapsulation
9. Study of transgenic plant production with the help of charts/photographs
10. Demonstration of DNA isolation from plant tissues
11. Demonstration of ELISA/ DNA electrophoresis

SUGGESTED READINGS

Chahal. Principles and procedures of Plant Breeding. L.B. Publications.

Gopalakrishnan, T.S., Itta Sambasivaiah and Kamalakar Rao. Principles of organic evolution

Gupta, P.K. Cytology, Genetics and Evolution. Rastogi publications, Meerut .

Khanna, S.S. Genetics, Heridity and Evolution.

Sinha and Sinha. Cytogenetics, Plant Breeding and Evolution. Vikas Publications.

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Menetre, S.S. Molecular basis of cytoplasmic male sterility in crop plants. International Book Distribution.

Purohit, S.S. Molecular Biology and Biotechnology. Daya Publishing House, New Delhi.

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Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

Bhojwani, S.S. 1990. Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York.

Collins, H.A. And Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxford, UK.

Old, R.W. and Primrose, S.B. 1989. Principles of Gene manipulation. Blackwell Scientific Publications, Oxford, UK.

Karnatak University, Dharwad

SUB:BOTANY

Semester – VI

Theory Question Paper Pattern

PAPER VIII: EVOLUTION, PLANT BREEDING AND PLANT BIOTECHNOLOGY

Time : 3 Hours — Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 1	:	One Sub question
From Unit – 2	:	Four Sub questions
From Unit – 3	:	Three Sub questions
From Unit – 4	:	Three Sub question
From Unit – 5	:	One Sub question

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 1	:	One Sub question
From Unit – 2	:	Two Sub question
From Unit – 3	:	Two Sub question
From Unit – 4	:	Two Sub question
From Unit – 5	:	One Sub question

Q. III. Descriptive answers: 10 Marks
Two questions from Unit – 2 with an internal choice.

Q. IV. Descriptive answers: 10 Marks
Two questions from Unit – 3 with an internal choice.

Q. V. Descriptive answers: 10 Marks
Two questions from Unit – 4 with an internal choice.

Karnatak University, Dharwad

SUB:BOTANY

Semester – VI

PAPER VIII: EVOLUTION, PLANT BREEDING AND PLANT BIOTECHNOLOGY

Practical - VIII

Time : 04 Hours Max. Marks: 40

Q. 1. Estimate the percentage of pollen viability in the given flower A by Hanging drop method — 07 marks

Q. 2. Demonstrate the plant propagation method ____________________ in the given Sample B. Show the preparation to the examiners and write the procedure. — 06 marks.

Q. 3. Prepare synthetic seeds by alginate encapsulation method using the provided embryos C. Show the preparation to the examiners. Explain the principle of the experiment. — 07 marks.

Q. 4. Identify and comment on the specimens D, E, F, G & H. — 15 marks.

Practical Record (Journal) — 05 Marks.

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Instruction to the Examiners

Q. 1. Unopened flowers with intact anthers (Preparation – 2 marks, procedure – 3 marks, Inference – 2 marks)

Q. 2. One plant propagation or hybridization technique (Grafting, Layering, emasculation. (Preparation – 2 marks, Procedure – 2 marks, inference – 2 marks)

Q. 3. Green embryos removed from fresh dicot seeds (Preparation – 2 marks, Procedure – 2 marks, Principle – 3 marks)

Q. 4. i. One material from Organic Evolution (Photos or Chart).

ii. One material each from plant propagation and plant breeding (photos / exhibits of propagation methods / hybridization techniques)

iii.Two materials from plant tissue culture and Biotechnology (Tissue culture laboratory equipments, culture media, Growth hormones culture types, Electrophoresis etc.)

KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION
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No. KU/Aca(S&T)/SVB-05/BOS /Botany (UG) /20-21 [illegible]

Date: 16 OCT 2020

NOTIFICATION

Sub: Regarding introduction of the syllabus of Botany UG under C.B.C.S. w.e.f. the academic year 2020-21 & onwards.

Ref: 1. UGC Letter DO No. 1-1/2016(SECY), dt. 10.08.2016.
2. Special BOS Res. No. 01, dt. 10.07.2020.
3. Special Faculty Res. No. 01, dt. 11.08.2020.
4. Special Academic Council Res. No. 38, dt. 21.08.2020.
5. Vice-Chancellor's order dated - 07-10-2020

Adverting to the above, it is hereby notified to the Principals of all constituent and affiliated degree colleges coming under the jurisdiction of Karnatak University, Dharwad that the Botany UG syllabus for I to VI Semester which is annexed herewith in Annexure-A is introduced under C.B.C.S. from the academic year 2020-21 & onwards.

Hence, the contents of this notification may please be brought to the notice of the students and all the concerned. The prescribed C.B.C.S. syllabus may also be obtained through K.U.website (www.kud.ac.in).

15/10/2020
(Dr. Hanumantappa K.T)
REGISTRAR

To,

1. The Chairman, BOS Botany (UG), Dept. of Botany, K.U.Dharwad.
2. The Chairman, Dept. of Botany, K.U.Dharwad.
3. The Principals of all the constituted and affiliated degree colleges under the jurisdiction of Karnatak University, Dharwad. (The same may be sent through e-mail)
4. The Registrar (Evaluation), K.U.Dharwad.

Copy fwcs to:

1. Dr. Ch.Ramesh, Dean, Faculty of Science & Tech., Dept. of Botany, K.U.Dharwad.
2. The Director, IT Section, Examination Section, K.U.Dharwad for information and to upload on K.U.Website (www.kud.ac.in).

Copy to:

1. PS to Vice-Chancellor, K.U.Dharwad.
2. S.A. to Registrar, K.U.Dharwad.
3. O.S., Exam UG / Confl / QP / GAD Section, K.U.Dharwad.
4. The System Analysist, Computer Unit Exam Section, K.U.Dharwad.

Annexure “A”

KARNATAK UNIVERSITY, DHARWAD

Syllabus and Structure

For

B. Sc. Botany

(I-VI SEMESTER)

Under

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. 2020 - 2021 onwards

SEMESTER I

CORE COURSE: BOTANY PAPER - I

BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Microbes **(10 Lectures)**

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit 2: Algae **(12 Lectures)**

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas, Oedogonium, VaucheriaSargassum, Batrachospermum*. Economic importance of algae

Unit 3: Fungi **(12 Lectures)**

Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition , nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium, Alternaria* (Ascomycota), *Puccinia, Agaricus* (Basidiomycota); Symbiotic Associations-Lichens:
General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

Unit 4: Introduction to Archegoniate **(2 Lectures)**

Unifying features of archegoniates, Transition to land habit, Alternation of generations.

Unit 5: Bryophytes **(10 Lectures)**

General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included) . Ecology and economic importance of Bryophytes with special mention of *Sphagnum*.

Unit 6: Pteridophytes **(8 Lectures)**

General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.

Unit 7: Gymnosperms **(6 Lectures)**

General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

Practical

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (Electron micrographs), *Oedogonium, Vaucheria, Fucus* and Polysiphonia* through temporary preparations and permanent slides. (* *Fucus* - Specimen and permanent slides)
5. *Rhizopus and Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. *Alternaria:* Specimens/photographs and tease mounts.
7. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
11. ***Marchantia***- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. ***Funaria***- Morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. ***Selaginella***- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
14. ***Equisetum***- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
15. ***Pteris***- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
16. ***Cycas***- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. ***Pinus***- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, , l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

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2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
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4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
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10. Sharma, O.P. 1992. Text Book of Thallophytes. McGraw Hill Publishing Co.
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15. Vashista, B.R. 1978. Algae. S Chand & Co. Ltd., New Delhi.
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25. Anil K.Thakur & Susheel K.Bassi. Diversity of Microbes and Cryptogams. Chand Publication.

26. A.V.S.S.Sambamurty. A Text Book of Algae. I.K. International Private Ltd.
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38. Agashe, S.N. 1995. Paleobotany. Plants of the past, their evolution, paleoenvironment and Application in exploration of fossi8l fuels. Oxford & IBH., New Delhi.
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SEMESTER I

CORE COURSE: BOTANY PAPER - I

BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

THEORY

Time : 3 Hours   Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 1	:	Two Sub questions
From Unit – 2	:	Two Sub questions
From Unit – 3	:	Two Sub question
From Unit – 4	:	One Sub questions
From Unit – 5	:	Two Sub questions
From Unit – 6	:	One Sub question
From Unit – 7	:	Two Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 1	:	One Sub question
From Unit – 2	:	Two Sub question
From Unit – 3	:	Two Sub question
From Unit – 5	:	One Sub questions
From Unit – 6	:	One Sub question
From Unit – 7	:	One Sub question

Q. III. Answer any **THREE** of the following: 3 x 10 = 30 Marks

From Unit – 1	:	One Sub question
From Unit – 2	:	One Sub question
From Unit – 3	:	One Sub question
From Unit – 5	:	One Sub questions
From Unit – 6	:	One Sub question

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SEMESTER I

CORE COURSE: BOTANY PAPER - I

BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

THEORY

Time : 3 Hours **Max. Marks: 80**

BLUE PRINT OF THE QUESTION PAPER

Sl. No.	Unit	Title	Teaching Hours	Total Questions Allotted			Total Marks
				2 marks	5 Marks	10 Marks	
1.	1	Microbes	10	02	01	01	19
2.	2	Algae	12	02	02	01	24
3.	3	Fungi	12	02	02	01	24
4.	4	Introduction to Archegoniate	02	01	00	00	02
5.	5	Bryophytes	10	02	01	01	19
6.	6	Pteridophytes	08	01	01	01	17
7.	7	Gymnosperms	06	02	01	00	09
		Total	60	12	08	05	114

SEMESTER I

CORE COURSE: BOTANY PRACTICAL - I

BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

Time : 03 Hours Max. Marks: 40

Q. 1.	Identify and classify the given specimen A. B, C, D, E and F giving reasons.	12 marks
Q. 2.	Make Simple/ Differential staining of the given specimen H and show the preparation to the examiner (No written answer is expected).	03 marks
Q. 3.	Identify the given specimen / slide I, J, K, L, M and N giving reasons.	09 marks
Q. 4.	Identify the given specimen / Photograph O giving reasons.	02 marks

Practical Record (Journal)	05 Marks
Botanical Study-Tour Report	05 marks
Viva-voce	04 Marks

Instructions to the Examiner

Q. 1. One Specimen each from Algae, Fungi, Bryophyte, Pteridophyte and Gymnosperm.

Q.2. Simple/ Differential staining of Bacteria

Q. 3. One specimen / slide each from Algae, Fungi, Bryophyte, Pteridophyte and Gymnosperm.

Q. 5. One specimen / slide / Electron Micrograph of Viruses or Bacteria.

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SEMESTER II

CORE COURSE BOTANY –PAPER II
PLANT ECOLOGY AND TAXONOMY
(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Introduction **(02 Hours)**

Unit 2: Ecological factors **(10 Hours)**

Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Unit 3: Plant communities **(06 Hours)**

Characters; Ecotone and edge effect; Succession; Processes and types.

Unit 4: Ecosystem **(08 Hours)**

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

Unit 5: Phytogeography **(04 Hours)**

Preinciple Biogeographical zones, Endemisim

Unit 6 : Introduction to Taxonomy **(02 Hours)**

Identification, Classification, Nomenclature

Unit 7 : Identification **(04 Hours)**

Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

Unit 8 : Taxonomic Evidences **(06 Hours)**

From Palynology, Cytology, Phytochemistry and Molecular data.

Unit 9 : Taxonomic Hierarchy Ranks, categories and taxonomic groups **(02 Hours)**

Unit 10 : Botanical Nomenclature **(06 Hours)**

Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Unit 11 Classification **(06 Hours)**

Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).

Unit 12 Biometrics, numerical taxonomy and cladistics **(04 Hours)**

Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

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PRACTICALS

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b)Study of biotic interactions of the following: Stem parasite (*Cuscuta)*, Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
7. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification):**Brassicaceae** - *Brassica, Alyssum / Iberis;* **Asteraceae** -*Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax;* **Solanaceae** -*Solanum nigrum, Withania;* **Lamiaceae** -*Salvia, Ocimum*; **Liliaceae -** *Asphodelus / Lilium / Allium.*
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

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For laboratory exercises

31. Krebs, C.J. 1989. Ecological Methodology. Harper and Row, New York.
32. Ludwig, J.A. and Reynolds, J.F. 1988. Statistical Ecology. Wiley, New York.
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SEMESTER II

CORE COURSE BOTANY –PAPER II

PLANT ECOLOGY AND TAXONOMY

(Credits: Theory-4, Practicals-2)

THEORY

Time : 3 Hours Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 2	:	Two Sub questions
From Unit – 3	:	One Sub questions
From Unit – 4	:	Two Sub questions
From Unit – 5	:	One Sub questions
From Unit – 7	:	One Sub questions
From Unit – 8	:	One Sub questions
From Unit – 9	:	One Sub questions
From Unit – 10	:	One Sub questions
From Unit – 11	:	One Sub questions
From Unit – 12	:	One Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 2	:	Two Sub questions
From Unit – 3	:	One Sub questions
From Unit – 4	:	One Sub questions
From Unit – 5	:	One Sub questions
From Unit – 7	:	One Sub questions
From Unit – 10	:	One Sub questions
From Unit – 11	:	One Sub questions

Q. III. Answer any **THREE** of the following: 3 x 10 = 30 Marks

From Unit – 2	:	One Sub questions
From Unit – 3	:	One Sub questions
From Unit – 4	:	One Sub questions
From Unit – 8	:	One Sub questions
From Unit – 11	:	One Sub questions

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SEMESTER II

CORE COURSE BOTANY –PAPER II

PLANT ECOLOGY AND TAXONOMY

(Credits: Theory-4, Practicals-2)

THEORY

Time : 3 Hours **Max. Marks: 80**

BLUE PRINT OF THE QUESTION PAPER

Sl. No.	Unit	Title	Teaching Hours	Total Questions Allotted			Total Marks
				2 marks	5 Marks	10 Marks	
1.	1.	Introduction	02	00	00	00	00
2.	2.	Ecological Factors	10	02	02	01	24
3.	3.	Plant communities	06	01	01	01	17
4.	4.	Ecosystem	08	02	01	01	19
5.	5.	Phytogeography	04	01	01	00	07
6.	6.	Introduction to Taxonomy	02	00	00	00	00
7.	7.	Identification	04	01	01	00	07
8.	8.	Taxonomic Evidences	06	01	00	01	12
9.	9.	Taxonomic Hierarchy	02	01	00	00	02
10.	10.	Botanical Nomenclature	06	01	01	00	07
11.	11.	Classification	06	01	01	01	17
12.	12	Biometrics, Numerical Taxonomy and Cladistics	04	01	00	00	02
		Total	60	12	08	05	114

SEMESTER II

CORE COURSE BOTANY – PRACTICAL - II

PLANT ECOLOGY AND TAXONOMY

(Credits: Theory-4, Practicals-2)

PRACTICAL

Time : 3 Hours Max. Marks: 40

Q. 1. Give an account of external and internal features of ecological adaptations of specimen A and mention the habitat to which it belongs. 05 marks

Q. 2. Assign the specimens B, C and D to the respective families giving diagnostic features and their classifications (up to family). 09 marks.

Q. 3. Estimate the salinity / P^H of given water sample E. Write the procedure and inference 04 marks

Q. 4. Draw the floral diagram and write floral formula of specimen F. 03 marks.

Q. 5. Identify the slides / specimens G, H, I, giving reasons. 06 marks

Practical Record (Journal)	05 Marks
Submission of Herbaria of weeds (Any Five)	04 marks
Viva-voce (On Ecology / Vegetation types)	04 Marks

Instructions to the Examiner

Q. 1. One ecological specimen (External adaptation – 1 mark, Internal adaptation – 2 marks, diagram (T.S.) – 2 marks, mentioning habitat – 1 mark)

Q. 2. Three families done in the practical class.
(Identification – 1 mark, Classification – 1 mark, Features – 2 marks)

Q. 3. For P^H (Setting instrument – 2 marks, record of reading – 2 marks, conclusion & result – 1 mark)
For salinity of water (conducting the test – 2 marks, tabulation of readings – 1 mark, calculation and result – 2 marks)

Q. 4. A twig with flower buds (Floral diagram – 2 marks, Floral formula – 1 mark)

Q. 5. 3 Slides / specimens of ecological interest (Identification – 1 mark, description – 1 mark)

SEMESTER III

CORE COURSE BOTANY –PAPER III
PLANT ANATOMY AND EMBRYOLOGY
(Credits: Theory-4, Practicals-2)
THEORY

Lectures: 60

Unit 1: Meristematic and permanent tissues **(8 Hours)**
Root and shoot apical meristems; Simple and complex tissues.

Unit 2: Organs **(4 Hours)**
Structure of dicot and monocot root stem and leaf.

Unit 3: Secondary Growth **(8 Hours)**
Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).

Unit 4: Adaptive and protective systems **(8 Hours)**
Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit 5: Structural organization of flower **(8 Hours)**

Structure and development of anther and pollen; Structure and development of ovule, types of ovules; Types of embryo sacs, organization and ultra structure of mature embryo sac.

Unit 6: Pollination and fertilization **(8 Hours)**
Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit 7: Embryo and endosperm **(8 Hours)**
Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship.

Unit 8: Apomixis and polyembryony **(8 Hours)**
Definition, types and practical applications.

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PRACTICALS

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.
14. Demonstration of Microtomy.

SUGGESTED READINGS

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
3. Bhoojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms. 4th revised and Enlarged edition. Vikas Publishing House, Delhi.
4. Cutter, E.G. 1969. Part I. Cells and tissues. Edward Arnold, London.
5. Cutter, E.G. 1971. Plant Anatomy: Experiment and Interpretation. Part II. Organs. Edward Arnold, London.
6. Easu, K. 1977. Anatomy of seed plants. 2nd edition. John Wiley & Sons, New York.
7. Fahn. A. 1974. Plant Anatomy. 2nd edition. Pergamon Press, Oxford.
8. Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publishing Co., Inc., Menlo Park, California, USA.
9. Raven, P.H. , Evert, R.F. and Eichhorn, S.E. 1999. Biology of Plants. 5th edition. W.H. Freeman and Co., Worth Publishers, New York.
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12. Shukla, A.K. 1999. Biology of Pollen. Atlas Books & Periodicals.
13. Raghavan, V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York.
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15. M.S.Tayal. Plant Anatomy
16. Singh, Pandey and Jain. Embryology of angiosperms.
17. V.K.Gupta. Embryology of angiosperms.
18. K.R.Shivanna. Pollen Biotechnology.

SEMESTER III

CORE COURSE BOTANY –PAPER III
PLANT ANATOMY AND EMBRYOLOGY

Time : 3 Hours | Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 1	:	One Sub questions
From Unit – 2	:	Two Sub questions
From Unit – 3	:	Two Sub questions
From Unit – 4	:	Two Sub questions
From Unit – 5	:	One Sub questions
From Unit – 6	:	One Sub questions
From Unit – 7	:	One Sub questions
From Unit – 8	:	Two Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 1	:	One Sub questions
From Unit – 3	:	One Sub questions
From Unit – 4	:	One Sub questions
From Unit – 5	:	One Sub questions
From Unit – 6	:	One Sub questions
From Unit – 7	:	One Sub questions
From Unit – 8	:	Two Sub questions

Q. III. Answer any **THREE** of the following: 3 x 10 = 30 Marks

From Unit – 1	:	One Sub questions
From Unit – 3	:	One Sub questions
From Unit – 5	:	One Sub questions
From Unit – 6	:	One Sub questions
From Unit – 7	:	One Sub questions

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SEMESTER III

CORE COURSE BOTANY –PAPER III
PLANT ANATOMY AND EMBRYOLOGY

THEORY

Time : 3 Hours **Max. Marks: 80**

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Sl. No.	Unit	Title	Teaching Hours	Total Questions Allotted			Total Marks
				2 marks	5 Marks	10 Marks	
1.	1.	Meristematic and Permanent Tissues	08	01	01	01	17
2.	2.	Organs	04	02	00	00	04
3.	3.	Secondary Growth	08	02	01	01	19
4.	4.	Adaptive and Protective System	08	02	01	00	09
5.	5.	Structural and Organization of flower	08	01	01	01	17
6.	6.	Pollination and Fertilization	08	01	01	01	17
7.	7.	Embryo and Endosperm	08	01	01	01	17
8.	8.	Apomixis and Polyembryony	08	02	02	00	14
		Total	60	12	08	05	114

SEMESTER III

CORE COURSE BOTANY –PRACTICAL- III
PLANT ANATOMY AND EMBRYOLOGY

PRACTICAL

Time : 3 Hours Max. Marks: 40

Q. 1. Prepare a double stained temporary micropreparation of T.S. of specimen A. Draw a labelled diagram and mention the features of anatomical interest. 07 marks
Show the preparation to the examiner.

Q. 2. Make a temporary micropreparation of specimen B so as to expose ______________.
Show the preparation to the examiner (No written answer is expected). 03 marks

Q. 3. Make a temporary micropreparation of specimen C so as to expose ______________.
Draw a neat labelled diagram Show the preparation to the examiners. 03 marks

Q. 4. Identify and describe the salient features observed in the specimen / slide D, E, F, G, H and I. 18 marks

Q. 5. Estimate the percentage of pollen viability in the given flower A by Hanging drop method 04 marks

Practical Record (Journal) 05 Marks

Instructions to the Examiner

Q. 1. Any one stem showing anomalous secondary growth.

Q. 2. One specimen from anatomy.

Q. 3. Mounting – Embryo / endosperm.

Q. 4. Two slides from anatomy, One specimen / Photograph from Pollination and Microtomy each, two slides from embryology.

Q. 5. Unopened flowers with intact anthers
(Preparation – 2 marks, procedure – 3 marks, Inference – 2 marks)

SEMESTER IV
CORE COURSE BOTANY –PAPER IV
PLANT PHYSIOLOGY, METABOLISM AND PHYTOCHEMISTRY
(Credits: Theory-4, Practicals-2)
THEORY

Lectures: 60

Unit 1: Plant-water relations **(8 Hours)**

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

Unit 2: Mineral nutrition **(6 Hours)**

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

Unit 3: Translocation in phloem **(6 Hours)**

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 4: Photosynthesis **(12 Hours)**

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C_3, C_4 and CAM pathways of carbon fixation; Photorespiration.

Unit 5: Respiration **(6 Hours)**

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Unit 6: Enzymes **(4 Hours)**

Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

Unit 7: Plant growth regulators **(6 Hours)**

Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

Unit 8: Plant response to light and temperature **(6 Hours)**

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

Unit 9: Phytochemistry **(6 Hours)**

1. **General account**: Plants as source of meducune. Phytochemistry and its importance in modern medicine. Classification of plant drugs. Chemical and and pharmacological drug evaluation – microscopic, physical, chemical and biological.

2. **Secondary Metabolites**: Definition of secondary metabolites and difference with primary metabolites. Major types – Terpenoids, phenolics, alkaloids and their protective action against pathogenic microbes and herbivores.

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PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.
9. Biochemical tests for proteins, carbohydrates and fats.
10. Microscopic features of some common powder drugs
11. Test for secondary metabolites - Terpenoids, phenolics, alkaloids.

Demonstration experiments (any four)

1. Bolting. 2. Effect of auxins on rooting. 3. Suction due to transpiration.
4. R.Q. 5. Respiration in roots.

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SUGGESTED READINGS

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell (eds). 1997. Plant Metabolism (2nd edition). Longman, Essex, England.
5. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.
6. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc. New York.
7. Lea, P.J. and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology. John Wiley Sons, Chichester, England.
8. Mohr, H. and Schopfer, P. 1995. Plant Physiology. Springer-Verlag, Berlin.
9. Salisbury, F.B.and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishin Co., California.
10. Taiz, L. and Zeiger, E. 2002 . Plant Physiology (3rd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
11. Devi P 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
12. Moore, T.C. 1974. Research Experiences in Plant Physiology: A Laboratory Manual. Springer-Verlag, Berlin.
13. Ninfa, A.J. and Ballou, D.P. 1998. Fundamental Laboratory Approaches for Biochemistry and Biotechnology., Fitzgerald Science Press, Ind., Maryland, USA.
14. Roberts, J. and Tucker, G.A. (Eds.) 2000 Plant Hormone Protocols. Humana Press, New Jersey, USA.
15. Scott, R.P.W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., New York.
16. Wilson, K. and Goulding, K.H. (eds.) 1986. A Biologists Guide to principles and Techniques of Practical Biochemistry. Edward Arnold, London.
17. V. Verma. Plant Physiology
18. S.N.Pandey and B.K.Sinha. Plant Physiology. IV Edition. Vikas Publication.
19. S.K.Verma. Plant Physiology. S. Chand Publications, Meerut.

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SEMESTER IV
CORE COURSE BOTANY –PAPER IV
PLANT PHYSIOLOGY, METABOLISM AND PHYTOCHEMISTRY

Time : 3 Hours — Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 1	:	One Sub questions
From Unit – 2	:	One Sub questions
From Unit – 3	:	One Sub questions
From Unit – 4	:	Three Sub questions
From Unit – 5	:	One Sub questions
From Unit – 6	:	One Sub questions
From Unit – 7	:	One Sub questions
From Unit – 8	:	Two Sub questions
From Unit – 9	:	One Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 1	:	One Sub questions
From Unit – 2	:	One Sub questions
From Unit – 3	:	One Sub questions
From Unit – 4	:	One Sub questions
From Unit – 6	:	One Sub questions
From Unit – 7	:	One Sub questions
From Unit – 8	:	One Sub questions
From Unit – 9	:	One Sub questions

Q. III. Answer any **THREE** of the following: 3 x 10 = 30 Marks

From Unit – 1	:	One Sub questions
From Unit – 4	:	One Sub questions
From Unit – 5	:	One Sub questions
From Unit – 7	:	One Sub questions
From Unit – 9	:	One Sub questions

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SEMESTER IV
CORE COURSE BOTANY –PAPER IV
PLANT PHYSIOLOGY, METABOLISM AND PHYTOCHEMISTRY

THEORY

Time : 3 Hours **Max. Marks: 80**

BLUE PRINT OF THE QUESTION PAPER

Sl. No.	Unit	Title	Teaching Hours	Total Questions Allotted			Total Marks
				2 marks	5 Marks	10 Marks	
1.	1	Plant water Relations	08	01	01	01	17
2.	2	Mineral Nutrition	06	01	01	00	07
3.	3	Translocation in Phloem	06	01	01	00	07
4.	4	Photosynthesis	12	03	01	01	21
5.	5	Respiration	06	01	00	01	12
6.	6	Enzymes	04	01	01	00	07
7.	7	Plant Growth Regulators	06	01	01	01	17
8.	8	Plant response to Light and Temperature	06	02	01	00	09
9.	9	Phytochemistry	06	01	01	01	17
		Total	60	12	08	05	114

SEMESTER IV
CORE COURSE BOTANY –PRACTICAL - IV
PLANT PHYSIOLOGY, METABOLISM AND PHYTOCHEMISTRY

PRACTICAL

Time : 3 Hours Max. Marks: 40

Q. 1. Set up an experiment as per slip A. Write requirements, principle involved, procedure and conclusion. (Show the set up of the experiment to the examiners). 12 marks.

Q. 2. Perform and write the Biochemical test of the given sample B for ____________________ (Show the result to the examiners). 04 marks.

Q. 3. Identify and comment on the physiological phenomenon involved in the experiments C, D, E. 12 marks.

Q. 5. Identify, mention the parts used and describe microscopic features of the given powdered drug G. 03 marks

Q. 6. Perform the phyto-chemical test for the given sample H. 04 Marks

Practical Record (Journal) 05 Marks.

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Instructions to the Examiner

Q. 1. One experiment as per the slip. (Requirements – 2 marks, setting – 4 marks, procedure – 4 marks, conclusion – 2 marks)

Q. 2. Perform the test for Carbohydrates or Proteins or Fats. (Procedure – 2 marks, result – 2 marks)

Q. 3. Any three physiology experiments as per the practical syllabus. (Identification – 1 mark, procedure – 1 mark and Inference – 2 marks)

Q. 5. Identification and parts used – 1 Mark and description – 2 Mark.

Q. 6. Procedure – 2 Marks, Result – 2 Mark.

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)

SEMESTER V

(Student shall choose either paper- I or Paper-II or paper –III)

PAPER-I: CELL AND MOLECULAR BIOLOGY

(Credits: Theory-4, Practicals-2)

THEORY **Lectures: 60**

Unit 1: Techniques in Biology **(8 Lectures)**
Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.

Unit 2: Cell as a unit of Life **(2 Lectures)**
The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.

Unit 3: Cell Organelles **(20 Lectures)**
Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body & Lysosomes: Structures and roles. Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants, ribosome structure and biogenesis.
Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus (brief).

Unit 4: Cell Membrane and Cell Wall **(6 Lectures)**
The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall-structure and functions.

Unit 5: Cell Cycle **(6 Lectures)**
Overview of Cell cycle, Mitosis and Meiosis; Molecular controls

Unit 6: Genetic material **(6 Lectures)**
DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material.DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi–conservative, mode of replication, replication of linear, ds-DNA, replicating the 5′end of linear chromosome including replication enzymes.

Unit 7: Transcription and Translation (Prokaryotes and Eukaryotes) **(6 Lectures)**
Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code.

Unit 8: Regulation of gene expression **(6 Lectures)**
Prokaryotes:Lac operon and Tryptophan operon ; and in Eukaryotes.

PRACTICAL

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. Study of mitosis and meiosis (temporary mounts and permanent slides).
5. Study the effect of temperature, organic solvent on semi permeable membrane.
6. Demonstration of dialysis of starch and simple sugar.
7. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
8. Measure the cell size (either length or breadth/diameter) by micrometry.
9. Study the structure of nuclear pore complex by photograph (from Gerald Karp) Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
10. Study DNA packaging by micrographs.
11. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

SUGGESTED READINGS

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Karnatak Universiry, Dharwad

DISCIPLINE SPECIFIC ELECTIVE (DSE)

SEMESTER V

CELL AND MOLECULAR BIOLOGY

Practical

Time : 04 Hours Max. Marks: 40

Q. 1.	Make a temporary micropreparation of the squash/ smear of the material A. Draw labeled diagram of any two stages of cell division seen in your preparation and show to the examiners	08 marks.
Q. 2.	Determine the length and breadth of the given material B by micrometric method.	05 marks.
Q. 3.	Conduct the experiment as per the direction given.	08 marks.
Q. 4.	Identify and describe the cytological stage in the slides F, G and H	09 marks.
	Practical Record (Journal)	05 marks.
	Submission of slides (2 meiosis slides and 3 mitosis slides)	05 marks.

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Instructions to the Examiner

Q. 1. Squash - *Allium* root tips.
Smear - *Allium , Tradescantia, Aloe vera* – flower buds may be given.
(preparation - 5 mark, drawing – 3 marks)

Q. 2. Onion peels
(calibration – 2 marks, drawing – 1 mark, measurement – 2 marks)

Q. 3. Any one experiment given in the practical list (Sl. No. 05 to 07)
(Requirements – 2 marks, setting – 2 marks, procedure – 2 marks, conclusion – 2 marks)

Q. 4. One slide from mitosis and two slides from meiosis
(identification – 1 mark, description – 1 mark, labelled diagram – 1 mark)

Karnatak Universiry, Dharwad

DISCIPLINE SPECIFIC ELECTIVE (DSE)

SEMESTER V

CELL AND MOLECULAR BIOLOGY

Time : 3 Hours Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 1	:	One Sub question
From Unit – 2	:	One Sub question
From Unit – 3	:	Two Sub question
From Unit – 4	:	One Sub questions
From Unit – 5	:	Two Sub questions
From Unit – 6	:	Two Sub questions
From Unit – 7	:	Two Sub questions
From Unit – 8	:	One Sub questions

Q. II. Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 1	:	One Sub question
From Unit – 3	:	Two Sub questions
From Unit – 4	:	One Sub questions
From Unit – 5	:	One Sub question
From Unit – 6	:	One Sub question
From Unit – 7	:	One Sub question
From Unit – 8	:	One Sub question

Q. III. Descriptive answers: 10 Marks

One questions from Unit – 1

OR

One questions from Unit – 3

Q. IV. Descriptive answers: 10 Marks

One questions from Unit – 3

OR

One questions from Unit – 4 or 5

Q. V. Descriptive answers: 10 Marks

One questions from Unit – 6

OR

One questions from Unit – 7 or 8

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KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)
SEMESTER V
(Student shall choose either paper- I or Paper-II or paper –III)

PAPER-II: ECONOMIC BOTANY AND BIOTECHNOLOGY
(Credits: Theory-4, Practicals-2)

THEORY **Lectures: 60**

Unit 1: Origin of Cultivated Plants **(4 Lectures)**
Concept of centres of origin, their importance with reference to Vavilov's work

Unit 2: Cereals **(2 Lectures)**
Wheat -Origin, morphology, uses

Unit 3: Legumes **(4 Lectures)**
General account with special reference to Gram and soybean

Unit 4: Spices **(4 Lectures)**
General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)

Unit 5: Beverages **(2 Lectures)**
Tea (morphology, processing, uses)

Unit 6: Oils and Fats **(2 Lectures)**
General description with special reference to groundnut

Unit 7: Fibre Yielding Plants **(4 Lectures)**
General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Unit 8: Introduction to biotechnology **(2 Lectures)**
Historical account, branches of biotechnology.

Unit 9: Plant tissue culture **(16 Lectures)**

Introduction, steps involved in plant tissue culture, Micropropagation: haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications

Unit 10: Recombinant DNA Technology **(20 Lectures)**

Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.

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PRACTICAL

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.
5. Preparation of synthetic seeds.

SUGGESTED READINGS

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4^{th} edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)

SEMESTER V

(Student shall choose either paper- I or Paper-II or paper –III)

PAPER-III: BIOINFORMATICS

(Credits: Theory-4, Practicals-2)
THEORY

Lectures: 60

Unit 1: Introduction to Bioinformatics (5 Lectures)
Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

Unit 2: Databases in Bioinformatics (5 Lectures)
Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System.

Unit 3 : Biological Sequence Databases (25 Lectures)
National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database. EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools. DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ. Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR. Swiss-Prot: Introduction and Salient Features.

Unit 4: Sequence Alignments (10 Lectures)
Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

Unit 5: Molecular Phylogeny (8 Lectures)
Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

Unit 6: Applications of Bioinformatics (7 Lectures)
Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.

Practical

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

Suggested Readings

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: SKILL ENHANCE COURSES (SEC-I)
(Student shall choose either paper- IA or Paper-IB for SEC-I)

SEMESTER V

PAPER-IA: HERBAL TECHNOLOGY

(Credits: 2)

THEORY **Lectures: 30**

Unit 1: Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants. **(6 Lectures)**

Unit 2: Pharmacognosy - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka. **(6 Lectures)**

Unit 3: Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster). **(8 Lectures)**

Unit 4: Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds) **(8 Lectures)**

Unit 5: Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy) **(2 Lectures)**

SUGGESTED READINGS

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book _Distributors.
3. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
4. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH _publishing Co.
5. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
6. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
7. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: SKILL ENHANCE COURSES (SEC-I)
(Student shall choose either paper- IA or Paper-IIB for SEC-I)

SEMESTER V

PAPER-IB: NURSARY AND GARDENING

(Credits: 2)

THEORY **Lectures: 30**

Unit 1: Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. **(4 Lectures)**

Unit 2: Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification. **(6 Lectures)**

Unit 3: Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glass house. **(6Lectures)**

Unit 4: Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting. **(8 Lectures)**

Unit 5: Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures. **(6 Lectures)**

SUGGESTED READINGS

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National _Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: SKILL ENHANCE COURSES (SEC-II)
(Student shall choose either paper- IIA or Paper-IIB for SEC-II)

SEMESTER V

PAPER-IIA: FLORICULTURE

(Credits: 2)

THEORY **Lectures: 30**

Unit 1: Introduction: History of gardening; Importance and scope of floriculture and landscape gardening. **(2 Lectures)**

Unit 2: 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. **(8 Lectures)**

Unit 3: 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. **(5 Lectures)**

Unit 4: 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. **(5 Lectures)**

Unit 5: Landscaping Places of Public Importance: Landscaping highways and Educational institutions. **(2 Lectures)**

Unit 6: Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold,Rose, Lilium, Orchids). **(6 Lectures)**

Unit 7: Diseases and Pests of Ornamental Plants. **(2 Lectures)**

SUGGESTED READINGS

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: SKILL ENHANCE COURSES (SEC-II)
(Student shall choose either paper- IIA or Paper-IIB for SEC-II)

SEMESTER V

MEDICINAL BOTANY

(Credits: 2)

THEORY **Lectures: 30**

Unit 1: History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations. **(10 Lectures)**

Unit 2: Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding. **(10 Lectures)**

Unit 3: Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases. **(10 Lectures)**

SUGGESTED READINGS

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)
SEMESTER VI
(Student shall choose either paper- I or Paper-II or paper –III)

PAPER-I: GENETICS AND PLANT BREEDING
(Credits: Theory-4, Practical-2)

THEORY **Lectures: 60**

Unit 1: Heredity **(20 Lectures)**
Brief life history of Mendel, Terminologies, Laws of Inheritance, Modified Mandelian Ratios: 2:1- lethal Genes; 1:2:1- Co- dominance, incomplete dominance; 9:7; 9:4:3; 13:3; 12:3:1., Chi- Square, Pedigree Analysis, Cytoplasmic Inheritance: Shell Coiling in Snail, Kappa particles in Paramecium, leaf variegation in ***Mirabilis jalapa***, Male sterility, Multiple allelism in ***Nicotiana tobaccum***, Pleiotropism, Chromosome theory of Inheritance.

Unit 2: Sex-determination and Sex-linked Inheritance **(4 Lectures)**
Sex-determination in ***Drosophila* sp.** and Sex-linked Inheritance in ***Melandrium album.***

Unit 3: **Linkage and Crossing over** **(8 Lectures)**
Linkage: concept & history, complete & incomplete linkage, bridges experiment, coupling & repulsion, recombination frequency, linkage maps based on two and three factor crosses. Crossing over: concept and significance, cytological proof of crossing over.

Unit 4: Mutations and Chromosomal Aberrations **(4 Lectures)**
Types of mutations, effects of physical & chemical mutagens. Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy ; Structural chromosomal changes: Deletions, Duplications, Inversions & Translocations.

Unit 5: Plant Breeding **(4 lectures)**
Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

Unit 6: Methods of crop improvement **(8 lectures)**
Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.

Unit 7: Quantitative inheritance **(4 lectures)**
Concept, mechanism, examples. Monogenic vs polygenic Inheritance.

Unit 8: Inbreeding depression and heterosis **(4 lectures)**
History, Genetic basis of inbreeding depression and heterosis; Applications.

Unit 9: Crop improvement and breeding **(4 lectures)**
Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.

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PRACTICAL

1. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square.
2. Chromosome mapping using point test cross data.
3. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
4. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
5. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes through photographs.
6. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
7. Hybridization techniques - Emasculation, Bagging (For demonstration only).
8. Induction of polyploidy conditions in plants (For demonstration only).
9. In-vitro germination of pollens and estimation of percentage of pollen viability by hanging drop method.

SUGGESTED READINGS

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
3. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings.
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
5. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning.
6. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
7. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.
8. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

Karnatak Universiry, Dharwad

DISCIPLINE SPECIFIC ELECTIVE (DSE)

SEMESTER VI

GENETICS AND PLANT BREEDING
(Credits: Theory-4, Practical-2)
THEORY

Time : 3 Hours — Max. Marks: 80

Q. I. Answer any **TEN** of the following: 10 x 2 = 20 Marks

From Unit – 1	:	Two Sub questions
From Unit – 2	:	One Sub question
From Unit – 3	:	Two Sub questions
From Unit – 4	:	One Sub question
From Unit – 5	:	One Sub question
From Unit – 6	:	Two Sub questions
From Unit – 7	:	One Sub question
From Unit – 8	:	One Sub question
From Unit – 9	:	One Sub question

Q. I. Answer any **SIX** of the following: 6 x 05 = 30 Marks

From Unit – 1	:	Three Sub questions
From Unit – 2 & 3	:	One Sub question
From Unit – 4 & 5	:	One Sub question
From Unit – 6	:	One Sub question
From Unit – 7 & 8	:	One Sub question
From Unit – 9	:	One Sub question

Q. III. Descriptive answers: 10 Marks
One questions from Unit – 1
OR
One questions from Unit – 2 & 3

Q. IV. Descriptive answers: 10 Marks
One questions from Unit – 1
OR
One questions from Unit – 4 or 5

Q. V. Descriptive answers: 10 Marks
One questions from Unit – 6
OR
One questions from Unit – 7 or 8

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Karnatak Universiry, Dharwad

DISCIPLINE SPECIFIC ELECTIVE (DSE)

SEMESTER VI

GENETICS AND PLANT BREEDING

Practical

Time : 04 Hours Max. Marks: 40

Q. 1.	Estimate the percentage of pollen viability in the given flower A by Hanging drop method	07 marks
Q. 2.	Demonstrate the emasculation technique in the given plant twig B Show the preparation to the examiners and write the procedure.	05 marks.
Q. 3.	Solve the genetic problem C and D. .	08 marks.
Q. 4.	Identify and comment on the specimens / photographs D, E, F, G & H.	15 marks.
	Practical Record (Journal)	05 Marks.

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Instructions to the Examiners

Q. 1. Unopened flowers with intact anthers (Preparation – 2 marks, procedure – 3 marks, Inference – 2 marks)

Q. 2. One plant propagation or hybridization technique
(Preparation – 2 marks, Procedure – 2 marks, inference – 2 marks)

Q. 3. Genetic Problems – 02 (04 Marks each)

Q. 4. One material from Practical 1, 2, 3, 4, 5, 6 & 8 (Any five)

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)
SEMESTER VI
(Student shall choose either paper- I or Paper-II or paper –III)
PAPER-II: ANALYTICAL TECHNIQUES IN PLANT SCIENCES

(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Imaging and related techniques (15 Lectures)
Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit 2: Cell fractionation (8 Lectures)

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, $CsCl_2$ gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3: Radioisotopes (4 Lectures)
Use in biological research, auto-radiography, pulse chase experiment.

Unit 4: Spectrophotometry (4 Lectures)
Principle and its application in biological research.

Unit 5: Chromatography (8 Lectures)
Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit 6: Characterization of proteins and nucleic acids (6 Lectures)
Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Unit 7:Biostatistics (15 Lectures)
Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

Practicals

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

Suggested Readings

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: DISCIPLINE SPECIFIC ELECTIVE (DSE)

SEMESTER VI

(Student shall choose either paper- I or Paper-II or paper –III)

PAPER-III: RESEARCH METHODOLOGY

(Credits: Theory-4, Practicals-2)
THEORY

Lectures: 60

Unit 1: Basic concepts of research (10 Lectures)
Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs emperical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

Unit 2: General laboratory practices (12 Lectures)
Common calculations in botany laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases. Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.

Unit 3: Data collection and documentation of observations (6 Lectures)
Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissuespecimens and application of scale bars. The art of field photography.

Unit 4: Overview of Biological Problems (6 Lectures)
History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics-Transcriptional regulatory network.

Unit 5: **Methods to study plant cell/tissue structure (6 Lectures)**
Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultrathin sections.

Unit 6: Plant microtechniques (12 Lectures)
Staining procedures, classification and chemistry of stains. Staining equipment. Reactiv dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags). Cytogenetic techniques with squashed plant materials.

Unit 7: The art of scientific writing and its presentation (8 Lectures)
Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

Practical

1. Experiments based on chemical calculations.
2. Plant microtechnique experiments.
3. The art of imaging of samples through microphotography and field photography.
4. Poster presentation on defined topics.
5. Technical writing on topics assigned.

Suggested Readings

1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

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KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: SKILL ENHANCE COURSES (SEC-I)

SEMESTER VI

(Student shall choose either paper- IA or Paper-IB)

PAPER-IA: PLANT DIVERSITY AND HUMAN WELFARE

(Credits: 2)

THEORY **Lectures: 30**

Unit 1: Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.
(8 Lectures)

Unit 2:Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss,

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.
(10 Lectures)

Unit 3:Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation,
Biodiversity awareness programmes, Sustainable development. **(6 Lectures)**

Unit 4: Role of plants in relation to Human Welfare; a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses. **(6 Lectures)**

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

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: SKILL ENHANCE COURSES (SEC-I)

SEMESTER VI

(Student shall choose either paper- IA or Paper-IB)

PAPER-IB: ETHNOBOTANY

(Credits: 2)

THEORY **Lectures: 30**

Unit 1: Ethnobotany
Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses. **(8 Lectures)**

Unit 2: Methodology of Ethnobotanical studies
a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places. **(4 Lectures)**

Unit 3: Role of ethnobotany in modern Medicine
Medico-ethnobotanical sources in India;Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina, Trichopus zeylanicus, Artemisia,Withania*.
Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management). **(12 Lectures)**

Unit 4: Ethnobotany and legal aspects
Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge. **(6 Lectures)**

SUGGESTED READINGS

1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
3) Lone et al., Palaeoethnobotany
4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
5) S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
6) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
7) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996-9)

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: SKILL ENHANCE COURSES (SEC-II)

SEMESTER VI

(Student shall choose either paper- IIA or Paper-IIB)

PAPER- IIA: MUSHROOM CULTURE TECHNOLOGY

(Credits: 2)

THEORY **Lectures: 30**

Unit 1: Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - *Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus*. **(5 Lectures)**

Unit 2: Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production. **(12 Lectures)**

Unit 3: Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins. **(8 Lectures)**

Unit 4: Food Preparation_: Types of foods prepared from mushroom. Research Centres - National level and Regional level._Cost benefit ratio - Marketing in India and abroad, Export Value. **(5 Lectures)**

SUGGESTED READINGS

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

KARNATAKA UNEVIRSITY, DHARWAD
BOTANY: SKILL ENHANCE COURSES (SEC-II)
SEMESTER VI

(Student shall choose either paper- IIA or Paper-IIB)

PAPER- IIB: INTELLECTUAL PROPERTY RIGHTS

(Credits: 2)
THEORY **Lectures: 30**

Unit 1: Introduction to intellectual property right (IPR) **(2 lectures)**
Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples.IPR and WTO (TRIPS, WIPO).

Unit 2 : Patents **(2 Lectures)**
Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.

Unit 3: Copyrights **(2 Lectures)**
Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement.

Unit4: Trademarks **(2 Lectures)**
Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.

Unit 5: Geographical Indications **(2 Lectures)**
Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position.

Unit 6:Protection of Traditional Knowledge **(6 Lectures)**
Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospecting and Bio-Piracy, Alternative ways, Protectability, needfor a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.

Unit 7: Industrial Designs **(2 Lectures)**
Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

Unit 8: Protection of Plant Varieties **(4 Lectures)**
Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India. Rights of farmers, Breeders and Researchers.National gene bank, Benefit sharing.Protection of Plant Varieties and Farmers' Rights Act, 2001.

Unit 9:Information Technology Related Intellectual Property Rights **(4 Lectures)**
Computer Software and Intellectual Property, Database and Data Protection, Protection of Semi-conductor chips, Domain Name Protection

Unit 10: Biotechnology and Intellectual Property Rights. **(4 Lectures)**
Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions.

SUGGESTED READINGS

1. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).
2. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).
3. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).
4. Arthur Raphael Miller, Micheal H.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
5. Jayashree Watal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford.

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KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ

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website: kud.ac.in

No. KU/Aca(S&T)/SVB-06/BOS /Zoology (UG) /20-21/ 992

Date: 16 OCT 2020

NOTIFICATION

Sub: Regarding introduction of the syllabus of Zoology UG under C.B.C.S. w.e.f. the academic year 2020-21 & onwards.

Ref: 1. UGC Letter DO No. 1-1/2016(SECY), dt. 10.08.2016.
2. Speciai BOS Res. No. 01, dt. 04.07.2020.
3. Special Faculty Res. No. 14, dt. 11.08.2020.
4. Special Academic Council Res. No. 39, dt. 21.08.2020.
5. Vice-Chancellor's order dated – 07-10-2020

Adverting to the above, it is hereby notified to the Principals of all constituent and affiliated degree colleges coming under the jurisdiction of Karnatak University, Dharwad that the Zoology UG syllabus for I to VI Semester which is annexed herewith in Annexure-A is introduced under C.B.C.S. from the academic year 2020-21 & onwards.

Hence, the contents of this notification may piease be brought to the notiee of the students and all the concerned. The prescribed C.B.C.S. syllabus may also be obtained through K.U.website (www.kud.ac.in).

15/10/2020
(Dr. Hanumantappa K.T)
REGISTRAR

To,

1. The Chairman, BOS Zoology (UG), Dept. of Zoology, K.U.Dharwad.
2. The Chairman, Dept. of Zoology, K.U.Dharwad.
3. The Principals of all the constituted and affiliated degree colleges under the jurisdiction of Karnatak University, Dharwad. (The same may be sent through e-mail)
4. The Registrar (Evaluation), K.U.Dharwad.

Copy fwcs to:

1. Dr. Ch.Ramesh, Dean, Faculty of Science & Tech., Dept. of Zoology, K.U.Dharwad.
2. The Director, IT Section, Examiuation Section, K.U.Dharwad for information and to upload on K.U.Website (www.kud.ac.in).

Copy to:

1. PS to Vice-Chancellor, K.U.Dharwad.
2. S.A. to Registrar, K.U.Dharwad.
3. O.S., Exam UG / Confl / QP / GAD Section, K.U.Dharwad.
4. The System Analysist, Computer Unit Exam Section, K.U.Dharwad.

KARNATAK UNIVERSITY, DHARWAD

CBCS SYLLABUS

FOR

BACHELOR OF SCIENCE

ZOOLOOY

(I TO VI SEMESTERS)

FROM

2020-21 & ONWARDS

PREAMBLE

Zoology is the study of animals as well as human heings. It comprises and deals with the study of the organisms; development, structure, classifieation, hahits, habitats, distribution, physiology, hioehemistry, genetics, evolution, etc. Many hranches, specialization and fields of Zoology have contrihuted immensely to the progress of human welfare. The university has introduced the CBCS system, which gives an opportunity to the students to ehoose any field and acquire knowledge in the subject Zoology. The knowledge gained in the subject not only leads the students to pursue higher edueation and research, but also enables them to undertake self employment.

OBJECTIVES

The main purpose of B.Sc. Zoology course is to create knowledge among the students to know the importance of animals with emphasis on the following domains.

- To improve the knowledge on the systematic classifieation, physieal strueture, physiological reaetions, hiologieal functions, culture and maintenance of benefieial organisms, etc.
- To gain skill in microscopy, preparation of sample, observations of animal aetivities at moleeular, structural and organisms level.
- To make the students to acquaint with estimations, analysis of molecules to earry out routine elinical analysis of any samples.
- To make the students to aware and emphasize the role of genes/chromosomes in inheritance and genetic diseases.
- To make them self employable and a good entrepreneur in due course.

For fulfillment of the above objeetives, the following papers namely, non ehordate, chordate, histology, evolution, paleontology, biostatistics, moleeular cell biology, developmental biology, biochemistry, physiology, ethology, applied zoology, geneties, biotechnology, nanoteehnology, ecology, zoogeography and wildlife hiology have heen introduced in the B.Sc. Zoology degree course.

OUTCOME OF TRE COURSE

By learning Zoology suhject with emphasis on above said different domains, the students will aequire the neeessary knowledge and skills to pursue further studies and researeh in a wide range of subjeets like, moleeular hiology, apphed zoology, genetics, biotechnology, environmental biology, wildlife biology, ethology, ete. One ean also make use of the knowledge to hecome a self entrepreneur using the economically important animals and their products.

Karnatak University, Dharwad

CBCS syllabus for Under Graduate Programme in Zoology (optional)

Effective from 2020-21

Sem	Theory / Practical	Subject Code	Total Teaching hours per week	Total Teaching hours per Semester	Duratio u of Exams	Internal Assessmeut Marks	Semaster End Exam Murks	Total Murks	Credits
I	Theory	DSC ZOOT: 1.1	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC ZOOP: 1.1	04 hrs	60	03 hrs	10	40	50	02
I	Theory	DSC ZOOT: 2.1	04 hrs	60	03 hrs	20	80	100	04
I	Practical	DSC ZOOP: 2.1	04 hrs	60	03 hrs	10	40	50	02
III	Theory	DSC ZOOT: 3.1	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC ZOOP: 3.1	04 hrs	60	03 hrs	10	40	50	02
IV	Theory	DSC ZOOT: 4.1	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSC ZOOP: 4.1	04 hrs	60	03 hrs	10	40	50	02
V	Theory	DSE ZOOT: 5.1A OR ZOOT: 5.1B	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSE ZOOP: 5..1A OR ZOOP:5.1B	04 hrs	60	03 hrs	10	40	50	02
	Theory	SEC-1 ZOOT: 5.2A	02 hrs	30	02 hrs	10	40	50	02
	Theory	SEC-2 ZOOT: 5.2B	02 hrs	30	02 hrs	10	40	50	02
VI	Theory	DSE ZOOT: 6.1A OR DSE ZOOT: 6.1B	04 hrs	60	03 hrs	20	80	100	04
	Practical	DSE ZOOP: 6.1A OR ZOOP: 6.1B	04 hrs	60	03 hrs	10	40	50	02
	Theory	SEC-1 ZOOT: 6.2A	02 hrs	30	02 hrs	10	40	50	02
	Theory	SEC-2 ZOOT: 6.2B	02 hrs	30	02 hrs	10	40	50	02
Total						220	880	1100	44

Credit means the unit by which the course work is measured. One hour session of Lecture per week for 16 weeks amounts to 1 eredit. Four hours session of Practicals per week for 16 weeks amounts to 2 credits per semester.

I SEMESTER
PAPER DSCZOOT I.I : NON-CHORDATA

Total Teaching Hours: 60 hrs

I INTRODUCTION 02 hrs
Biodiversity and its importance, Principles of animal classification definition of species.

II KINGDOM PROTISTA (PROTOZOA) 06 hrs
General characters and classification up to classes with suitahle examples. Structure aud life history of malarial parasite *Plasmodium vivax.*

III PORIFERA 05 hrs
General characters and classification up to classes with suitahle examples. Canal system in sponges.

IV CNIDARIA 05 hrs
General characters and classification upto classes with suitable examples. Polymorphism in Cnidaria.

V PLATYHELMINTHES 05 hrs
General characters and classification up to classes with suitable examples. Parasitie adaptation. Life history of *Fasciola hepatica.*

VI ASCHELMINTHES 06 hrs
General characters and classification up to classes with suitable examples. Life history of *Ascaris and Wuchereria bancrofti.*

VII ANNELIDA 08 hrs
General characters and classification upto classes with suitable examples. *Hirudinea* type study – Externals, setae, digestive system; circulatory system, nervous system, nephridia and reproductive system. Tuhicolous polychaetes – *Sabella Chaetopterus.*

VIIIVIII
IX ONYCHOPHORA 02 hrs
Salient features of *Peripatus* and is systematic position

X ARTHROPODA 10 hrs
General characters and classification up to classes with suitable examples. Collection and preservation methods of insects. Beneficial and harmful insects – Integrated Pest Management (IPM).

XI MOLLUSCA 06 hrs
General Characters and classification upto classes with suitable examples. Foot and shell in mollusca.

XII ECHINODERMATA 05 hrs
General Characters and classification upto classes with suitahle examples. Water vascular system..

PRACTICAL DSCZOOP 1.1

1. Classification of each phylum upto classes with at least one suitable example.
2. Study of Leech/Cockroach- externals, digestive system, nervous system, Jaws, nephridia, ovary of Leech, Mouth parts, salivary glands, spermatheca of cockroach.
3. Mouth parts of insects permanent slides.
4. Study of protozoan culture/Vermiculture.
5. Collection and preservation methods of insects.

Collection methods: Hand picking, beating, aerial and aquatic nets, Burlese funnel and aspirator.
Trapping methods, types; light trap, sticky trap, pitfall Trap, bait, pheromone trap.
Preservation methods: Dry method (Pinning), Wet method (Liquid preservation) and microscopic preservation (Slide preservation).
Morphological Identification and Dissection of Insects:
Digestive, Circulatory, Nervous, excretory and Reproductive system.

6. Insect Culture: Media preparation for collection and culture. (*Drosophila*).
7. Field study.

SCHEME OF PRACTICAL EXAMINATION

1. Explain the system in	10
2. Protozoan culture/ Rectal parasites /nephredia/ovary/jaw/mouthparts/ salivary glands/Spermatheca	05
3. Identifieations (A to E)	10
4. Field Study Report	06
5. Viva	04
6. Journal	05
	Total 40

D SEMESTER

PAPER DSCZOOT 2.1 : CHORDATA

Total Teaching Hours:60hrs

I INTRODUCTION 05 hrs

General characters of the phylum and classification up to sub phyla. Hemichordata, Urochordata, Cephalochordata with suitable examples. Retrogressive metamorphosis in Urochordates.

II VERTEBRATA 02 hrs

General characters of vertebrates and outline classification.

III CYCLOSTOMATA 02 hrs

General organization and distribution.

IV PISCES 06 hrs

Chondrichthies: General Characters with suitable examples.
Osteichthyes: General Characters with examples. Fish migration, types of scales and fins.

V AMPHIBIA 04 hrs

General characters and classification up to orders with suitahle examples.

VI REPTILIA 05 hrs

General characters and classification up to orders (living reptiles only) with suitable examples. Poisonous and non-poisonous snakes of India and types of venom.

VII AVES 09 hrs

General characters and classification. Distinctive features of archaeornithes and neornithes with reference to palaeognathae (flightless birds), Impennae and Neognathae, giving suitable examples. Flight adaptations, beak and foot modifications.

VIII MAMMALIA 15 hrs

General characters and classification up to orders. Distinctive features of prototheria and metatheria with examples (with special emphasis on monotremes and marsupials). Important characters of primates, Chiroptera, Cetacea, Perissodactyla. Artiodactyla, Carnivora, Rodentia, Lagomorpha and Pholiodota with examples. Rat as type study – (muscular system excluded)

IX OSTEOLOGY 08 hrs

Study of endoskeleton of *Frog* and *Rabbit.*

X COMPARATIVE ANATOMY 04 hrs

Comparative account of Heart, brain.

PRACTICAL DSCZOOP 2.1

1. Classification up to orders with at least one suitable example.
2. Study of Local fish/rat/chick (anyone) exteruals, Digestive system, Circulatory system, Uriuogenital system and brain
3. Endoskeleton of *frog* and *rabbit*
4. Comparative anatomy of heart and braiu.

FIELD ORIENTED PROJECTS:

1. Field Study is compulsory
2. Visit to Zoo/forest/sanctuaries/ national park/ surroanding area to study the animal diversity related to project i.e., study the fishes, amphibians, reptiles, birds and mammals.

SCHEME OF PRACTICAL EXAMINATION

1. Explain the system in	06
2. Comparative anatomy (anyone)	05
3. Osteology (any two)	06
4. Identify and comment on A to D	08
5. Field study trip	06
6. Viva	04
7. Journal	05
	Total 40

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SCHEME OF THEORY EXAMINATION QUESTION PAPER

B.Sc. Degree Examination Month/Year

Semester

Zoology (CBCS System)

PAPER; DSCZOOT 1.1 Name of the paper

Time: Three Hours **Maximum: 80 Marks**

Instruction to Candidate

a. Answer all the questious.

b. Draw a neat labelled diagram wherever necessary.

I. Answer any TEN of the following in 3-4 sentences each: **10X2 = 20**

1-12 Questions

H. Answer any SIX of the following in 10-15 sentences each : **6X5 = 30**

13-20 Questions

III. Answer the following **3X10 = 30**

21. a OR b
22. a OR b
23. a OR b

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Suggested Readings:

1. Agarwal V. P. and Dalela R. C. (1975): Textbook of Vertebrate Zoology. Jai Prakashnath Co.
2. Barnes, R.D. (1982): Invertebrate Zoology. Fifth edition
3. Barnes, R.D. (1982): Vertebrate Zoology. Fifth edition
4. Barnes, R.S.K., Calow, P., Olive, P.J.W Golding, D.W. and Spicer, J.I. (2002): The Invertebrates: A New Synthesis, III Edition, Blackwell Science
5. Barrington E. J. W. (1981): Invertebrate structure and Functiou. ELBS.
6. Dhami P.S. and Dhami J. K. (2000): Chordate Zoology. S. Chand & Co. Dhami P.S. and Dhami J.K (2000): Invertebrate Zoology. S. Chand & Co.
7. Ekambaranatha Iyer M. and Anantakrishnan T. N. (1990): A manual of Zoology. Vol. I. Invertebrata (Part 1 &2). S. Vishwanathan Pvt. Ltd.
8. Ekambaranatha Iyer M. and Anantakrishnan T. N. (1990): A manual of Zoology. Vol. II. Chordata S. Vishwanathan Pvt. Ltd.
9. Jordan E. L. and Verma P.S. (1976): Chordate Zoology. S. Chand & Co. Jordan E. L. and Verma P.S. (1976): Invertebrate Zoology. S. Chand & Co.
10. Kotpal R. L. (1993): Protozoa- Echinodermata (all volumes). Rastogi Publ. Pough H (2004): Vertebrate life, VIII Edition, Pearson International.
11. Ruppert and Barnes, R.D. (2006): Invertebrate Zoology, VIII Edition. Holt Saunders International

III SEMESTER

PAPER DSCZOOT 3.1: HISTOLOGY, EVOLUTION, PALEONTOLOGY AND RIOSTATISTICS

Credits:04 **Total Teaching Hours: 60hrs**

I HISTOLOGY 20 hrs

Study of histological structure and functions of the following mammalian organs

a. Tongue
b. Stomach
c. Intestine
d. Testis
e. Ovary
f. Liver
g. Islets of Langerhans
h. Thyroid
i. Kidney
j. Adrenal

II EVOLUTION 18 hrs

Origin of earth, origin of life, theories of organic evolution. Lamarckism, *Darwin Wallace* Theory of natural selection Evidences in favor of evolution.

Neo-Darwinism (synthetic theory of evolution, gene mutation, gene flow, genetic diift, *Hardy Weinberg* equilibrium) concept of species Speciation, allopatric and sympatric species

III PALEONTOLOGY 15 hrs

Geological time scales, fossils and fossilization. Radiometric dating – detection of age of fossils. Indian fossil sites. Mesozoic reptiles. Connecting links, living fossils, origin and evolution of man. Evolution of horse.

IV BIOSTATISTICS 07 hrs

Use of statistics in life sciences, data collection, observations and variables, sampling and sampling methods, representation, tabular and graphical representations; frequency tables, line graphs, bar graphs, histograms, frequency polygon and curve and pie charts; measure of central tendency; mean; median and mode. Measures of dispersion; range, standard deviation; Standard error

PRACTICAL DSCZOOP 3.1

Total Teaching Hours : 60 hrs

1. Observation of mammalian histology slides of the organs studied in the theory paper.
2. Preparation of permanent histology slides, three slides to be submitted at the time of practical examination.
3. Evolution of man and horse (charts or models)
4. Mesozoic reptiles (charts or models)
5. Connectinglinks/living fossils : *Neopilina, peripatus, limulus, latimuria, sphenodon, archaeopteryx and duck billed platypus*
6. Vestigial organs
7. Biostatistics practicals
    a. Measures of central tendency i) Obtain the mean, medium and mode, ii) Form a frequency distribution table of the data and then compute mean, median andmode.
    b. Prepare a frequency distribution table and draw a histogram, frequency polygon and frequency curve.

SCHEME OF PRACTICAL EXAMINATION

1.	Preparation of permanent histology slide	08
2.	Identifications	
	a. Histology – Any 4	08
	b. Evolution – Any 1	02
	c. Connecting links/living fossils –Any 1	02
3.	Histology slide submission – 3 slides	06
4.	Biostatistics	05
5.	Viva	04
6.	Journal	05
	Total	**40**

IV SEMESTER
PAPER DSCZOOT 4.1: BIOCHEMISTRY AND PHYSIOLOGY

Credits: 04 **Total Teaching Hours: 60 hrs**

I CARBOHYDRATES, PROTEINS and LIPIDS 09 hrs

Deflnition, classification and biological significance.

fl. ENZYMES 06 hrs

Classification of enzymes – IUB system, mechanism of enzyme action, enzyme substrate complex, specificity of enzymes, reversibility of enzyme action, enzyme inhibitors, a brief account of coenzymes, cofactors and ions, clinical importance of enzymes

III. NUCLEIC ACIDS 03hrs

Nucleotides, nucleosides, nitrogen bases, structure of nucleic acid (DNA & t-RNA).

IV. VITAMINS 04hrs

Fat soluble vitamins (A, D, E and K) water soluble vitamins (B-complex and C) functions and deficiency symptoms

V BIOENERGETICS 04 hrs

Concept of bioenergetics, energy yielding pathways, glycolysis, bioenergetics of glycolysis, the Kreb's cycle, bioenergetics of Kreb's cycle, the electron transportsystem, phosphorylation

VI. DIGESTION 03 hrs

Mechanical digestion, chemical digestion, assimilation and absorptiou of proteins, carbohydrates and lipids. Hormonal regulation of enzyme secretion

VII. RESPIRATION 03 hrs

External and internal respiration. Respiratory pigments, hemoglobin, hemocyanin and hemerythrin. Physiology of respiration, exchange of gases, transport of oxygen, oxygen dissociation curves, Bohr Effect, transport of carbon dioxide, chloride shift, respiratory quotient

VIII. CIRCULATION 03 hrs

Types of circulation, structure, functions and regulation of human heart, blood pressure, Composition of human blood, Neurogenic and myogenic hearts

IX. NITROGEN EXCRETION 04 hrs

Nitrogen excretion in aquatic terrestrial and aerial animals; ammonotelism, ureotelism and uricotelism with examples; ornithine cycle, physiology of urine formation in man

X. MUSCLE CONTRACTION 05 hrs

Principal types of muscles, ultra-structure of striated muscles, role of myosin, actin, tropomyosin, troponin and actinin; Mechanism of muscle contraction and relaxation, the sliding fllament theory, Chemical changes during muscle contraction, Neuromuscular junction

XI. NERVOUS COORDINATION 04 hrs

Structure and conduction of nerve impulse in medullated and non-medullated nerves, synaptic transmission.

XII. ENDOCRINE SYSTEM 06hrs

Structure and function of endocrine glands. Hypothalamo-hypophyseal Portal system. Types of hormones and their mechanism.

XIII. IMMUNOLOGY 06 hrs

Type of immunity: Innate and adaptive immunity, Cell mediated and humoural mediated immunity, Haematopoiesis, Activation of adaptive immunity, Generation of antibody diversity, Vaccines and its types.

AIDS: causative factors, effects and preventive measures

(Unit I to IV: Biochemistry; Unit V to XIII: Physiology)

PRACTICAL DSCZOOP 4.1

Total Teaching Hours: 60 hrs

1. Biochemical tests for proteins, carbohydrates and fats.
2. Normal and abnormal constituents of urine.
3. Action of salivary amylase.
4. Preparation of haematin crystals.
5. Estimation of hemoglobin.
6. Total count (TC) differential count (DC) or RBC and WBC.
7. Blood clotting time.
8. Demonstration of blood pressure.
9. Blood typing – A, B, AB, O and Rh factors in Human blood.

SCHEME OF PRACTICAL EXAMINATION

1.	Qualitative test for proteins/carbohydrates/fats	10
2.	Normal/abnormal constituents of urine	05
3.	Preparation of hematincrystals/clottingtime/ Action of salivary amylase	06
4.	Hemoglobin estimation TC/DC	10
5.	Viva	04
6.	Journal	05
	Total	**40**

PAPER DSEZOOT 5.1 A V SEMESTER

PAPER DSCZOOT 5.1A: MOLECULAR CELL RIOLOGY AND DEVELOPMENTAL BIOLOGY

Credit: 04 **Total Teaching Hours: 60 hrs**

I MICROSCOPY 03 hrs

Properties of Light. Light, fluorescence, electron and phase coutrast microscopes.

II CELL AND ITS ORGANELLES 05 hrs

Ultra-structure of prokaryotes and eukaryotes (animals cefl) molecular structure and fuuction of Plasma membrane, endoplasmic reticulum, Golgi complex, mitochondria, lysosomes, ribosomes, uucleus and uucleolus.

III CHROMOSOMES 03 hrs

Types of Chromosomes, heterochromatin and euchromatin, polytene chromosomes.

IV FLOW OF GENETIC MATERIAL ANDITS MAINTAINENCE AND REGULATION: 05 hrs

Griffith's transformation experiment, Avery–MacLeod–McCarty experimaut. Hershey – Chase experiment, Double helical structure of DNA, Messilson and Sthal semi-conservative replication, Replication in prokaryotes and eukaryotes. DNA _Transcription, Translation in prokaryotes, RNA_ RNA as genetic material, types of RNA and structure of t-RNA. Genetic code and its properties.

IV MITOSIS AND CELLCYCLE 04 hrs

Stages of Mitosis, Interpbase, G_1 S and G_2 pbases, molecular events at different stages of cell cycle.

V MEIOSIS 04 hrs

Phases of meiotic cycle, first meiotic division - prophase-l, leptotene, zygotene, pachytene, synaptonemal complex and recombination and diplotene, diakinesis, Mechanism of crossing over, metaphase I, anaphase l and telophase I and cytokinesis, second meiotic division, Significance of meiosis

VI CANCER ANDCARCINOGENIC AGENTS 03 hrs

Types of cancer, proto-oncogenes, oncogenes, carcinogenic agents, physical, chemical and biological causes and suppressor genes (RB gene, p53 gene).

VII INTRODUCTION TO DEVELOPMENTAL BIOLOGY 02 hrs

Scope and theories of development biology. Gametogenesis (in detail)

VIII FERTILIZATION 03 hrs

Types and mechanism of fertilization, approximation of gametes, fertilizin and antifertilizin acrosome reaction, amphimixis, Monspermic and polyspermic fertilization. Significance of fertilization.

IX PARTHENOGENESIS 03 hrs

Kinds of parthenogenesis. Natural arrhenotoky, thelytoky and cyclical. Artificial parthenogenesis, significance of parthenogenesis

X CLEAVAGE 04 hrs

Types of cleavage, holoblastic, meroblastic, radial and spiral types with examples

XI EARLY DEVELOPMENTOF FROG 05 hrs

Structure of frog's egg, cleavage, blastula, fate maps, gastrulation, morphogenesis, notogenesis, and neurulation.

XII ORGANIZER PHENOMENON 05 hrs

Definition, potencies of the dorsal lip of the blastopore of amphibian gastrula, Brachet's experiment, experiment of Spemann and Mangold, induction, chemical nature of organizer, parts of organizer, theories of organizer phenomenon

XIII EXTRA-EMBRYONIC MEMBRANES AND EARLY DEVELOPMENTOF CHICK 08 hrs

Development, structure and functions of yolk sac, amnion, chorion and allantois. Structure of hen's egg, cleavage, blastula, gastrulation, origin and structure of primitive streak, structure of 18, 24, 36 and 48 hrs chick embryos

XIV PLACENTA 03hrs

Yolksac placenta, allantoic placenta, structure (morphological and histological) and functions of placenta, classification of placenta with examples

(Unit I to VII: Cell Molecular Biology; Unit VIII to XV: Developmental Biology)

PRACTICAL DSE ZOOP 5.1A

Credit: 04

1. Study of fixatives and stains: Preparation of formaldehyde (4 to 10%), alcohol (70 to 100%) Boin's fluid, Carnoy's fluid, borax carmine (alcoholic), eosin (alcoholic) iron hematoxylin, acetocarmine, aceto-orcieu, Schiff's reageut (Feulgen method) and Giemsa's stain.
2. Observation and study of permanent slides for mitosis, meiosis and salivary gland chromosomes
3. Squash preparation of onion root tip to study stages of mitosis
4. Squash preparation of grass hopper testis/flower bud to study stages of meiosis
5. Squash preparation of salivary gland chromosomes of Drosophila
6. Stages of development of frog : the study of cleavage stages, blastula, gastrula and neurula and various stages of tadpole
7. Observation of various stages of frog development in nature
8. Study of permanent slides of chick embryo: 18 hrs, 24 hrs, 36 hrs and 48 hrs wbole mounts and T, S of 18 hrs and 24 hrs chick embryos
9. Mounting of chick embryo

SCHEME OF PRACTICAL EXAMINATION

1.	Composition and preparation	i. Fixative	02
		ii. Stain	02
2.	Stages of mitosis/meiosis (two stages)		04
3.	Squash preparatiou (mitosis/meiosis)		07
4.	Mounting of chick embryo		08
5.	Identifications, Developmental stages of frog (2) chick (2)		08
6.	Viva		04
7.	Journal		05
		Total	**40**

OR

Credit: 04 **DSEZOOT: 5.1 B ETHOLOGY& APPLIED ZOOLOGY**

5.2.1: ETHOLOGY: (Unit I to VIII)

i INTRODUCTION 04 hrs

Definition, scope of ethology, contributions of Konrad Lorenz, Niko Tinbergen and Karl Von Frisch.

1l TYPES OFAN1MAL BEHAV1OUR 06 hrs

lunate behavior, taxes, reflexes, instincts and motivation, learned behavior, habituation, imprinting, conditioned reflexes and insight learning.

i1I SOC1AL ORGANIZATIONIN ANIMALS 05 hrs

Honey bees, termites and langur.s

iV COURTSHIP BEHAV1OUR 05 hrs

General principles of courtship bebavior with snitable examples

Courtship behavior, Types of courtship behavior witb snitable examples

(Fiddler crab, Scorpion, Salamander, Bower bird).

V PARENTAL CARE 05 hrs

Parental care in fishes, amphibians and birds with suitable examples.

V1 NESTING BEHAV1OUR 05 hrs

Types of Nests: Nests and nesting behavior in wasps and birds (with suitable examples).

V1l COLORAT1ON AND MIMICRY 05 hrs

Definition, types of mimicry, Batesian Muflerian protective, aggressive and warning mimicry with suitable Indian examples.

APPLIED ZOOLOGY (Unit IX to XIV)

V1lI AQUACULTURE 05 hrs

Fresh water, brackish and marine water fish culture in India, prawn and pearl culture.

IX VERM1CULTURE 05 hrs

Introduction and importance of vermiculture. Different species of earthworm used in vermiculture, uses of earthworms for biodegradation of organic waste materials, earthworm as protein source, vermiculture technique.

XII. POULTRY SCIENCE 05 hrs

Introduction, breeds of fowls, poultry keeping, uutritive value of egg and meat, poultry diseases.

XIII. DAIRY TECHNOLOGY 05 hrs

Introduction, breeds of cattle, breeding and cattle improvement in India nutritive value of milk and milk byproducts.

XIV SERICULTURE 05 hrs

Introduction,Life cycle of Bombyx mori, Rearing of silkworm (Early and Late age), Types Of montages, Harvesting of cocoons and Spinning. Diseases of silkworm and control . Measures.

Credit : 02 PRACTICAL DSCZOOP 5.1B

1. Identification of castes in social insects.
2. Observation of courtship behavior in animals.
3. Observation of parental care in auimals.
4. Observation of different types of nests and nest materials.
5. Coloration and mimicry.
6. Breeds of poultry.
7. Study of commercially important
    a. Crustaceans
    b. Molluscs
    c. Fisbes
8. Visit to nearby diary, poultry, bee keeping unit, vermiculture unit and termite mound for observation.

SCHEME OF PRACTICAL EXAMINATION

1.	Identification	20
	a. Types of Nest (any 1)	
	b. Castes in social insects (any 2)	
	c. Coloration and mimicry	
	d. Ponltry breeds	
	e. Commercially important fisbes, crustaceans, molluscans, freshwater fish and marine water fisb (one from each)	
	f. Courtship behavior (any oue)	
	g. Parental care (any one).	
2.	Project	10
3.	Viva	04
4.	Journal	05
		Total 40

Fifth Semester B.Sc. (Zoology) Skill Enhancement Conrse

Paper Code: SEC-1 ZOOT 5.2A | **Paper Title:** lmmuuology
Teaching Honrs: 2 H / Week | **Marks:** Th-40+lA-10
Total honrs: 30 | **Credits :**2

Unit 1: **Overview of the Immune System.** 08 Hours
lutroductiou to basic coucepts in immuuology, principles of innate and adaptive immuue system

Unit 2: **Cells and Organs of the Immune System:** **06 Hours**
Haematopoeisis, Cells of immuue system and organs (primary and secondary lymphoid organs) of the immuue system

Unit 3: Antigens: **06 Hours**
Basic properties of antigeus, B and T cell, epitopes.

Unit 4: Antihodies: **06 Hours**
Structure, classes and fuuctiou of antibodies, monocloual autibodies, antigeu antibody interactions as tools for research and diagnosis.

Uult 5: **Vaccines:** **04 Hours**
General introduction to vaccines, Various types of vaccines; Attenuated viral aud bacterial (Live) vaccines, lnactivated vaccines, Toxoid vaccines, Sub unit vaccines and Conjugate vaccines.

SUGGESTED READINGS

1. Kindt, T. J., Goldsby, R.A., Osborue, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.
2. David, M., Jonathan, B., David, R. B. and lvan R. (2006). *Immunology,* Vl1 Editiou,
3. Mosby, Elsevier Publicatiou.
4. Abbas, K. Abul aud Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology.* V Edition. Sauuders Publication.

Fifth Semcster B.Sc. (Zoology) Skill Enhancemcnt Course

Papcr Code: SCE-2 ZOOT 5.2B
Teaching Hours: 2 H / Week
Total hours:30

Papcr Titic: APICULTURE
Marks: Th-40+IA-10
Credits :2

Unit 1: Biology of Bees 5hr

History, classification and biology of honey bees.
Social organization of bee colony, honey bee foraging plants.

Unit 2: Rearing of Bees 12hr

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth
Bee Pasturage
Selection of Bee species for Apicnlture
Bee keeping eqnipment.
Methods of extraction of honey (Indigenons and Modern).

Unit 3: Diseases and Enemies 5hr

Bee diseases and enemies.
Control and preventive measures

Unit 4: Bee economy 4hr

Products of Apiculture indnstry and its uses (honey, bee wax, propolis), pollen, etc.

Unit 5: Entrepreneurship in Apiculture 6hr

Bee keeping industry – recent efforts, modern methods in employing artificial Bee hives for cross pollination in horticultural gardens.

SUGGESTED READINGS

1. Bisht D.S.-.Apiculture, ICAR Pnblication.
2. Singh S., ( ) Beekeeping in India, Indian conncil of Agricnltural Research, New Delhi.
3. Prost. P.J. (1962) – Apicnlture, Oxford and IBH, New Dhelli

VI SEMESTER

PAPER DSEZOOT:6.1A: GENETICS, BIOTECHNOLOGY AND NANO TECHNOLOGY
Credits:04

Totai Teaching Hours : 60 hrs

I INTRODUCTION 04 hrs

Heredity and environment, definition of genotype, phenotype, Mendel and his contributions, monobybrid and dihybrid cross.

II INTERACTION OF GENES 08 hrs

Supplementary factors- 9:3:3:1	Example : comb pattern in fowls
Dominant epitasis – I2:3:I	Example : plnmage color in Leghorn and Wyandotte
Recessive epistasis - 3:3:4	Example – coat color in mice
Complementary factors 9:7	Example – flower color in sweet peas
Lethal gene	Example- coat color in mice

III MULTIPLE ALLELES 04 hrs

Inheritance of coat color in rabbit, isoalleles – psuedoalleles and position effect, ABO blood groups in human, Rh factor

IV LINKING AND CROSSING OVER 04 hrs

Linkage in Drosophila, theories of llnkage, crossing over, cytological basis of crossing over, significance of crossing over, genetic map of chromosomes

V SEX DETERMINATION 04 hrs

Chromosomal mechanism of sex determination, genic balance theory, gynandromorpbs and intersexes. Environmental and bormonal effects on determination of sex, Amniocentesis.

VI SEX LINKED INHERITANCE 04 hrs

Sex linked inheritance in Drosophila and man. Hemophilia and color bllndness in mau. Sex linkage in ponltry. Y linked genes.

VII MUTATIONS 03 hrs

Chromosomal aberrations, molecular basis of gene mutation and types.

VIII HUMAN GENETICSAND EUGENICS 09 hrs

Karyotype analysis: normal male, normal female, Down's syndrome, cat cry syndrome, Turner syndrome, Klinefelter syndrome, and 21 trisomy; Common human genetic disorders, inborn errors of metabolism, albinism, pbenylketonuria, alkaptoneuria, sickle cell anemia, thalassemia, Huntington's chorea, Eugenics.

IX EXTRACHROMOSOMAL INHERITANCE 02 hrs

Kappa particles in paramecinm

X CONCEPT AND SCOPE OF BIOTECHNOLOGY 04 hrs

XI Isolation of DNA, molecnlar cloning, gene cloning, gene library, diagnosis of hereditary diseases, DNA flnger printing, PCR tecbnique, application of biotechnology, animal cloning, transgenic animals/proteomics, genomics, buman genome project. 08 hrs

XII Introdnction to nano science and nanotechnology, Types of nano-materials, nanobiotecbnology in healthcare, environmental nanotechnology 06 hrs

(Unit I to X: Genetics; Unit XI: Biotechnology; Unit XII : Nanotechnology)

PRACTICAL: DSCZOOP :6.1A

Credits: 02

1. Karyotype analysis; normal male, normal female, Down's syndrome, Catcry syndrome, Tnner's syndrome, Klinefelter's syndrome, and 21 trisomy
2. Mntant forms of Drosophila
3. Genetic problems; monohybrid inheritance (3), dihybrid inheritance (3)
4. Genetic problems: multiple alleles- ABO blood groups in bumans (3)
5. Genetic problems: sex llnked inheritance in Drosophila (2) and man (2)
6. Calculation of allele frequency – PTC (Phenyl thio Carbamide) tongue rolling, attached ear lobes

SCHEME OF PRACTICAL EXAMINATION

1.	Karyotype analysis	10
2.	Mutant forms of drosophila (any 2)	06
3.	Genetic problem (5) Monohybrid, dibybrid, multiple alleles and sex-linkedinheritance in drosophila and man	15
4.	Viva	04
5.	Journal	05
	Total	**40**

OR

PAPER DSEZOOT 6.1B: ENVIRONMENTAL BIOLOGY& ZOOGEOGRAPHY AND WILDLIFE BIOLOGY

Credit: 04 **Total Teaching Hours: 60 hrs**

I INTRODUCTION 03 hrs

Ecological spectrum, subdivisions of ecology, scope of ecology

II BIOGEOCHEMICAL CYCLES 06 hrs

Principles and coucepts to biogeocbemical cycles. Hydrological, Carbon, Nitrogen, Oxygen, Sulphur and Pbospborus cycles

III ABIOTIC AND BIOTIC FACTORS 08 hrs

Biotic factors, light, effect of light on plants and animals. Temperature; tbermal stratification, cyclomorpbosis. Adaptatious to extreme temperatures; soil; soil organisms; water; oxygen; carbon dioxide; fire and wind

Biotic factors, animal relationships, mutualism, commensalism, parasitism, ameusalism, predation and competition with relevant examples

IV HABITATS 06 hrs

Marine habitat, zonation of the sea and ecological classification of mariue biota, coastal ecology, estuarine ecology and mangroves.

Freshwater habitat, lentic and lotic systems. Ecological classificatiou of fresh water animals'

Terrestrial babitat; a brief account of biomes

Ecological adaptations to marine, freshwater and terrestrial habitats

V POPULATION ECOLOGY 04 hrs

Population density, natality and mortality, age distribution, population growth rate, population growth curves, biotic potential, Allee's principle and Gause's Principle

VI COMMUNITY ECOLOGY 06 hrs

Community structure, ecological determinants, ecological stratification, ecotone and edge effect, ecological niches, ecological succession, climax community, alpba, beta, gamma diversity, Shanon index. Liebig's and Shelford's laws and combined concept of limiting factors

VII POLLUTION 06 hrs

Air, Water, Soil Pollution, noise, visual aud agricultural pollutiou, e-waste, solid and hazardous waste management with example. **Toxicants – natural and synthetie toxicants and toxicity measorements. Global warming, acld rain, bio-accumuiation, bio - magnification, eutrophication- types and its impaet.**

ZOOGEOGRAPHY AND WILDLIFE BIOLOGY (Unit – VIII to XII)

VIII GEOGRAPHIC DISTRIBUTIONOF ANIMALS 03 hrs

Continuous and discontinuous distributions with examples, barriers of dispersal, topographic and vegetation barriers, large bodies of water as barriers, climatic barriers

IX ZOOGEOGRAPHY 06 hrs

Zoogeographical realms (with subdivisions) of world, with climatic conditions and examples of cbaracteristic fauna, a brief account of Wallace's line

X DISTRIBUTION OF WILD LIFE IN INDIA 04 hrs

The Himalayan ranges, the peninsular India subregion, deccan plateau, western ghats, eastern hill chain, Aravali ranges, Indian desert, tropical rain forests, wildlife in Andaman and Nicobar Islands

XI WILD LIFE PROBLEMS 02 hrs

Hunting, overharvesting, habitat destruction degradation, due to over population, and possibilities of climatic changes

XII WILD LIFE CONSERVATION 06 hrs

Need for wild life conservation agencies eugaged in wild life conservation. Government organization and nongovernment organizations. Wild Life Protection Act 1972, CITES: Convention on International Trade in Endangered Species of wild life flora and fauna; endangered fauna and flora of India. Red data book. Ramsar convention. CBD: convention of Biological Diversity, Project Tiger

PRACTICAL DSCZOOP 6.1B

Credit: 02

1. Estimation of dissolved oxygen, carbon dioxide, hardness, chloride, alkalinity and pH of waters.
2. Study of tropical pond as an ecosystem, study of fauna and llora and interaction between tbe various coustitueuts using Charts
3. Study of community by quadrat method to determine frequency, density and abundance of different species present in the community, alpba diversity
4. Location of species of zoological interest on the Indian map and world map, lligbtless birds, Tiger, Lion, Gorilla, Hippopotamus, Rhiuoceros, Dipnoi and Peripatus.
5. Location of tiger reserves, national parks, biosphere reserves, wild life sanctuaries of India on map
6. Study of threatened animals of India (by models/pictures/charts) Tiger, Lion, One borned Rhinoceros, Gaur, Golden Langur, Lion tailed monkey, Musk deer, Mouse deer, Kashmir stag, Great Indian Hornbill and Indian rock python
7. Study of biomass of consumers of a particular area by quadrat method- by determiniug tbe dry weigbt of living organisms – both animals and plants per unit area.
8. Study of ecological adaptations and morphological peculiarities- Hermit crab, Stick insect, Glow worm,Stinkbug, Pufferfish, Anglerfish, Exocoetes, Phrynosoma, Draco, Cbameleon, and Bat

SCHEME OF PRACTICAL EXAMINATION

1.	Estimation	10
2.	Identification-5	10
3.	Project works report on ecology/wildlife biology	10
4.	Viva counected with field work report	05
5.	Journal	05
	Total	**40**

Sixth Semester B.Sc. (Zoology) Skill Enhancement Course

Paper Code: SEC-1 ZOOT 6.2 A **Paper Title: INSECT, VECTOR AND DISEASES**
Teaching Hours: 2 H / Week **Marks:** Th-40+IA-10
Total hours: 30 **Credits :**2

Unit I: **05 Hours**
Introductlou to Insects: Geueral Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts and feeding habits.

Unit H: **04 Hours**
Concept of Veetors: Brief introduction of Carrier and Vectors (mechanical and biological vector).

Unit III: **10 Honrs**
Dipteran as Disease Vectors : Dipterans as important insect vectors – Mosquitoes, Houseflies; Study of mosquito-borne diseases – Malaria, Deugue, Chikuugunya, Filariasis; Causes, symptoms Control of mosquitoes and Control of house fly.

Unit IV: **04 Hours**
Siphonaptera as Disease Vectors: Fleas as important insect vectors; Study of Flea-borne diseases – Plague, Coutrol of fleas.

Unit VI: **04 Honrs**
Siphuncniata as Disease Vectors: Human louse (Head, Body) as important insect vectors; Study of louse-borne diseases –Typhus fever and Coutrol of humau louse.

Unit VII: **03 Hours**
Hempitera as Disease Veetors
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Control and preventiou measures.

SUGGESTED READINGS

1. Imms, A.D. (1977). *A General Text Book of Entomology*. Chapmau & Hall, UK
2. Chapman, R.F. (1998). *The Insects: Structure and Function.* IV Edition, Cambridge University Press, UK
3. Pedigo L.P. (2002). *Entomology and Pest Management.* Prentice Hall Publication
4. Mathews, G. (2011). *Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases*. Wiley-Blackwell

Sixth Semester B.Sc. (Zoology) Skill Enhancement Course

Paper Code: SEC-2 ZOOT 6.2 B | **Paper Title**: Aquarium fish keeping
Teaching Hours: 2 H / Week | **Marks:** Th-40+IA-10
Total hours:30 | **Credits:** 2

UNIT – 1 **15 Hours**

Introductlon to Aquarium Fish Keeping: The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic aud Endemic species of Aquarium Fisbes.

Biology of Aqnarium Fishes: Commou characters and sexual dimorphism of Fresh water and Mariue Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemoue fish and Butterfly fish.

Food and feeding of Aqnarium fishes: Use of live fish feed organisms. Preparation and compositiou of formulated fish feeds.

UNIT – 2 **15 Hours**

Fish Transportation: Live fish transport - Fish handling, packing and forwarding techniques.
Maintenance of Aquarium: Geueral Aquarium maiutenauce – budget for setting up an Aquarium Fish Farm as a, Cottage ludustry.

Aquarium design, Constructlon and preparatlon: size, shape, substrate, ornamental aquatic plauts. Construction and functions of Bio-filters; aerators – accessories for fish tanks and maintenance of water quality: controlling ammonia bulld up, Pb.

SUGGESTED READINGS

1. Baradach, JE, JH Ryther and WO Mc Larney (1972). Aquaculture. The Farming nnd Husbandry of Freshwater and Mariue Organisms. Wiley Interscience, New York.
2. Jameson, J.D. and R. Santhanam (1996). Manual of ornamental fisheries and farming techuology. Fisheries College and Research Institute, Thoothukudi.
3. Mitchell Beazley, 1998. The complete guide to tropical aquarium fish care. Read and Consumes Book Ltd., London.
4. Jameson, J.D. Alangara Meen Valarpu (in Tamil). National Book House, New Delhi. 5. Mill Dick, 1993: Aquarium fish, DK Pnbl. Co, luc. New York –USA

SCHEME OF THEORY EXAMINATION QUESTION PAPER

B.Sc Degree examination Month/Year

Semester

Zoology (CBCS System)

PAPER; DSC-ZT (code) Name of the paper

Time: Three Hours Maximum marks; 80

Instruction to Candidates

a) Answer all the questions
b) Draw a neat labeled diagram wherever necessary

I. Answer any TEN of the following iu 3-4 sentences each 10 x2 =20

Q. 1- 12

II. Answer any SIX of the following in 10 - 15 sentences each 5 x6 =30

Q. 13- 20

III. Answer any of the following 3 x10 =30

Q. 21. a OR b.
22. a OR b
23. a OR b

****

The question paper should be prepared from all the units with equal weight age.

SCHEME OF THEORY EXAMINATION QUESTION PAPER
B.Sc Degree examination Mouth/Year
Semester
Zoology (CBCS System)
PAPER; SEC-ZT (code) Name of the paper

Time: Two Hours Maximum marks; 40

Iustructiou to Candidates

a) Answer all the questions
b) Draw a neat labeled diagram wherever necessary

I. Answer any FOUR of the following in 3-4 sentences each 4 x2 = 8
Q. 1- 6

11. Answer auy THREE of the following in 10 - 15 sentences each 3 x4 =12

Q. 7- I2

III. Answer any of the following 2 x10 =20

Q. 13. a OR b.
14. a OR b

****

The question paper should be prepared from all the units with equal weight age.

XII POULTRY SCIENCE 03 hrs

Introduction, breeds of fowls, poultry keeping, nutritive value of egg and meat, poultry diseases

XIII DAIRY TECHNOLOGY 02 hrs

Introduction, breeds of cattle, breeding and cattle improvement in India nutritive value of milk and milk byproducts

XIV SERICULTURE 05 hrs

Mulberry varieties and cultivation methods (Pit system and Row system) Types of silkworms, a. Mulberry silkworms and b. Non-Mulberry silkworms. Life history of silkworm and importance of sericulture. Silkworm rearing, chawki rearing and late age worms rearing, Mounting and harvesting. Silk worm diseases in brief

(Unit I to VIII : Ethology; Unit IX to XIV : Applied Zoology)

PRACTICAL 5.2

1. Identification of castes in social insects
2. Observation of courtship behavior in animals
3. Observation of parental care in animals
4. Observation of different types of nests and nest materials
5. Coloration and mimicry
6. Breeds of poultry
7. Life cycle of silk worm, study of diseases of silk worm
8. Study of commercially important
   a. Crustaceans
   b. Molluscs
   c. Fishes
9. Visit to nearby diary, poultry, sericulture farm bee keeping unit, vermiculture unit and termite mound for observation

PAPER 5.2 : ETHOLOGY AND APPLIED ZOOLOGY

Total Teaching Hours : 45 hrs

I INTRODUCTION 02 hrs

Definition, scope of ethology, contributions of Konrad Lorenz, Niko Tinbergen and Karl Von Frisch

II TYPES OF ANIMAL BEHAVIOUR 04 hrs

Innate behavior: taxes, reflexes, instincts and motivation; learned behavior: habituation, imprinting, conditioned reflexes and insight learning

III SOCIAL ORGANIZATION IN ANIMALS 04 hrs

Honey bees, termites and langurs

IV COURTSHIP BEHAVIOUR 04 hrs

General principles of courtship behavior with suitable examples

V PARENTAL CARE 04 hrs

Parental care in fishes, amphibians and birds with suitable examples

VI NESTING BEHAVIOUR 03 hrs

Types of Nests: Nests and nesting behavior in wasps and birds (with suitable examples)

VII COLORATION AND MIMICRY 03 hrs

Definition, types of mimicry: Batesian, Mullerian, protective, aggressive and warning mimicry with suitable Indian examples

VIII ANIMAL COMMUNICATION 02 hrs

Functions of signals, odors, sounds and light

IX APICULTURE 07 hrs

Importance, history and developments of bee keeping. Different species of honey bees and their distribution. Management of bees, product and byproducts of apiculture and their uses

X AQUACULTURE 04 hrs

Fresh water, brackish and marine water fish culture in India, prawn and pearl culture

XI VERMICULTURE 02 hrs

Introduction and importance of vermiculture. Different species of earthworms used in vermiculture; uses of earthworms for biodegradation of organic waste materials, earthworm as protein source, vermiculture technology

II SEMESTER

PAPER 2.1 : CHORDATA

Total Teaching Hours : 70 hrs

I INTRODUCTION — 06 hrs

General characters of the phylum and classification up to subphyla Hemichordata, Urochordata, Cephalochordata with suitable examples. Retrogressive metamorphosis in urochordates

II VERTEBRATA — 02 hrs

General characters of vertebrates and outline classification

III CYCLOSTOMATA — 02 hrs

General organization and distribution

IV PISCES — 08 hrs

a. Chondrichthies: General Characters with examples
b. Osteichthyes: General Characters with examples

Fish migration, types of scales and fins

V AMPHIBIA — 04 hrs

General characters and classification up to orders with suitable examples

VI REPTILIA — 06 hrs

General characters and classification up to orders (living reptiles only) with suitable examples. Arcades and fossae in reptiles, Indian snakes, poisonous and non poisonous snakes

VII AVES — 10 hrs

General characters and classification. Distinctive features of archaeornithes and neornithes with reference to palaeognathae (flightless birds), Impennae and Neognathae, giving suitable examples. Flight adaptations, beak and foot modifications. Bird migration

VIII MAMMALIA — 16 hrs

General characters and classification up to orders. Distinctive features of prototheria and metatheria with examples (with special emphasis on monotremes and marsupials). Important characters of primates, Chiroptera, Cetacea, Perissodactyla, Artiodactyla, Carnivora, Rodentia, Lagomorpha and

I SEMESTER

PAPER 1.1 : NON-CHORDATA

Total Teaching Hours : 70 hrs

I INTRODUCTION 02 hrs

Biodiversity and its importance, Principles of animal classification definition of species

II KINGDOM PROTISTA (PROTOZOA) 08 hrs

General characters and classification up to classes with suitable examples. Structure and life history of malarial parasite *Plasmodium vivax* and parasitic protozoan *Entamoeba histolytica*

III PORIFERA 04 hrs

General characters and classification up to classes with suitable examples. Spicules and canal system in sponges and economic importance of sponges

IV Cnidaria 05 hrs

General characters and classification up to classes with suitable examples. Polymorphism in Cnidaria. Coral reefs and importance of corals

V CTENOPHORA 02 hrs

Salient features and systematic position of Ctenophora

VI PLATYHELMINTHES 06 hrs

General characters and classification up to classes with suitable examples. Host parasite relationship and parasitic adaptations. Life history of *Fasciola hepatica*

VII ASCHAHELMINTHES 06 hrs

General characters and classification up to classes with suitable examples. Host parasitic relationship and parasitic adaptations – life history of *Ascaris and Wuchereria bancrofti*

VIII ANNELIDA 08 hrs

General characters and classification up to classes with suitable examples. *Hirudinea* type study – Externals, setae, digestive system, circulatory system, nervous system, nephridia and reproductive system. Tubicolous polychaetes –

V SEMESTER

PAPER 5.1 : BIOCHEMISTRY AND PHYSIOLOGY

Total Teaching Hours : 45 hrs

I CARBOHYDRATES, LIPIDS AND PROTEINS 05 hrs

Definition, classification and biological significance

II ENZYMES 05 hrs

Classification of enzymes – IUB system, mechanism of enzyme action, enzyme substrate complex, specificity of enzymes, reversibility of enzyme action, enzyme inhibitors, a brief account of coenzymes, cofactors and ions, clinical importance of enzymes

III VITAMINS 04 hrs

Fat soluble vitamins (A,D,E and K), water soluble vitamins (B-complex and C) functions and deficiency symptoms

IV BIOENERGETICS 04 hrs

Concept of bioenergetics, energy yielding pathways, glycolysis, bioenergetics of glycolysis, the Kreb's cycle, bioenergetics of Kreb's cycle, the electron transport system, phosphorylation

V DIGESTION 03 hrs

Mechanical digestion, chemical digestion, assimilation and absorption of proteins, carbohydrates and lipids. Hormonal regulation of enzyme secretion

VI RESPIRATION 03 hrs

External and internal respiration. Respiratory pigments: hemoglobin, hemocyanin and hemerythrin. Physiology of respiration, exchange of gases, transport of oxygen, oxygen dissociation curves, Bohr effect, transport of carbon dioxide, chloride shift, respiratory quotient

VII CIRCULATION 03 hrs

Types of circulation, structure, functions and regulation of human heart, blood pressure, Composition of human blood, Neurogenic and myogenic hearts

VIII NITROGEN EXCRETION 03 hrs

Nitrogen excretion in aquatic terrestrial and aerial animals, ammonotelism, ureotelism and uricotelism with examples, ornithine cycle, Physiology of urine formation in man

IX MUSCLE CONTRACTION 03 hrs

Principal types of muscles, ultrastructure of striated muscles, role of myosin, actin, tropomyosin, troponin and actinin. Mechanism of muscle contraction and relaxation, the sliding filament theory, Chemical changes during muscle contraction. Neuromuscular junction

Sabella, Terebella, Chaetopterus, Ecological adaptation

IX ONYCHOPHORA 02 hrs

Salient features of *Peripatus* and its systematic position

X ARTHROPODA 10 hrs

General Characters and classification up to classes with suitable examples. Life history of *Butterfly*. Ecology and distribution with special reference to bees, spiders, butterflies and termites.

XI MOLLUSCA 09 hrs

General Characters and classification up to classes with suitable examples. Foot and shell in mollusca

XII ECHINODERMATA 08 hrs

General Characters and classification up to classes with suitable examples. Water vascular system, Echinoderm larvae

PRACTICAL I.1

1. Classification of each phylum up to classes with at least one suitable example.
2. Study of Leech/Cockroach- externals, digestive system, nervous system, Jaws, nephridia, ovary of Leech, Mouth parts, salivary glands, spermatheca of cockroach
3. Mouth parts of insects permanent slides.
4. Study of protozoan culture/frog rectal parasites.
5. Field study.

SCHEME OF PRACTICAL EXAMINATION

1.	Explain the ________ system in ________	10
2.	Protozoan culture/ Rectal parasites / nephridia / ovary/ jaw/ mouthparts / salivary glands / Spermatheca	05
3.	Identifications (A to E)	10
4.	Field Study Report	06
5.	Viva	04
6.	Journal	05
	Total	40

KARNATAK UNIVERSITY, DHARWAD

SYLLABUS

FOR BACHELOR OF SCIENCE

ZOOLOGY

(I TO VI SEMESTERS)

FROM

2016-17 & ONWARDS

VI SEMESTER

PAPER 6.1 : ECOLOGY, ZOOGEOGRAPHY AND WILD LIFE BIOLOGY

Total Teaching Hours : 45 hrs

I INTRODUCTION 02 hrs

Ecological spectrum, subdivisions of ecology, scope of ecology

II BIOGEOCHEMICAL CYCLES 07 hrs

Principles and concepts in biogeochemical cycles. Hydrological, Carbon, Nitrogen, Oxygen, Sulphur and Phosphorus cycles

III ABIOTIC AND BIOTIC FACTORS 06 hrs

Abiotic factors: light, effect of light on plants and animals. Temperature: thermal stratification, cyclomorphosis. Adaptations to extreme temperatures; soil; soil organisms; water; oxygen; carbon dioxide; fire and wind

Biotic factors: animal relationships; mutualism, commensalism, parasitism, amensalism, predation and competition with relevant examples

IV HABITS 06 hrs

Marine habitat, zonation of the sea and ecological classification of marine biota, coastal ecology, estuarine ecology and mangroves.

Freshwater habitat, lentic and lotic systems. Ecological classification of fresh water animals

Terrestrial habitat; a brief account of biomes

Ecological adaptations to marine, freshwater and terrestrial habitats

V POPULATION ECOLOGY 05 hrs

Population density, natality and mortality, age distribution, population growth rate, population growth curves, biotic potential. Allee's principle and Gause's Principle

VI COMMUNITY ECOLOGY 04 hrs

Community structure, ecological determinants, ecological stratification, ecotone and edge effect, ecological niches, ecological succession, climax community, alpha, beta, gamma diversity, Shannon index, Liebig's and Shelford's laws and combined concept of limiting factors

VII POLLUTION 04 hrs

Air, Water, Soil Pollution [illegible], [illegible] and agricultural pollution, [illegible]

VI SEMESTER

PAPER 6.2 : GENETICS, BIOTECHNOLOGY AND NANO TECHNOLOGY

Total Teaching Hours : 45 hrs

I INTRODUCTION 02 hrs

Heredity and environment, definition of genotype, phenotype, Mendel and his contributions, monohybrid and dihybrid crosses

II INTERACTION OF GENES 06 hrs

Supplementary factors- 9:3:3:1	Example : comb pattern in fowls
Dominant epistasis – 12:3:1	Example : plumage color in Leghorn and Wyandotte
Recessive epistasis – 9:3:4	Example : coat color in mice
Complementary factors 9:7	Example : flower color in sweet peas
Lethal gene	Example : coat color in mice

III MULTIPLE ALLELES 03 hrs

Inheritance of coat color in rabbit, isoalleles – pseudoalleles and position effect, ABO blood groups in human, Rh factor

IV LINKING AND CROSSING OVER 03 hrs

Linkage in Drosophila, theories of linkage, crossing over, cytological basis of crossing over, significance of crossing over, genetic map of chromosomes

V SEX DETERMINATION 03 hrs

Chromosomal mechanism of sex determination, genic balance theory, gynandromorphs and intersexes. Environmental and hormonal effects on determination of sex, Amniocentesis

VI SEX LINKED INHERITANCE 03 hrs

Sex linked inheritance in Drosophila and man. Hemophilia and color blindness in man. Sex linkage in poultry. Y linked genes

VII MUTATIONS 02 hrs

Chromosomal aberrations, molecular basis of gene mutation and types

VIII HUMAN GENETICS AND EUGENICS 08 hrs

Karyotype analysis: normal male, normal female, Down's syndrome, Edward's syndrome, Turner syndrome, Klinefelter syndrome, and 21 trisomy. Common human genetic disorders: inborn errors of metabolism: albinism, phenylketonuria, alkaptonuria, sickle cell anemia, thalassemia, Huntington's disease, Eugenics

V SEMESTER

PAPER 5.1 : BIOCHEMISTRY AND PHYSIOLOGY

Total Teaching Hours : 45 hrs

I CARBOHYDRATES, LIPIDS AND PROTEINS 05 hrs.

Definition, classification and biological significance

II ENZYMES 05 hrs

Classification of enzymes – IUB system, mechanism of enzyme action, enzyme substrate complex, specificity of enzymes, reversibility of enzyme action, enzyme inhibitors, a brief account of coenzymes, cofactors and ions, clinical importance of enzymes

III VITAMINS 04 hrs

Fat soluble vitamins (A,D,E and K) water soluble vitamins (B-complex and C) functions and deficiency symptoms

IV BIOENERGETICS 04 hrs

Concept of bioenergetics, energy yielding pathways, glycolysis, bioenergetics of glycolysis, the Kreb's cycle, bioenergetics of Kreb's cycle, the electron transport system, phosphorylation

V DIGESTION 03 hrs

Mechanical digestion, chemical digestion, assimilation and absorption of proteins, carbohydrates and lipids. Hormonal regulation of enzyme secretion

VI RESPIRATION 03 hrs

External and internal respiration. Respiratory pigments, hemoglobin, hemocyanin and hemoerythrin. Physiology of respiration, exchange of gases, transport of oxygen oxygen dissociation curves. Bohr effect, transport of carbon dioxide, chloride shift, respiratory quotient

VII CIRCULATION 05 hrs

Types of circulation, structure, functions and regulation of human heart, blood pressure, Compstion of human blood. Neurogenic and myogenic hearts

VIII NITROGEN EXCRETION 03 hrs

Nitrogen excretion in aquatic terrestrial and aerial animals; ammonotelism, uricotelism and ureotelism with examples, ornithine cycloe, Physiology of urine formation in man

IX MUSCLE CONTRACTION 03 hrs

Principal types of muscles, ultrastructure of striated muscles, role of myosin, actin, tropomyosin, troponin and actinin. Mechanism of muscle contraction and relaxation, the sliding filament theory. Chemical changes during muscle contraction. Neuromuscular junction

5. Study of threatened animals of India (by models/pictures/charts) tiger, lion, one horned rhinoceros, gaur, golden langur, lion tailed monkey, musk deer, mouse deer, Kashmir stag, great Indian hornbill and Indian rock python
6. Study of community by quadrat method to determine frequency, density and abundance of different species present in the community, alpha diversity
7. Study of biomass of consumers of a particular area by quadrat method- by determining the dry weight of living organisms – both animals and plants per unit area
8. Study of ecological adaptations and morphological peculiarities- hermit crab, stick insect, glowworm, stinkbug, pufferfish, anglerfish, exocoetus, phrynosoma, draco, chameleon, and bat

SCHEME OF PRACTICAL EXAMINATION

1	Estimation	10
2	Identification-5	10
3	Project works report on ecology/wildlife biology	10
4	Viva connected with field work report	05
5	Journal	05
	Total	**40**

Pholidota with examples. Rat as type study – (muscular system excluded)

IX. OSTEOLOGY 10 hrs

Study of endoskeleton of *Frog* and *Rabbit*

X. COMPARATIVE ANATOMY 05 hrs

Comparative account of Aortic arches, heart, brain and urinogenital systems

PRACTICAL 2.1

1. Classification up to orders with at least one suitable example
2. Study of Local fish/rat/chick (any one): externals, Digestive system, Circulatory system, Urinogenital system and brain
3. Endoskeleton of *frog* and *rabbit*
4. Comparative anatomy of heart and brain

FIELD ORIENTED PROJECTS :

1. Field Study is compulsory
2. Visit to Zoo/forest/sanctuaries/ national park/ surrounding area to study the animal diversity related to project i.e., study the fishes, amphibians, reptiles, birds and mammals.

SCHEME OF PRACTICAL EXAMINATION

1.	Explain the ________ system in __________	06
2.	Comparative anatomy (any one)	05
3.	Osteology (any two)	06
4.	Identify and comment on A to D	08
5.	Field study trip	06
6.	Viva	04
7.	Journal	05
	Total	**40**

solid and hazardous waste management with example

VIII GEOGRAPHIC DISTRIBUTION OF ANIMALS — 06 hrs

Continuous and discontinuous distributions with examples, barriers of dispersal, topographic and vegetation barriers, large bodies of water as barriers, climatic barriers

IX ZOOGEOGRAPHY — 04 hrs

Zoogeographical realms (with subdivisions) of world, with climatic conditions and examples of characteristic fauna, a brief account of Wallace's line

X DISTRIBUTION OF WILD LIFE IN INDIA — 10 hrs

The Himalayan ranges, the peninsular India subregion, deccan plateau, western ghats, eastern hill chain, Aravalli ranges, Indian desert, tropical rain forests, wildlife in Andaman and Nicobar islands

XI WILD LIFE PROBLEMS — 02 hrs

Hunting, overharvesting, habitat destruction degradation, due to over population, and possibilities of climatic changes

XII WILD LIFE CONSERVATION — 04 hrs

Need for wild life conservation agencies engaged in wild life conservation: Government organization and nongovernment organizations. Wild Life Protection Act 1972, CITES: Convention on International Trade in Endangered Species of wild life flora and fauna, endangered fauna and flora of India, Red data book, Ramsar convention, CBD - convention of Biological Diversity, Project Tiger

(Unit I to VII : Ecology; Unit VIII to IX : Zoology; Unit X to XII : Wild Life Biology)

PRACTICAL 6.1

1. Estimation of dissolved oxygen, carbon dioxide, hardness, chloride, alkalinity and pH of water of RO
2. Study of tropical pond as an ecosystem, study of fauna and flora and interaction between the various constituents using Charts
3. Location of species of zoological interest on the Indian map and world map: flightless birds, tigers, lions, gorilla, hippopotamus, rhinoceros, dipnoans and penguins
4. Location of tiger reserves, national parks, biosphere reserves, wild life sanctuaries of India on map

IX EXTRA CHROMOSOMAL INHERITANCE — 01 hr

Kappa particles in paramecium

X GENETIC CODE AND GENE EXPRESSION — 04 hrs

Genetic code, properties of genetic code, Wobble hypothesis, dogma of molecular cell biology, protein synthesis, Operon concept

XI Isolation of DNA, molecular cloning, gene cloning, gene library, diagnosis of hereditary diseases, DNA finger printing, PCR technique, application of biotechnology, animal cloning, transgenic animals/proteomics, genomics human genome project — 08 hrs

XII Introduction to nano science and nanotechnology. Types of nano-materials, nanobiotechnology in healthcare, environmental nanotechnology — 04 hrs

(Unit I to X : Genetics, Unit XI : Biotechnology; Unit XII : Nanotechnology)

PRACTICAL 6.2

1. Karyotype analysis: normal male, normal female, Down's syndrome, Catcry syndrome, Turner's syndrome, Klinefelter's syndrome and 21 trisomy
2. Mutant forms of Drosophila
3. Genetic problems: monohybrid inheritance (4), dihybrid inheritance (4)
4. Genetic problems - multiple alleles- ABO blood groups in humans (4)
5. Genetic problems - sex linked inheritance in Drosophila (2) and man (2)
6. Calculation of allele frequency – PTC (Phenyl Thio Carbamide) tongue rolling, attached ear lobes

SCHEME OF PRACTICAL EXAMINATION

1	Karyotype analysis	10
2	Mutant forms of drosophila (any 2)	06
3	Genetic problem (3) Monohybrid, dihybrid, multiple alleles and sex linked inheritance in drosophila and man	15
4	Viva	04
5	Journal	05
	Total	**40**

IV SEMESTER

PAPER 4.1 : MOLECULAR CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY

Total Teaching Hours : 70 hrs

I MICROSCOPY — 03 hrs

Light, electron and Phase contrast microscopes

II CELL AND ITS ORGANELLES — 06 hrs

Ultra structure of prokaryotes and eukaryotes (animals cell) molecular structure and function of Plasma membrane, endoplasmic reticulum, Golgi complex, mitochondria, lysosomes, ribosomes, nucleus and nucleolus

III CHROMOSOMES — 05 hrs

Types of Chromosomes, chromosomal fine structure, heterochromatin and euchromatin, polythene chromosomes

IV NUCLEIC ACIDS — 05 hrs

Identification of genetic material, Hershey- Chase experiment, structure of DNA, Watson and Crick DNA model types of DNA, replication of DNA, RNA, Types, Structure and functions

V MITOSIS AND CELL CYCLE — 05 hrs

Stages of Mitosis, Interphase, G_1 S and G_2 phases, molecular events at different stages of cell cycle

VI MEIOSIS — 05 hrs

Phases of meiotic cycle, first meiotic division – prophase-I, leptotene, zygotene, pachytene, synaptonemal complex and recombination and diplotene, diakinesis, Mechanism of crossing over, metaphase I, anaphase I and telophase I and cytokinesis, second meiotic division; Significance of meiosis

VII CANCER AND CARCINOGENIC AGENTS — 04 hrs

Types of cancer, oncogenes, carcinogenic agents, physical, chemical and biological causes of cancer

VIII INTRODUCTION TO DEVELOPMENTAL BIOLOGY — 02 hrs

Scope of Developmental Biology, overview of gametogenesis

IX FERTILIZATION — 04 hrs

Types and mechanism of fertilization, approximation of gametes, fertilizin and antifertilizin, acrosome reaction, amphimixis, Monospermic and polyspermic fertilization. Significance of fertilization

X PARTHENOGENESIS 04 hrs

Kinds of parthenogenesis: Natural arrhenotoky, thelytoky and cyclical. Artificial parthenogenesis, significance of parthenogenesis

XI CLEAVAGE 04 hrs

Types of cleavage: holoblastic, meroblastic, radial and spiral types with examples

XII EARLY DEVELOPMENT OF FROG 06 hrs

Structure of frog's egg, cleavage, blastula, fate maps, gastrulation, morphogenesis, notogenesis, and neurulation

XIII EXTRAEMBRYONIC MEMBRANES OF CHICK 04 hrs

Development, structure and functions of yolk sac, amnion, chorion and allantois

XIV EARLY DEVELOPMENT OF CHICK 05 hrs

Structure of hen's egg, cleavage, blastula, gastrulation, origin and structure of primitive streak, structure of 18, 24, 36 and 48 hrs chick embryos

XV ORGANIZER PHENOMENON 05 hrs

Definition, potencies of the dorsal lip of the blastopore of amphibian gastrula, Brachet's experiment, experiment of Spemann and Mangold, induction, chemical nature of organizer, parts of organizer, theories of organizer phenomenon

XVI PLACENTA 03 hrs

Yolksac placenta, allantoic placenta, structure (morphological and histological) and functions of placenta, classification of placenta with examples

(Unit I to VII : Cell Molecular Biology; Unit VIII to XVI : Developmental Biology)

PRACTICAL 4.1

1. Study of fixatives and stains : Preparation of formaldehyde (4 to 10%), alcohol (70 to 100%) Bouin's fluid, Carnoy's fluid, borax carmine (alcoholic), eosin (alcoholic) iron hematoxylin, acetocarmine, aceto-orcein, Schiff's reagent (Feulgen method) and Giemsa's stain
2. Observation and study of permanent slides for mitosis, meiosis and salivary gland chromosome
3. Squash preparation of onion root tip to study stages of mitosis
4. Squash preparation of grass hopper testis/flower bud to study stages of meiosis

PAPER 5.2 : ETHOLOGY AND APPLIED ZOOLOGY

Total Teaching Hours : 45 hrs

I INTRODUCTION 02 hrs

Definition, scope of ethology, contributions of Konrad Lorenz, Niko Tinbergen and Karl Von Frisch

II TYPES OF ANIMAL BEHAVIOUR 04 hrs

Innate behavior, taxes, reflexes, instincts and motivation, learned behavior, habituation, imprinting, conditioned reflexes and insight learning

III SOCIAL ORGANIZATION IN ANIMALS 04 hrs

Honey bees, termites and langurs

IV COURTSHIP BEHAVIOUR 04 hrs

General principles of courtship behavior with suitable examples

V PARENTAL CARE 04 hrs

Parental care in fishes, amphibians and birds with suitable examples

VI NESTING BEHAVIOUR 03 hrs

Types of Nests. Nests and nesting behavior in wasps and birds (with suitable examples)

VII COLORATION AND MIMICRY 03 hrs

Definition, types of mimicry, Batesian Mullerian protective, aggressive and warning mimicry with suitable Indian examples

VIII ANIMAL COMMUNICATION 02 hrs

Functions of signals, odors, sounds and light

IX APICULTURE 03 hrs

Importance, history and developments of bee keeping. Different species of honey bees and their distribution, Management of bees, product and byproducts of apiculture and their uses

X AQUACULTURE 04 hrs

Fresh water, brackish and marine water fish culture in India, prawn and pearl culture

1	Identification	20
	a. Nest/Castes of social insects (any 2)	
	b. Coloration and mimicry	
	c. Poultry breeds	
	d. Silkworm life cycle	
	e. Commercially important fishes, crustaceans, molluscans, freshwater fish and marine water fish (one from each)	
	f. Courtship behavior/ Parental care (any one)	
2	Project report	10
3	Viva	04
4	Journal	05
	Total	**40**

5. Squash preparation of salivary gland chromosomes of Drosophila
6. Stages of development of frog : the study of cleavage stages, blastula, gastrula and neurula and various stages of tadpole
7. Observation of various stages of frog development in nature
8. Study of permanent slides of chick embryo: 18 hrs, 24 hrs, 36 hrs and 48 hrs whole mounts and T. S of 18 hrs and 24 hrs chick embryos
9. Mounting of chick embryo

SCHEME OF PRACTICAL EXAMINATION

1.	Composition and preparation	i. Fixative	02
		ii. Stain	02
2.	Stages of mitosis/meiosis (two stages)		04
3.	Squash preparation (mitosis/meiosis)		07
4.	Mounting of chick embryo		08
5.	Identifications, Developmental stages of frog (2) chick (2)		08
6.	Viva		04
7.	Journal		05
	Total		**40**

X NERVOUS COORDINATION 05 hrs

Structure and conduction of nerve impulse in medullated and non medullated nerves, synaptic transmission and neurotransmitters

XI ENDOCRINE SYSTEM 05 hrs

Functions of human endocrine glands, hypothalamus, pituitary, thyroid, parathyroid, islets of Langerhans, adrenal, testis, ovary, placenta and pineal gland. Hypothalamus and its stimulating and inhibitory effects

XII IMMUNOLOGY

Components of immune system, Bone marrow, thymus, spleen, bursa of Fabricius, peyer's patches, T and B cells, antigens and antigenicity, immunoglobulin, structure of immunoglobulin G (Ig G) and immunization

AIDS : causative factors, effects and preventive measures

(Unit I to IV : Biochemistry; Unit V to XII : Physiology)

PRACTICAL 5.1

1. Biochemical tests for proteins, carbohydrates and fats
2. Normal and abnormal constituents of urine
3. Action of salivary amylase
4. Preparation of haematin crystals
5. Estimation of hemoglobin
6. Total count (TC) differential count (DC) of RBC and WBC
7. Blood clotting time
8. Demonstration of blood pressure
9. Osmotic haemolysis in blood cells

SCHEME OF PRACTICAL EXAMINATION

1.	Qualitative test for proteins/carbohydrates/fats	10
2.	Normal/abnormal constituents of urine	05
3.	Preparation of haematin crystals/clotting time/ Action of salivary amylase	06
4.	Hemoglobin estimation TC/DC	10
5.	Viva	04
6.	Journal	05
	Total	40

XI VERMICULTURE 02 hrs

Introduction and importance of vermiculture. Different species of earthworm used in vermiculture, uses of earthworms for biodegradation of organic waste materials, earthworm as protein source, vermiculture technique

XII POULTRY SCIENCE 03 hrs

Introduction, breeds of fowls, poultry keeping, nutritive value of egg and meat, poultry diseases

XIII DAIRY TECHNOLOGY 02 hrs

Introduction, breeds of cattle, breeding and cattle improvement in India nutritive value of milk and milk byproducts

XIV SERICULTURE 05 hrs

Mulberry varieties and cultivation methods (Pit system and Row system). Types of silkworms, a. Mulberry silkworms and b. Non-Mulberry silkworms. Life history of silkworm and importance of sericulture. Silkworm rearing, chawki rearing and late age worms rearing. Mounting and harvesting. Silk worm diseases in brief

(Unit I to VIII : Ethology; Unit IX to XIV ; Applied Zoology)

PRACTICAL 5.2

1. Identification of castes in social insects
2. Observation of courtship behavior in animals
3. Observation of parental care in animals
4. Observation of different types of nests and nest materials
5. Coloration and mimicry
6. Breeds of poultry
7. Life cycle of silk worm, study of diseases of silk worm
8. Study of commercially important
   a. Crustaceans
   b. Molluscs
   c. Fishes
9. Visit to nearby diary, poultry, sericulture farm bee keeping unit, vermiculture unit and termite mound for observation

SCHEME OF PRACTICAL EXAMINATION

PRACTICAL 3.1

1. Observation of mammalian histology slides of the organs studied in the theory paper
2. Preparation of permanent histology slides, three slides to be submitted at the time of practical examination.
3. Evolution of man and horse (charts or models)
4. Mesozoic reptiles (charts or models)
5. Connecting links/living fossils : *Neopilina, peripatus, limulus, latimeria, sphenodon archaeopteryx and duck billed platypus*
6. Vestigial organs
7. Biostatistics practicals
   a. Measures of central tendency i) Obtain the mean, medium and mode, ii) Form a frequency distribution table of the data and then compute mean, median and mode.
   b. Prepare a frequency distribution table and draw a histogram, frequency polygon and frequency curve.

SCHEME OF PRACTICAL EXAMINATION

1. Preparation of permanent histology slide	08
2. Identifications	
a. Histology – Any 4	08
b. Evolution – Any 1	02
c. Connecting links/living fossils – Any 1	02
3. Histology slide submission – 3 slides	06
4. Biostatistics	05
5. Viva	04
6. Journal	05
Total	**40**

III SEMESTER

PAPER 3.1 : HISTOLOGY, EVOLUTION, PALEONTOLOGY AND BIOSTATISTICS

Total Teaching Hours : 70 hrs

I HISTOLOGY 22 hrs

Study of histological structure and functions of the following mammalian organs

a. Tongue
b. Salivary glands
c. Stomach
d. Intestine
e. Testis
f. Ovary
g. Liver
h. Islets of Langerhans
i. Thyroid
j. Kidney
k. Adrenal

II EVOLUTION 20 hrs

Origin of earth, origin of life, theories of organic evolution: Lamarckism, *Darwin Wallace* theory of natural selection. Evidences in favour of evolution.

Neo-Darwinism (synthetic theory of evolution, gene mutation, gene flow, genetic drift, *Hardy Weinberg* equilibrium) concept of species. Speciation, allopatric and sympatric species

III PALEONTOLOGY 16 hrs

Geological time scales, fossils and fossilization. Mesozoic reptiles with a note on Indian Dinosaurs. Connecting links, living fossils, origin and evolution of horse and man

IV BIOSTATISTICS 08 hrs

Use of statistics in life sciences, data collection, observations and variables, sampling and sampling methods. representation, tabular and graphical representations: frequency tables, line graphs, bar graphs, histograms, frequency polygon and curve and pie charts. measure of central tendency: mean, median and mode. Measures of dispersion; range, standard deviation,