The University of Burdwan
Syllabus for B.Sc. General
(1+1+1 Pattern)
in
Chemistry
with effect from 2014-2015

Category A: For students with honours in subjects other than chemistry

Total Marks: 200 (theoretical) + 100 (Practical) = 300

Category B: For pass course students only

Total Marks: 265 (theoretical) + 135 (Practical) = 400

PART I

Theoretical		**Marks**
Paper I:	Group A: General principles	50
	Group B: Organic	50
	Total:	100
Practical		20

Examination will be conducted by the college and marks will be kept for final addition with the Practical Examination of **Part II**.

PART II

Paper II:	Group A: Inorganic	50
	Group B: Physical	50
	Total:	100
Practical		**Marks**
Paper III:	Qualitative (Inorganic + Organic)	65
	Laboratory Note Book	05
	Viva-Voce	10

PART III

For pass course (Category B) students only

Theoretical		**Marks**
Paper IV:	Chemistry (General)	65
Practical		
Paper V:	Inorganic Quantitative	35
	Total:	100

PART I

Paper I

Group A

General Principles (Full Marks: 50)

1. Atomic Structure

Bohr's theory: energy and radius calculations for H-like atoms, dual nature of matter and light, de Broglie's relationship, Heisenberg's uncertainty principle (qualitative), quantum numbers, Pauli exclusion principle, qualitative introduction of orbitals, shapes of orbitals, electron distribution of elements - Aufbau principle and Hund's rule.

2. Radioactivity

Theory of disintegration, rate constant, half life period (their interrelationship – deduction) idea of disintegration series, artificial transmutation and artificial radioactivity, uses and abuses of radioactivity. Stability of atomic nucleus, n/p ratio, mass defect, binding energy.

3. Periodic Table and Periodic Properties

Periodic law, Periodic classification of elements on the basis of electron distribution, s-, p- and d-block elements, connection among valencies, electron distribution and positions of the elements in the long form of the periodic table. Periodic properties: atomic radii, ionic radii, covalent radii, ionisation energy, electron affinity, electronegativity and its different scales.

4. Chemical Forces and Molecular Structure

Ionic bond, covalent bond (octet rule and expanded octet), dative bond, deformation of ions and Fajan's rules, Born-Haber cycle, hydrogen bond: intra- and intermolecular, bond polarity and dipole moment. Bond lengths, bond angles and qualitative description of shapes of some simple molecules like CO_2, SO_2, H_2O, $BeCl_2$, BF_3, NH_3, CH_4, C_2H_4, C_2H_2, C_6H_6.

5. Oxidation and Reduction

Electronic concepts, oxidation number, ion-electron method of balancing equations, application of redox reactions, idea of standard potential and formal potential. Derivation of thermodynamic quantities of cell reactions (ΔG, ΔH and ΔS).

6. Acids and Bases, Buffers and Ionic Equilibrium

Different concept of acids and bases, ionic product of water, salt hydrolysis, pH and its colorimetric determination, Strengths of strong and weak acids and bases, Ostwald dilution law, Henderson equation, neutralization and acid-base indicators, buffers, common ion effect, solubility product (application in analytical chemistry)

Group B

Organic Chemistry (Full Marks: 50)

1. Functional Nature of Organic Compounds

Classification of organic compounds in terms functional groups, their IUPAC nomenclature and valence bond structures.

2. Electron Displacement in Molecules

Concept of Inductive effect, Electromeric effect, Hyperconjugation, Resonance, Aromaticity and Tautomerism.

3. Introduction to Organic Reaction Mechanism

Homolytic and heterolytic bond cleavage; Reaction intermediates: carbocation, carbanion, free radical.

Classification of organic reactions (substitution, elimination, addition and rearrangement) and reagent types (electrophiles, nucleophiles, acids and bases), Ideas of organic reaction mechanism (S_N1, S_N2, E1 and E2).

3. Chemistry of Hydrocarbons

a) Free radical substitutions of alkanes; b) Formation of alkenes, electrophilic addition reactions of alkenes (upto four carbon atoms), Markwonikoff's rule, peroxide effect, ozonolysis, radical addition and catalytic reductions; c) Formation of alkynes, their partial and complete reductions and hydration. Halogen derivatives of alkanes, their nucleophilic substitutions and elimination reactions.

4. Mono and Bifunctional Compounds

Preparations and properties of primary, secondary and tertiary monohydric alcohols, ethers, ethylene glycol, pinacol and glycerol; aldehydes and ketones; monocarboxylic acids and their derivatives: acid chlorides, anhydrides, esters, amides; amines; unsaturated alcohol (allyl alcohol), unsaturated aldehyde (acrolein), unsaturated carboxylic acid (acrylic acid), unsaturated ester (methyl acrylate), di- and tribasic acids (oxalic, malonic, succinic acids; malic and citric acids).

5. Stereochemistry

Concept of optical activity, optical properties of lactic acid and tartaric acid, *D,L* and *R,S* nomenclature; Geometrical isomerism with reference to fumaric acid and maleic acid; *cis-trans* and *E, Z* nomenclature.

6. Chemistry of Aromatic Compounds

Modern concept of structure of benzene, general mechanism of aromatic electrophilic substitution reactions, preparations and properties of toluene, xylene, halobenzenes, benzyl chloride, benzoyl chloride, benzotrichloride, nitrobenzene, dinitrobenzene, TNT, aniline, methyl and dimethyl aniline, benzyl amine benzene diazonium chloride, phenols, benzyl alcohol, benzaldehyde, acetophenone, benzoic acid, anhydride, amides, esters; phenyl acetic acid, salicylic acid, cinnamic acid, sulphanilic acid, phenyl hydrazine, nitrophenols and picric acid.

7. Organic Synthesis

Preparation and synthetic uses of diethyl malonate and ethylacetoacetate. Application of Grignard reagents in synthesis of ketones, secondary and tertiary alcohols and carboxylic acids.

8. Carbohydrates

Open-chain and ring structures glucose, fructose and their mutarotation, idea of dissacharides with reference to cane sugar.

PART II

Paper II

Group A

Inorganic Chemistry (Full Marks: 50)

1. **Coordination Chemistry**

Double and complex salts, Werner's theory, ligands, coordination number, inner metallic complexes, chelate effect, different types of isomerism, IUPAC nomenclature.

2. **Group Chemistry**

A **comparative study** of the elements belonging to a particular group to be made in brief on the basis of their electron distribution and position in the periodic table. Structures (excluding stereochemistry) and properties of important compounds mentioned to be explained.

Group 1: Hydrogen – isotopes and binary hydrides, lithium and its similarities and differences from other alkali metals, diagonal relationship with magnesium, lithium aluminium hydrides.

Group 2: Calcium, stroncium and barium, hydrolith, calcium cyanamide, gypsum and plaster of paris.

Group 12: Zinc, cadmium and mercury. Nesslar's reagent, Millon's base.

Group 13: Diborane, boron trifluoride, sodium borohydride, inorganic benzene.

Group 14: Carbon, silicon, tin and lead, carbide, silicon carbide, silica, sodium silicate. Silica gel, hydrofluorosilicic acid, silicon tetra chloride, glass, fullerene.

Group 15: Nitrogen, phosphorus, arsenic, antimony and bismuth, hydrazine, hydrazoic acid, hydroxyl amine, hyponitrous acid, phosphorus oxyacids (H_3PO_2, H_3PO_3, H_3PO_4, $H_4P_2O_7$ and HPO_3), sodium bismuthate.

Group 16: Oxygen and sulphur, composition and structure of ozone, oxyacids of sulphur (H_2SO_3, H_2SO_4, $H_2S_2O_3$, $H_2S_2O_8$), persulphate

Group 17: Fluorine, chlorine, bromine and iodine, oxides and oxyacids of chlorine, isolation of fluorine.

Group 18: Rare gases (isolation and uses) with special reference to general fluorides (structure)

3. Transition Metals
Groups 6 and **7:** Chromium, manganese, K_2CrO_4, $K_2Cr_2O_7$, CrO_2Cl_2, $KMnO_4$, chrome alum.
Groups 8, 9 and **10:** Iron, cobalt and nickel, principles of isolation of Ni (excluding details), composition and uses of alloys, steels, rusting of iron, galvanization and tin plating
Group 11: Cu, Ag, Au, principles of Ag and Au isolation, different valency states

Group B
Physical Chemistry (Full Marks: 50)

1. Kinetic Theory of Gases

Ideal gas equation, derivation of gas laws, Maxwell's speed and energy distributions (derivation excluded); distribution curves; different types of speeds and their significance, concept of equipartition principle, van der Waals equation, Virial equation, continuity of state, Boyle temperature, critical constants, specific heats and specific ratios, laws of partial pressure, vapour density and density method of determination of molecular weights, limiting density, abnormal vapour density, frequency of binary collisions; mean free path

2. Thermodynamics

Thermal equilibrium and zeroth law, First law, reversible and irreversible work, criteria of perfect gas, isothermal and adiabatic expansions, Joule-Thomson effect (derivation excluded); Thermochemistry: Hess's law and its application

Second law and its elementary interpretation, Carnot's cycle and theorems, Clausius inequality, criteria of spontaneity, free energy and entropy

3. Equilibrium

Conditions of spontaneity and equilibrium, degree of advancement and Le Chatelier principle; Van't Hoff isotherm, isobar and isochore

4. Phase Equilibria and Colligative Properties

Phase rule equation (derivation excluded); phase diagram of water system, Miscibility (phenol-water) and distillation of completely miscible binary liquid mixtures; azeotropes, Steam distillation

Graphical approach of Raoult's law of vapour pressure and colligative properties: osmosis, lowering of freezing point, elevation of boiling point, experimental methods of determination of molecular weights of substances in dilute solutions, van't Hoff 'i' factor and abnormal behaviour of electrolytic solutions

5. Properties of Matter

Viscosity of fluids, temperature and pressure dependence, Surface energy and surface tension of liquids: temperature dependence

Unit cell, Bravais lattice; crystal system, Miller indices; Bragg's equation and its applications

6. Electrochemistry

Electrolytic conduction, transport number (experimental determination excluded), velocity of ions: specific, equivalent and molar conductances, determination of equivalent conductivity of solutions, Kohlrausch's law, strong and weak electrolytes, Ion atmosphere; electrophoretic and relaxation effects, Debye-Huckel theory (qualitative) and the limiting law.

Electrochemical cells, half-cells (with types and examples), Nernst equation and standard electrode potentials, standard cells

7. Chemical Kinetics

Order and molecularity of reactions, integrated rate laws (first and second order), average life period, concept of Arrhenius activation energy

Catalysis, autocatalysis, enzyme catalyst, catalyst poisons, promoters, elementary treatment of mechanism of catalysis

8. Photochemistry and Spectroscopy

Absorption, Lambert-Beer's law, photochemical laws, primary photophysical processes, potential energy diagram, Franck-Condon principle, fluorescence and phosphorescence, Jablonsky diagram, Laws of photochemistry, quantum yield, kinetics of HI decomposition, H_2-Br_2 reactions

Elementary idea of rotational and vibrational spectra

Practical

Paper III Full Marks: 65

Inorganic Qualitative (Marks: 35)

Detection of three radicals by analysis of mixture containing not more than three radicals from the following list (insoluble salts excluded)

Silver, lead, mercury, bismuth, copper, cadmium, arsenic, antimony, tin, iron, aluminium, chromium, zinc, manganese, cobalt, nickel, calcium, strontium, barium, magnesium, sodium, potassium, ammonium and their oxides, hydroxides, chlorides, bromides, iodides, sulphates, sulphites, sulphides, thiosulphates, chromates, phosphates, nitrites, nitrates and borates.

Organic Qualitative (Marks: 30)

Detection of elements (N, S, Cl) and any one of the following groups in organic compounds (solid only): $-NH_2$, $-NO_2$, $-CONH_2$, -OH, >C=O, -CHO, -COOH

Marks distribution under following headings in Inorganic

1. Physical characteristics
2. Preliminary tests for basic radicals
   (i) Dry test heating
   (ii) Flame test
   (iii) Borax bead test
3. Special test for basic radicals:
   Mn, Cr, Fe, Co, Ni, Cu etc
4. Preliminary test for acid radicals:
   (i) Dil. H_2SO_4
   (ii) Conc. H_2SO_4
   (iii) Conc. H_2SO_4 + MnO_2
   (iv) Conc. H_2SO_4 + Cu turnings
5. Tests for interfering acid radicals:
   Special test for S^{2-}
6. Solubility Tests
7. Wet and confirmatory tests for acid radicals: solution preparation, confirmation
8. Wet tests for basic radicals: preparation and confirmation
9. Conclusion

Marks distribution under following headings in Organic

1. Physical characteristics
2. Detection of elements
3. Solubility test and conclusion from solubility test
4. Functional group (presence or absence)
5. Confirmation
6. Conclusion

PART III

Paper IV Full Marks: 65

Chemistry (General)

1. Analytical Chemistry

(a) Accuracy and precision in analysis, types of errors, data analysis and curve fitting (linear Y = mX + C type), numerical problems, mean, mode and variant

(b) Principles of acid-base titration, use of indicators and indicator constant, titration of Na_2CO_3 + $NaHCO_3$ mixture vs HCl using different indicators, estimation of mixture of strong and weak acids, qualitative discussion of salt hydrolysis (no derivation)

(c) Single electrode potential and emf of a chemical cell, principles of redox titration, use of redox potentials, iodometry, iodimetry, use of $K_2Cr_2O_7$ and $KMnO_4$ as oxidant (acid, neutral and alkaline media)

2. **Green Chemistry**

Basic principles of green chemistry. Tools of green chemistry including the use of alternative feed stocks or starting materials, reagents, solvents, target molecules, and catalysts (homogeneous, heterogeneous and biocatalysis), green chemistry as the alternative chemistry for protection of environment.

3. **Chemistry of Selected Biomolecules**

Structural aspects (excluding elucidation and stereochemistry, unless specified) and important function of d/l-sucrose and polysaccarides (starch and cellulose), amino acids (classification, essential amino acids like glycine, alanine, methionine and tryptophan with d/l), proteins (special reference to the peptide bond, action of haemoglobin, idea of denaturation of proteins, classification and functions of enzymes in general), pyrrole, pyridine, pyrimidine and purine, nucleic acids (DNA and RNA), nucleotide and nucleoside.

4. **Medicinal Chemistry**

Antipyretics and analgesics like paracetamol and aspirin, sulpha-drugs like sulphadiazine, antibiotics like penicillin and chloramphenicol,ofloxacin; antiamoebic like metronidazole, anticancer drugs, drugs used for AIDS (detailed structures are not needed, only the nature and function of the drugs)

5. **Nano Chemistry**

Elementary idea on nano materials. Basic chemical strategy for making nanomaterials. Nanoclusters, Nanowires and Carbon Nanotubes. Applications.

6. **Colloidal State**

General classification, general methods of preparation of lyophobic colloids and general properties of colloids, ideas of coagulation, peptization, protective colloids, dialysis, gold number, isoelectric point, Brownian motion

7. **Macromolecular Chemistry**

Introduction, definition of macromolecules, natural and synthetic polymers, monomers, polymers, degree of polymerization, simple idea of polymer structure: homopolymer (linear, branched, cross-linked) and copolymer (random, block, graft), polymerization reaction step (growth, addition, ring opening), importance of polymers both natural and synthetic

Number and weight average molecular weights of polymers – significance, structure and use of natural rubber, synthetic rubber (neoprene), synthetic fibres (Nylon 66, poly ester), plastics like polyethylene and PVC, macromolecules and environment

Practical

Paper V Full Marks: 35

Inorganic Quantitative

a. Titration of Na_2CO_3 + $NaHCO_3$ mixture vs HCl using phenolphthalein and methyl orange indicators
b. To find the total hardness of water by EDTA titration
c. To find the pH of an unknown solution by comparing colour of a series of (HCl solutions + 1 drop of methyl orange) and a similar series of (NaOH solutions + 1 drop of phenolphthalein)
d. Estimation of saponification equivalent of a supplied ester/oil
e. Titration of ferrous iron by $KMnO_4$/$K_2Cr_2O_7$
f. Titration of ferric iron by $KMnO_4$/$K_2Cr_2O_7$ using $SnCl_2$ reduction

Notes: Duration of the examination will be 3 hours (for any one of the above experiments). Marks will be divided as follows: Experiment = 25 (Theory = 5, Presentation = 5, Correct calculation = 5, Results = 10); Viva-voce = 5, Note book = 5

Accurate weighing by the students should be avoided. Standard solutions will be supplied. Teachers need not disclose exact strengths of supplied solution to students, but encourage them to perform required calculations by assuming a factor in each case. Examiners will set more than one experiments in the examination and students will perform one drawing card. Properly signed laboratory note book should be a must for the examinee to the practical laboratory where examination will be conducted.

Tentative list of Recommended Books

Paper I

1. Advanced Organic Chemistry, Vol. 1, Aditi Sangal, Krishna Prakashan Media (P) Ltd, Meerut, India, 2012
2. Elementary Physical Chemistry, S.R. Palit, 30th Edn, Book Syndicate Private Limited
3. Physical Chemistry; P.C. Rakshit, 7th Edn, Sarat Book Distributers, 2004.
4. Degree Bhouto O Sadharan Rasayan; Dr. A. K. Mondal: Sarat Book Distributers.
5. Sadharan O Bhouto Rasayan; Amalendu Ghoshal: Books and Allied (P) Ltd.
6. General Chemistry, S. Ekambaram, 1st Edn, Pearson, 2006.
7. Inorganic Chemistry, R. L. Dutta and G. S. De, Part – I, The New Book Stall, 7th Edn, 2013
8. Inorganic Chemistry, R. L. Dutta, Part –II, The New Book Stall, 5th Edn, 2006
9. General and Inorganic Chemistry, P. K. Dutt, 15th Edn, Levant Books, 2003.
10. Organic Chemistry, S. Sengupta, M/s Subrata Sengupta.
11. Organic Chemistry, B. S. Bahl and A. Bahl, 21st Edn, S. Chand, 2012.
12. Organic Chemistry, R. K. Bansal, 5th Edn, New Age International, 2007.
13. B. M. Mahan and R. J. Meyers, University Chemistry, 4th Edn, Pearson, 2009

Paper II

1. Elementary Physical Chemistry, S.R. Palit, 30th Edn, Book Syndicate Private Limited
2. Physical Chemistry; P.C. Rakshit, 7th Edn, Sarat Book Distributers, 2004.
3. Degree Bhouto O Sadharan Rasayan; Dr. A. K. Mondal: Sarat Book Distributers.
4. Sadharan O Bhouto Rasayan; Amalendu Ghoshal: Books and Allied (P) Ltd.
5. General Chemistry, S. Ekambaram, 1st Edn, Pearson, 2006.
6. Inorganic Chemistry, R. L. Dutta and G. S. De, Part – I, The New Book Stall, 7th Edn, 2013
7. Inorganic Chemistry, R. L. Dutta, Part –II, The New Book Stall, 5th Edn, 2006
8. General and Inorganic Chemistry, P. K. Dutt, 15th Edn, Levant Books, 2003.
9. B. M. Mahan and R. J. Meyers, University Chemistry, 4th Edn, Pearson, 2009

Paper III (Practical)

1. A. K. Nad, B. Mahapatra and A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007.
2. Vogel's Text Book of Practical Organic Chemistry (5th Edn).
3. Mann and Saunders, Practical Organic Chemistry.
4. S. C. Das, Advanced Practical Chemistry.

Paper IV

1. Advanced Organic Chemistry, Vol. 1, Aditi Sangal, Krishna Prakashan Media (P) Ltd, Meerut, India, 2012
2. Elementary Physical Chemistry, S.R. Palit, 30th Edn, Book Syndicate Private Limited
3. Physical Chemistry; P.C. Rakshit, 7th Edn, Sarat Book Distributers, 2004.
4. Degree Bhouto O Sadharan Rasayan; Dr. A. K. Mondal: Sarat Book Distributers.
5. Sadharan O Bhouto Rasayan; Amalendu Ghoshal: Books and Allied (P) Ltd.
6. General Chemistry, S. Ekambaram, 1st Edn, Pearson, 2006.
7. Inorganic Chemistry, R. L. Dutta and G. S. De, Part – I, The New Book Stall, 7th Edn, 2013

8. Inorganic Chemistry, R. L. Dutta, Part –II, The New Book Stall, 5th Edn, 2006.
9. General and Inorganic Chemistry, P. K. Dutt, 15th Edn, Levant Books, 2003.
10. Organic Chemistry, S. Sengupta, M/s Subrata Sengupta.
11. Organic Chemistry, B. S. Bahl and A. Bahl, 21st Edn, S. Chand, 2012.
12. Organic Chemistry, R. K. Bansal, 5th Edn, New Age International, 2007.
13. Environmental Chemistry With Green Chemistry, Asim Kr Das, Books & Allied (P) Ltd, 2004.
14. Medicinal Chemistry, A. Kar, 5th Edn, New Age International, 2011.
15. Medicinal Chemistry, D. Sriram and P. Yogeswari, 1st Edn, Pearson, 2006.
16. Nanochemistry: A Chemical Approach to Nanomaterials, G. A. Ozin, A. C. Arsenult, L. Cademartiri and C. A. Mirkin, 2nd Edn, Royal Society of Chemistry, 2009.
17. Nanomaterial Chemistry: Recent Development and New Directions, C. N. R. Rao, A. Muller and A. K. Cheetham, Wiley-VCH, 2007.
18. A. K. Nad, B. Mahapatra and A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007.
19. B. M. Mahan and R. J. Meyers, University Chemistry, 4th Edn, Pearson, 2009.
20. S. M. Khopkar, Basic Concepts of Analytical Chemistry, Wiley Eastern Ltd., New Delhi, 1998.
21. A. L. Underwood and R. A. Day, Quantitative Analysis 6th Edn, Prentice-Hall, 2009.
22. J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Text Book on Quantitative Chemical Analysis, 6/e, Pearson.

Paper V (Practical)

1. A. K. Nad, B. Mahapatra and A. Ghosal, An Advanced Course in Practical Chemistry, New Central, 2007.
2. M. J. K. Thomas, J. Mendham, R. C. Denney, J. D. Barnes, Vogel's Quantitative Chemical Analysis, 6th Edn, Pearson Higher Education, 2000.
3. Vogel's Text Book of Practical Organic Chemistry (5th Edn).
4. Mann and Saunders, Practical Organic Chemistry.
5. S. C. Das, Advanced Practical Chemistry.

The University of Burdwan

Syllabus for
3-year B.A. /B.Sc. (General) Course
(1+1+1 Pattern)
in
Mathematics
(With effect from 2015-2016 onward)

[One hour lecture (1L) per one mark]

Part-I

Paper – I :	Group A: Differential Calculus	40 Marks (40 L)
	Group B: Integral Calculus	30 Marks (30 L)
	Group C: Ordinary Differential Equations	30 Marks (30 L)

Part-II

Paper –II :	Group A: Abstract Algebra	15 Marks (15 L)
	Group B: Classical Algebra	15 Marks (15 L)
	Group C: Linear Algebra	15 Marks (15 L)
	Group D: Geometry (2D)	10 Marks (10 L)
	Group E: Geometry (3D)	30 Marks (30 L)
	Group F: Vector Analysis	15 Marks (15 L)
Paper – III :	Group A: Dynamics of a Particle	40 Marks (40 L)
	Group B: Statics	20 Marks (20 L)
	Group C: Probability and Statistics	40 Marks (40 L)

Part-III

Paper –IV :	Group A: Linear Programming	40 Marks (40 L)
	Group B: Numerical Analysis	30 Marks (30 L)
	Group C: Computer programming	30 Marks (30 L)

Part-I

Paper –I

Group –A

Differential Calculus (Marks - 40)

Rational and Irrational numbers, Linear continuum, Functions, limit of functions, Algebra of limits, Continuous functions, Properties of continuous functions, Monotone functions, Inverse function.

Derivative and its applications, Successive differentiation, Leibnitz's theorem, Rolle's theorem, Mean value theorem of Lagrange and of Cauchy with geometrical interpretations. Taylor's theorem and Maclaurin's theorem with remainder in Lagrange's and Cauchy's form, and application of mean value theorem, Darboux's theorem. Series expansion of $\sin x$, $\cos x$, $\log(1+x)$, $(1+x)^n$, a^x with domain of convergence. Determination of maxima and minima, Indeterminate forms.

Sequence and its convergence, Cauchy's Criteria of convergence. Tests of convergence, Infinite series of constant terms, comparison test, D'Alembert's ratio test, Cauchy's root test, Raabe's, test, Logarithmic test, Gauss' test. Alternating series, Leibnitz's test for alternating series (proofs are not required).

Functions of several variables, repeated and simultaneous limits, continuity, partial derivatives, total differentials, directional derivatives. Euler's theorem on homogeneous functions of two and three variables.

Rectilinear asymptotes, Envelopes, Curvature, Radius of curvature, tangent and normal, pedal equation of a curve.

Group –B

Integral Calculus (Marks-30)

Definite integral as limit of a sum, its geometrical interpretation, Fundamental theorem of integral calculus, Reduction formula, Evaluation of definite integral ,viz:

$$\int_0^{\pi/2} \sin^n x dx, \int_0^{\pi/2} \cos^n x dx, \int_0^{\pi/2} \sin^m x \cos^n x dx$$ (m,n being positive integers).

Idea of improper integrals and test of convergence of the following improper integrals (proofs are not required).

$$\int_0^1 \frac{dx}{x^\mu}, \int_a^\infty f(x)dx, \int_a^\infty \frac{f(x)dx}{(x-a)^\mu}$$

Beta and Gamma functions (only simple properties and examples).

Quadratures, Rectification of curves, Volume and surface of solids of revolutions, Pappus theorem (statement only), Centre of gravity of simple bodies.

Group – C

Ordinary Differential Equations (Marks – 30)

First order and first degree ordinary differential equation : Existence and uniqueness theorem of solution, Exact differential equation, Integrating factor, First order linear differential equation , Equation reducible to linear form.

Trajectories, orthogonal trajectories.

Equation of first order but not of first degree: Equations solvable for $p = \frac{dy}{dx}$, Equations solvable for x, Equations solvable for y, Clairaut's form of equation, singular solution, Equations reducible to Clairaut's form .

Higher order linear differential equations with constant coefficients : Both homogeneous and non-homogeneous forms.

Simultaneous differential equation of first order.

References:

1. B.C. Das and B.N.Mukherjee, *Differential Calculus*, U. N. Dhur and Sons Pvt.Ltd., 53rd Edition.
2. B.C. Das and B.N.Mukherjee, *Integral Calculus*, U. N. Dhur and Sons Pvt.Ltd. 56th Edition.
3. *Calculus: Differentiation and Integration* , ICFAI University Press, Pearson Education, 2012.
4. Richard R.Goldberg, *Methods of Real Analysis*, Oxford and IBH , 2012.
5. Shanti Naryayn and P. K. Mittal, *Differential Calculus*, S Chand, 30th Revised Edition, 2005.
6. Shanti Naryayn and P. K. Mittal, *Integral Calculus*, S Chand, 35th Revised Edition, 2005.
7. Daniel A.Murray, *Introductory Course in Differential Equations*, Orient Logman, 1991.
8. K.C.Maity and R.K.Ghosh, *Differential Calculus*, Books and Allied (P) Ltd.,1997.
9. K.C.Maity and R.K.Ghosh, *Integral Calculus*, Books and Allied (P) Ltd., 1997.
10. J.G.Chakraborty and P.R.Ghosh, *Differential Equation*, U. N. Dhur and Sons Pvt. Ltd., 1998.
11. R.K.Ghosh and K.C.Maity, *An introduction to Differential Equation*, New Central Book Agency (P) Ltd., 2004.
12. E. Rukmangadachari, *Differential Equations*, Pearson Education, 2012.
13. S. N. Mukhopadhyay and A. Layek – *Mathematical Analysis – Vol-I* , U. N. Dhar & Sons. Pvt. Ltd.

14. S. N. Mukhopadhyay and S. Mitra – *Mathematical Analysis – Vol-II,* (U. N. Dhar & Sons. Pvt. Ltd.

Part-II

Paper –II

Group –A

Abstract Algebra (Marks-15)

Mapping – injective, surjective and bijective.

Composition of two mappings, Inverse mapping.

Binary composition, groupoids, semigroups, monoids, groups – simple examples, properties like uniqueness of identity and inverse element, law of cancellation and solution of the equation $ax = b$ and $ya = b$. Commutative property, subgroups, permutation, even and odd permutation, group of permutation, divisor of zeros, Rings, Integral domain, fields.

Group –B

Classical Algebra (Marks 15)

Polynomials, Division Algorithm, Fundamental Theorem of Classical algebra (proof not required) and its consequences, Descartes, rule of signs – its applications, Relation between roots and co-efficients, symmetric functions of roots, transformation of polynomial equations, Cardan's solution of cubic equation.

Complex numbers, De-Moivre's theorem, exponential, logarithm, sine and cosine of complex numbers.

Group-C

Linear Algebra (Marks-15)

Solution of non-homogeneous system of three linear equations by matrix inversion method.

Elementary row and column operations, rank of a matrix, row reduced echelon form and fully reduced normal form.

Vector spaces over reals, simple examples, Euclidean 3-space E^3, linear dependence and independence of a finite set of vectors, sub-spaces, definition and examples.

Cayley – Hamilton Theorem (statement only), verification of Cayley-Hamilton Theorem, inverse of a square matrix by Cayley-Hamilton Theorem.

Group – D

Geometry (2- Dimension) (Marks - 10)

Transformation of rectangular axes, Invariants, General equation of second degree –reduction to standard forms and classification. Polar co-ordinates, polar equation of a straight line, circle and conic.

Group – E

Geometry (3- Dimension) (Marks - 30)

Rectangular Cartesian co-ordinates. Transformation of axes. Equations of a plane and a straight line, Shorter distance between two skew lines. Sphere, Cone, Cylinder, Ellipsoid, Hyperboloid and Paraboloid referred to principal axes. Tangent planes and normals.

Group – F

Vector Analysis (Marks - 15)

Definition of vector, Resolution of vectors into components along three directions. Scalar and vector products of two and three vectors. Applications to geometry and mechanics**.**

Continuity and differentiability of vector-valued function of one variable. Velocity and acceleration. Vector-valued functions of two and three variables, Gradient of scalar function, Divergence curl and their properties.

References:

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2. Promode Kumar Saikia, *Linear Algebra With Applications*, Pearson, Second Edition, 2014.
3. Burnside and Panton, *The Theory of Equations*, Hodges Figgis And Company, 1924.
4. U. M. Swamy & A. V. S. N. Murthy, *Algebra: Abstract and Modern*, Pearson, 2011.
5. Ghosh & Chakravorty, *Higher Algebra (Classical & Modern),* U. N. Dhur & Sons Pvt. Ltd., Revised 22nd Edition.
6. Loney, *Co-ordinate Geometry*, Reem Publication Pvt. Ltd.
7. R. J. T. Bell, *An Elementary Treatise on Co-ordinate Geometry,* Macmillan & Co. Ltd., 1963.
8. N. Dutta & R. N. Jana, *Analytical Geometry and Vector Algebra*, Shreedhar Prakashani, Kolkata.

9. A. A. Shaikh & S. K. Jana, *Vector Analysis with Applications*, Narosa Publishing House Pvt. Ltd., New Delhi, 2009.
10. B. Spain, *Vector Analysis*, D.Van Nostrand Company Ltd. 1965.
11. L. Brand, *Vector Analysis*, Dover Publications Inc., 2006.
12. Shanti Narayan, *A Text Book of Vector Analysis*, 19th Edn, S.Chand publishing, 2013
13. M. Spiegel, S.Lipschutz , D. Spellman, *Vector Analysis*, McGraw-Hill, 2nd edn, 2009.
14. C.E.Weatherburn, *Elementary Vector Analysis: With Application to Geometry and Physics*, Bell, 1921

Paper –III

Group –A

Dynamics of a Particle (Marks - 40)

(*Vector methods and calculus may be used.*)

Motion of a particle in one dimension **:** Rectilinear motion under constant and variable forces ; Motion under gravity in a resisting medium where resistance varies as the velocity or square of the velocity; Terminal velocity; Simple Harmonic Motion (S.H.M); Elastic string; Damped and forced oscillations.

Motion of a heavy particle along a smooth and rough inclined plane.

Laws of motion; Impulse and Impulsive forces; Work, power and energy; Principle of conservation of energy and linear momentum; One dimensional collision of two elastic bodies; Coefficient of restitution; Loss of kinetic energy in direct collision.

Motion of a connected system and related problems.

Motion of a particle in two dimension **:** Expressions of velocity and acceleration components in Cartesian and polar co-ordinates; Angular velocity and angular accelerations; Equations of motion in Cartesian and polar co-ordinates; Motion of a projectile under gravity (neglected air resistance); Circular motion; Tangential and normal accelerations; Central forces and central orbits; Apses; Motion under inverse square law; Planetary motions; Keplar's laws; Escape velocity.

Group -B

Statics (Marks-20)

Forces (various types) : Forces acting at a point, Parallelogram of forces, Composition and resolution of forces, Triangle law of forces and polygon of forces, Lami's theorem, Converse of Lami's theorem, Parallel forces (like, unlike), Moments, Couples, General conditions for equilibrium of coplanar forces.

Group –C

Probability and Statistics (Marks 40)

Probability (Marks 20)

Probability: Random variable, probability mass function and distribution function of discrete random variable.

Probability density function and distribution function for continuous random variable and its properties.

Mathematical Expectations: Properties, Addition theorem, Multiplication theorem. Variance, properties of variance. Tchebyshev's inequality and Bernoulli's theorem (statement only).

Discrete uniform distribution, Bernoulli's distribution, Binomial, Poisson and Normal distribution, Expectation, Variance of the distributions.

Statistics (Marks 20)

Measures of Dispersion**:** Range, semi-inter quartile range, Mean deviation, standard deviation, effect of change of origin and scale on S.D., variance of the combined series, coefficient of dispersion:- based upon 1.Quartile deviation 2.Mean deviation 3.S.D.,coefficient of variation.

Moments: Relation between moments about mean in terms of moments about any point and vice versa, effect of change of origin and scale on moments, Pearson's beta and gamma coefficients, measures of Skewness and Kurtosis, Bivariate frequency distribution, scatter diagram, lines of regression, regressin coefficients, coefficient of correlation, samples, types of population, method of sampling, random sampling.

References:

1. J. L. Synge and B. A. Griffith, *Principles of Mechanics*, McGraw-Hill, 1959.
2. S. L. Loney, *An Elementary Treatise on The Dynamics of a Particle*, Cambridge University Press, 1913.
3. F. Chorlton, *A Text Book of Dynamics*, E. Horwood, 1983.
4. B. C. Das and B. N. Mukherjee, *Dynamics*, U. N. Dhur & Sons (P) Ltd., Kolkata, 23rd Edition, 1996.
5. P. R. Ghosh and J.G. Chakraborty, *Advanced Analytical Dynamics*, U. N. Dhur & Sons (P) Ltd., Kolkata.
6. A. Gupta, *Ground Work of Mathematical Probability and Statistics*, Academic Publishers, Calcutta, 3rd Edition, 1983.
7. A. M. Goon, M. K. Gupta and B. Dasgupta, *Fundamentals of Statistics, Vol. 1*, World Press, 1998.
8. A. M. Goon, M. K. Gupta and B. Dasgupta, *Fundamentals of Statistics, Vol. 2*, World Press, 2001.
9. F. E. Croxton, D. J. Cowden and Klein, *Applied General Statistics*, Prentice Hall, 1969.
10. J. F. Kenney and E.S. Keeping, *Mathematics of statistics, Part I*, Van Nostrand, 3rd Edition, 1954.
11. A. P. Baisnab and M. Jas, *Elements of Probability and Statistics*, Tata-McGraw Hill Pvt. Ltd., 2004.
12. K. N. Hari Bhat, J. Ganguly and K. Anitha Sheela, *Probability Theory and Stochastic Processes for Engineers*, Pearson Education, 2010.
13. S. Ross, *A First Course in Probability*, 9th Edition, 2012.
14. S. Ganguly and S. Saha, *Dynamics of a particle*, New Central Book Agency (P) Ltd., 1996.
15. N. Dutta and R. N. Jana, *Dynamics of a particle*, Shreedhar Prakashani, 4th Edition, 2000.
16. M. D. Raisinghania, *Dynamics*, S. Chand & Company Ltd., 2006.
17. S. Ganguly and S. Saha, *Analytical dynamics of a particle including elements of statics*, New Central Book Agency (P) Ltd., 1996.
18. B. C. Das and B. N. Mukherjee, *Statics*, U. N. Dhur & Sons (P) Ltd., Kolkata, 25th Edition, 1996.

Part-III

Paper - IV

Group – A

Linear Programming (Marks-40)

General introduction of LPP (Motivation, Formulation). Convex set, hyper plane, extreme point, convex polyhedron, basic solution, feasible solution, basic feasible solution.

Fundamental theorem of L.P.P. (statement only), replacement of a basis vector, improved basic feasible solutions, unbounded solutions, condition of optimality, simplex method, simplex algorithm, artificial variable technique (big M method).

Duality in L.P.P.: Concept of duality, fundamental properties of duality, fundamental theorem of duality (statement only), duality and simplex method.

Transportation problem (T.P.): Matrix form of T.P., the transportation table, Initial basic feasible solutions by North West corner, matrix minima and Vogel's Approximation method, loops in T.P. table, optimal solutions (simple problems).

Assignment problem: Balanced problem, optimal solution of assignment problem (Hungarian method).

Group –B

Numerical Analysis (Marks – 30)

Approximate numbers, significant figures, rounding off numbers. Errors - absolute, relative and percentage. General formula for errors. Errors in arithmetic operations.

Ordinary and divided differences. Propagation of error in difference table. Newton's forward and backward interpolation formulae. Newton's divided difference formula. Lagrange interpolation formula. Errors in interpolation formulae. Problems related to interpolations.

Numerical integration - Newton- Cotes' formula. Trapezoidal rule and Simpson's 1/3 rule - their inherent error and geometrical significance.

Solution of system of linear equations - Gauss Elimination Method , Gauss - Seidel Method, condition of convergence (statement only).

Solution of first order o.d.e. - Picard's method and Euler's method.

Solution for real roots of algebraic and transcendental equations - Regula Falsi Method , Fixed point iteration method and Newton - Raphson Method - their convergences (statement only).

Group –C

Computer Programming (Marks 30)

Functional units of a computer. Common Hardware components. Computer software. Concept of Computer Languages - Machine language and High level languages . Operating system. Compiler and Interpreter.

Concept of Algorithm and Flowchart - their basic features and differences . Flowcharts of some common problems.

Binary decimal, octal and hexadecimal number systems and their conversions.

Programming Language C: C-Character set, Keywords, Basic data types, Numeric constants and variables operators, Expressions, Assignment statements, I/0 – Statements.

Control Statements: Decision making and Looping statements in C, Break continue and goto statements, Example of simple programs.

C programs of ---

1) Evaluation of finite series
2) Factorial of an integer
3) Fibonacci sequence
4) Largest and smallest of n given numbers
5) Roots of a quadratic equation with real coefficients
6) HCF and LCM of two positive integers

References :

1. F. B. Hildebrand, *Introduction to Numerical Analysis*, McGraw-Hill Book Company Inc., 1974.
2. C. F. Gerald and P. O. Wheatley, *Applied Numerical Analysis*, Pearson, 7th Edition, 2003.
3. J. B. Scarborough, *Numerical Mathematical Analysis*, Oxford and IBH Publishing, 1966
4. B. Dasgupta, *Applied Mathematical Methods*, Pearso, 1st Edition, 2006.

5. S. S. Sastry, *Introductory Methods of Numerical Analysis*, PHI, Fifth Edition, 2012.
6. A. Gupta and S. C. Bose , *Introduction to Numerical Analysis,* Academic Press
7. G. Hadley, *Linear Programming*, Addison, 2nd Printing edition, 1963.
8. J. K. Sharma, *Operations Research - Theory and Applications*, Macmilian, 5th Edition, 2013.
9. H. A. Taha, *Operations Research: An Introduction*, Prentice Hall, 9th Edition, 2010
10. R. Bronson and G. Naadimuthu, *Schaum's Outline of Operations Research,* McGraw-Hill, 2nd Edition, 1997.
11. J.G. Chakraborty & P. R. Ghosh, *Linear Programming and Game Theory*, Moulik Library.
12. G. C. Layek, A. Samad and S. Pramanik, *Computer Fundamentals, Fortran-77, C & Numerical Program*, Levant, 2008.
13. E. Balagurusamy, *Programming in Ansi C,* Tata McGraw-Hill Education, 2004.

The University of Burdwan

Syllabus for B.Sc. GENERAL COURSE

(1+1+1 Pattern)

in

PHYSICS

with effect from 2014-2015 onward

Course Structure

Part-I

Paper I (Theoretical) (100 marks):

Part II

Paper II (Theoretical) (100 marks):
Paper III (Practical Paper) (100 marks)

Part III

Paper IVA (Theoretical) (65 marks):

Paper V B (Practical) (35 marks):

All lecturers is of 45 minutes duration

PART- I (General)

PAPER-I **FULL MARKS: 100**

[Units and dimensions, Vector, Mechanics, General properties of matter, Thermal physics, Vibration and Waves & Ray-Optics]

SI units and modern symbols are to be used. If otherwise not stated, mathematical derivation and analysis are necessary at relevant places.

Group – A : UNITS, DIMENSIONS & VECTOR

SI Units and Dimensions – Fundamental and derived, principle of dimensional homogeneity. L1

Vector: Scalar and vector products of two vectors with examples (work done, surface area, angular momentum and torque), polar and axial vectors, scalar and vector fields with examples, gradient, divergence and curl (definition, expression and meaning only), triple products of vectors, Laplacian operator and curl of curl, line-integral, surface integral and volume-integral; statements of divergence and Stokes' theorem. L6

MECHANICS

Principles of conservation of : Mass, linear momentum (including mathematical analysis of variable mass and rocket motion) angular momentum, energy and mass-energy [statement and explanations only] L5

Force laws: Mass-spring, gravitational, electric and magnetic forces; application of Newton's 2nd law to each case of the above forces and corresponding differential equations (case of mass-spring: force law – force $\alpha(-x)$ or force = -Kx, Newton's 2nd law – mass x acceleration = force, then mass x acceleration = -kx and the differential equation $m\frac{d^2x}{dt^2} = -kx$ or $\frac{d^2x}{dt^2} + kx = 0$; Conservative force, path-integral, potential energy, kinetic energy and total energy; non-conservative forces (mentioning validity of conservation of energy). L5

Central force : Central forces. Two-body central force problem and its reduction to two one-body problems. Reduced mass. Important properties of motion under central force. Velocity and acceleration and their radial and transverse components. Differential equation of the orbit. Inverse square law of force. Conditions for parabolic, elliptic and hyperbolic orbits. Kepler's laws. Motion of artificial satellites. Geocentric satellites. L8

Dynamics of rigid body : Definition of rigid body, its translation in terms of centre of mass, linear momentum and force, pure rotation, rotational kinetic energy, rotational inertia (M.I.) and radius of gyration, angular momentum and torque; parallel and perpendicular axes theorems, calculation of M.I. about usual axes of symmetrical bodies (rod, disc and cylinder) and M.I. about a diameter of spherical shell and sphere; translation combined with rotation, rolling of spherical shell and solid sphere on horizontal and inclined planes. L12

GROUP-B : GENERAL PROPERTIES OF MATTER

Gravitation : : Gravitation. Gravitational potential and intensity due to spherical and other symmetrical bodies. Principle of Boys' method for the determination of gravitational constant. L4

Elasticity: Relation between elastic moduli, torsion of a cylinder and strain energy; bending of a beam, cantilever (simple deduction), light beam supported at a both ends and loaded at the centre. L6

Fluid motion: Streamline and turbulent motion of liquid, continuity equation, critical velocity, Newtonian fluid, co-efficient of viscosity, Poiseuille's formula, dimensional analysis for critical velocity, Reynold's number and Stokes' law; Bernoulli's theorem using conservation of energy and illustration; Mention of variation of viscosity with temperature. L6

Surffa ce Tension: Surface tension and surface energy, molecular theory, angle of contact, Newman's triangle capillary rise and fall of liquid column, Jurin's law verification, excess pressure in spherical bubble and drop, variation of surface tension with temperature (mention only), experimental determination of surface tension by capillary rise method L6

Group-C : THERMAL PHYSICS

Kinetic theory of gases: Ideal gas, pressure exerted by it, kinetic interpretation of temperature, Maxwell's distribution of moleculer speeds (only statement and explanation with distribution curve), idea of mean, r.m.s. and most probable speeds; degrees of freedom, principle of equipartition of energy with application in simple cases; C_p and C_v - two molar specific heats of gases, $C_p - C_v = R$ and pVT-relations for adiabatic changes; variation of atmospheric pressure and temperature with height; Andrew's experimental results on CO_2, Behavour of real gases, Vander Waal's equation (simple derivation), critical constants in terms of Vander Wasl's constants. L12

Thermal conduction: Steady and variable state, thermal conductivity and diffusivity, Fourier equation for one dimensional heat flow and its solution, theory of Ingen Hausz's experiment, cylindrical flow of heat, experimental determination of thermal conductivity by Lee's method; statement of Wiedemann and Franz's Law. L6

Group D: THERMODYNAMICS

System and surroundings, thermal equilibrium and zeroth law of thermodynamics - concept of temperature (T), state variables and state functions; 1st law of thermodynamics - concept of internal energy (U) and work-energy conversion, different processes (isothermal, adiabatic, reversible and irreversible) for change of states, work done and p-v diagram; Carnot cycle, Carnot engine and its efficiency; 2nd law of thermodynamics - concept of entropy (S), physical interpretation of entropy, change in entropy in reversible and irreversible processes, Carnot theorem, thermodynamic scale of temperature; Joule Thomson effect, enthalpy and temperature of inversion; Joule Thomson cooling versus adiabatic cooling. L15

Thermal radiation: Nature of radiation, emissive and absorptive power, black body and blackbody radiation, Kirchhoff's law, Stefan's law, Newton's law of cooling; Planck's idea of quantization, Planck's distribution law (statement only) and graphical interpretation, Wien's displacement law (statement and graphical explanation); pyrometer principle. L4

Group E : MECHANICAL VIBRATION AND WAVES

Vibration: Superposition of two S.H. vibrations (collinear and perpendicular), Lissajous' figures; damped and forced vibration, resonance and its sharpness (using complex quantity). L4

Waves: Wave motion and differential equation of plane progressive waves, energy and intensity, bel and decibel; loudness and phon; velocity of longitudinal wave in solid and gas, velocity of transverse wave in string (simple theory), qualitative discussion of standing waves and energy-distribution with examples; Doppler effect. L8

Group E : Ray – Optics

(Rational or Cartesian sign convention to be followed)

Fermat's principle and laws of reflection and refraction at plane surfaces; refraction law at spherical surface, lens maker's formula, combination of thin lenses and equivalent focal length. L8

Dispersion of light, dispersive power, chromatic aberration and its remedy, mention of other Seidel aberrations; Huygen and Ramsden eyepieces. L8

[Problems related to physical theories to be covered]

Part II (General)

Paper – II Full Marks : 100

[Electromagnetism, Wave- optics, Modern Physics and Electronics]

If otherwise not stated, mathematical derivation and analysis are necessary at relevant places.

ELECTROMAGNETISM

(SI units and modern symbols are to be used)

Group A

[Electromagnetism is a single subject of electricity and magnetism. An electric charge appears to be static with respect to (w.r.t.) one observer and moving w.r.t. another. First observer finds only electric field E, but the second detects simultaneous existence of both electric field E and magnetic field B. An electric current I (moving charge) transports electric charge q, and set up magnetic field B too. Then a suitable choice of unit for I will lead to consistent units of both q and B.]

Unit of electric current: Ampere (A), the fundamental SI unit of electromagnetism; Definition of 1A in terms of force between two long straight filamentary parallel currents; 1 coulomb = 1A x 1s, net charge transported by 1 A in 1 second – derived SI unit of electric charge. L1

Electrostatics (both q and E statics): Electric field, force on a charge q, Millikan's oildrop experiment, idea of quantized charge and value of e, the electronic charge, conservation or electric charge;. Electric flux through an surface area. Gauss's law and its application in simple cases. Relation between field and potential in electrostatics. Electric dipole, dipole placed in an electric field. Field and potential due to electric dipole at any point L8

Dielectric and Capacitor: Polarisation and three electric vectors, **E**, **P** and **D**, polarisability, $\mathbf{D}=\varepsilon_0\mathbf{E}+\mathbf{P}$; Gauses's law in dielectric constant, parallel plate and cylindrical capacitors with dielectric inside, energy density in electric field. L2

Group-B

Direct current (steady): Electric current density **J**, I= $\int J.ds$, and equation of continuity; voltage source and current source; linear passive circuit elements, Kirchhoff's laws and analysis of multi-loop circuits; Thevenin and Norton theorems (statements and explanation) and reduction of two-terminal linear network. Calculation of galvanometer- current in an unbalanced Wheatstone bridge with ideal voltage source by Thevnin theorem; applications of Wheatstone bridge principle; potentiometer – principle and applications. L6

Magnetostatics (Static magnetic field B): Defining equation of B (magnetic induction vector) – the fundamental magnetic vector, **F=qv×B** or **F=H×B** i.e., Lorentz force equation, Thomson experiment for the determination of em , Dempster's mass spectrometer; nonexistence of magnetic monopole - $\nabla.\mathbf{B}=0$ (Maxwell's 2nd equation) i.e, non existence of magnetic charge, causes of magnetic field B: electric current, electromagnet, permanent magnet, time varying electric field, some atoms, molecules and some elementary particles; Biot-Savart law, Ampere' law in magnetostatics $\mathbf{B.dl}=\mu_0\mathbf{I}$ enclosed→ $\nabla\times\mathbf{B}=\mu_0\mathbf{J}$, **B** due to long straight filamentary current, force between two long parallel currents and $\mu_0=4\pi\times10^{-7}NA^{-2}$ (assigned value); B on the axis of circular current, solenoidal current and toroidal current; torque on a current loop in uniform B, magnetic moment of a magnetic dipole, equivalence of current loop with magnetic dipole. L10

Materials and magnetization: Three magnetic vectors - **B, M & H=B/μ_0 - M** and illustration referred to a bar magnet; magnetic susceptibility and relative permeability; dia, para and ferromagnetic properties, idea of domain theory, statement of Curie's law; hysteresis and hysteresis loss. L5

Electromagnetic Induction: Magnetic flux, $\phi_S = \int B.ds$, flux-linkage with a coil of N turns, Faraday's law and Lenz's law of electromagnetic induction, $e=-\partial\phi/\partial t$ for a single turn, integral form $\int E.dl = \frac{\partial}{\partial t}\int B.ds$, using Strokes' theorem differential form $\nabla\times\mathbf{E}=-\frac{\partial B}{\partial t}$ (Maxwell's 3rd equation); self (L) and mutual inductances, calculation of L for circular and solenoidal coils; energy stored in current carrying inductor and energy density in magnetic field. L5

Direct current (varying): Growth and decay of current in L R circuit, charging and discharging of a capacitor through a resistor using voltage source. L3

Alternating current (steady state): Sinusoidal voltage and current, mean and effective (r.m.s) values, steady state solution (using complex quantity) for current in LR and CR series circuit excited by sinusoidal voltage; reactance, impedance, phase angle and phasor diagam; power analysis and power factor, resonance in series RLC and parallel RLC circuit (using complex quantity and phasor diagram), sharpness of resonance including Q factor and bandwidth; basic idea about transformer.

Electromagnetic waves : Laws of electromagnetism before Maxwell: $\nabla.\mathbf{E}=\frac{\rho}{\varepsilon_o}$, $\nabla.\boldsymbol{B}=0$, $\nabla\mathbf{xE}=\frac{\partial B}{\partial t}$, $\nabla\times\mathbf{B}=\mu_0\mathbf{J}$, (only expressions), introduction of displacement current density $\frac{\partial}{\partial t}$ and Maxwell's equation: : $\nabla.E=\frac{\rho}{\varepsilon_o}$, $\nabla.\boldsymbol{B}=0$, $\nabla\mathbf{xE}=\frac{\partial B}{\partial t}$, $\nabla\times\mathbf{B}=\mathbf{J}+\frac{\partial D}{\partial t}$. (electromagnetic wave equations in free space), wave speed $\frac{1}{\sqrt{\mu_o\varepsilon_o}}$ = $3x10^8$ m/s, speed of light in free space and wave nature of light.

Group – C : WAVE – OPTICS & LASER

Wave Optics :

Huygen's principle: Idea of wave fronts – plane, spherical and cylindrical; secondary wavelets, construction and propagation of wave front L2

Interference: Young's experiment, intensity redistribution, condition of stable interference-pattern, coherent source, interference by division of amplitude and Newton's ring experiment, interference by division of wave front and experiment with Fresnel's biprism; idea of coherence-time and coherence-length. L5

Diffraction: Fresnel and Fraunhofer classes, Fresnel's half period zones, zone plate, explanation of rectilinear propagation of light and zone-plate; Fraunhofer diffraction in single slit, double slit and plane diffraction grating (simple theory), Resolving power and the Rayleigh criterion for resolution (statement), grating spectra versus prism spectra. L6

Polarization: Transverse nature of light (e.m.) wave, different states of polarization, plane polarized light, Brewster's law, double refraction; uniaxial crystal, Polaroid and Nicol prism (qualitative function); optical activity and rotation of plane of polarization. L6

Laser: Spontaneous and stimulated emission, Einstein's A & B coefficients; idea of population inversion, principle of laser, laser versus ordinary light, Ruby Laser. L3

Group D : Modern Physics

Special Theory of Relativity: Reference frames, postulates of special theory of relativity, Lorentz transformation formula (only explanation) and consequences such as length contraction and time dilatation: relativistic transformation of velocity and mass, mass-energy relation and total energy, zero and finite rest masses. L5

Elements of statistical mechanics: System of very large number of particles, microscopic and macroscopic properties, most probable behavior; MB, BE and FD statistics (only distribution formulae with explanation) and respective kind of particles. L2

Elements of Quantum Physics: Failure of classical physics to explain black body radiation, photoelectric effect, Compton effect, Raman effect etc. and success of quantum theory (qualitative discussion only); Bohr's theory of hydrogen spectra, principal quantum numbers, limitations, correspondence principle, qualitative introduction of four quantum numbers and Pauli's exclusion principle; wave-particle duality, De Broglie wave length, Davisson and Germer experiment; Superposition of two waves, wave packet and group velocity; Heisenberg's uncertainty relation (statement and explanation): Idea of wave function and Schordinger equation (time dependent and time independent parts), interpretation of wave function in terms of probability, just mention of the remarkable results of application of Schrodinger equation (A) particle in a box , (B) Linear harmonic oscillator and (C) barrier penetration problem. L11

Crystal nature of solid: Diffraction of x-rays, Bragg's law; Mosley's law and its importance L2

Nuclear physics: Nucleus (mass, size, nucleons & binding energy), binding energy-mass number curve and explanation of stability, fission and fusion of nuclei, radioactive disintegration, successive equilibrium, radio isotopes and uses; nuclear reactor, nuclear reaction, thermonuclear reaction and stellar energy, basic information about some elementary particles, principles of operations of G.M. counter as detector and cyclotron as accelerator. L9

Group- E : SOLID STATE DEVICES ELECTRONICS

Semiconductorphysics: Qualitative ideas of energy bands at 0 K, generation of hole-election pairs at room- temperature and intrinsic semiconductor, carrier density; doping and impurity semiconductor, majority and minority carriers, p-type and n-type semiconductors, advantage of silicon over germanium as semiconductor device material, p-n junction and its properties (depletion region, barrier voltage, barrier width and junction- capacitance). L4

Devices and circuits: Junction diode, forward and reverse biased characteristics, diode equation (I-V expression only), a.c. and d.c. resistances of a diode, use of diode as rectifier, calculation of ripple facor and efficiency of half and full wave rectifier. qualitative explanation of use of capacitor filter, properties and uses of zener and light emitting diodes, bipolar junction transistor (n-p-n and p-n-p), current components in a transistor under normal bias and current gain, CE output characteristics and current gain , use of transistor as CE amplifier, h-parameter model of BJT CE amplifier, basic idea of feedback in amplifier and principle of oscillator. L8

Digital electronics: Binary numbers, binary-decimal inter-conversion, binary addition, OR and NOT gates, De Morgan's theorem, NOR & NAND universal gates, XOR gate, half adder and full adder (using half adders). L4

[Problems related to physical theories to e covered]

Paper – III : Full Marks 100

At least 16 (sixteen) different experiments of the list given below are to be set up in each laboratory, and to be performed by the students in each college from the session 2014; and 4 (four) other experiments of the list are to be set up and performed for the session, 2014-2015

Theory, record of experimental data, results with calculation, and discussion are to be entered in "standard" bound laboratory note books (LNB) by the students; and to be signed by the class-teachers during the laboratory classes regularly; and these notebooks are to be submitted at the time of final examination. For each group of experiments, separate LNB is Necessary. No fair notebook other than that used in the class-work will be accepted. One experiment from Group-A and one from Group-B of the list given below are to be performed by each candidate in the final part-I examination. Each experiment will be allotted 50 marks, and is to be completed in 3 hours-time during examinations.

List of Exeriments

Group-A

1. Moment of inertia of cylindrical body about an axis passing through its centre of gravity.
2. Young's modulus of the material of a wire by Searle's method.
3. Rigidity modulus of the material of a wire by dynamical method.
4. Frequency f (or ν) versus 1/l curve for a sonometer-wire and hence unknown frequency of a tuning fork.
5. Coefficient of linear expansion of the material of a rod using optical lever (or using traveling microscope)
6. Pressure coefficient of air.
7. Focal length of a convex lens by combination method and calculation of its power.
8. Verification of Thevenin and maximum power transfer theorems using Wheatstone bridge with load- resistances in place of the galvanometer.
9. To draw I-V characteristics of a suitable resistance and that of a junction diode within specified limit on a graph, and hence to find d.c. and a.c. resistances of both the elements at the point of intersection.

Group- B

1. Refractive index μ of water by traveling microscope.
2. Refractive index μ of the material of a lens by lens-mirror method.
3. Refractive index μ of the liquid by lens-mirror method.
4. Refractive index μ of the material of a prism for a monochromatic light by spectrometer.
5. Horizontal component of the earth's magnetic field B at the place using deflection and vibration magnetometers.
6. Resistance of a suspended coil galvanometer by half deflection method and hence the current sensitivity of the galvanometer.
7. Temperature-coefficient of the material of a given resistance with the help of a meter-bridge (without end correction).
8. Potential difference across a low resistance and hence the current through it with the help of a potentiometer (potentiometer resistance and the source voltage to be supplied).
9.. Output characteristics of a transistor (silicon) in CE mode and hence β_{dc} and β_{ac} at any operating point.
10. Verification of truth table of NAND gate using IC chip and to construct NOT & OR/AND gates from NAND gates and to verify respective truth tables on breadboard.

Part III (General)

PAPER – IV : Full Marks 100

Theory Marks: 65 (**Paper IVA)** Practical Marks: 35 (**Paper: IVB)**

THEORY

Guide lines for setting questions (to be sent to the paper setter)

Short answer questions on physical theory and principles involved. [20]

Short answer questions on construction and functions of each part of a system [30]

Objective questions based on information. [15]

Paper IV A (Theory Portion) Full Marks: 65

Application oriented topics covering different branches of physics: Basic theories and principles of operations (without long mathematical derivation and complicated involvements) to be studied.

[1 compulsory question of objective type based on information from the topics of the entire syllabus and 5 other questions out of 8 to be answered]

Titles of the topics

1. **LASESR :** Principle of Laser action. He-Ne Laser, Holography principle only. L4

2 **MAXWELL EQUATIONS:** Maxwell equations inside matter. Gauge fields, Poynting theorem, Poynting vector, Transverse nature of e.m. field. Dispersion and scattering (elementary idea), blueness of sky and redness of setting sun. L10

3. **FIELD EFFECT TRANSISTOR :** Field effect transistor, Comparison between FET and BJT, Construction and characterstics of FET. , FET parameters and their dependence , MOSFET, Construction and characterstic of MOSFET. Fabrication of IC. L7

4. **OSCILLATORS :** Principle of oscillators, Barkhausen Criteria, Phase shift oscillator, LC & RC oscillators. L5

5**. BONDING IN SOLIDS** : Different types of interatomic binding in solids. Ionic crystals. Electrostatic energy.. Cohesive energy of ionic crystals with repulsive interaction. L 5

6. **DIELECTRICS :** Dielectric materials. Polarization. Lorentz local field. Clausius-Mosotti relation. Induced and orientational polarization. Dipolar polarizability. L5

.

7 **GENERATORS & MOTORS :** Electric generator, transformer and motor. (d.c. & a.c.) L4

8. **Building Acoustics** : Reverberation, Sabine Formula and absorption coefficient, Acoustic requirements for an ideal auditorium. L5

9. **DIGITAL ELECTRONICS :** FLIP FLOPS, 4 : 1 Multiplexor and Demulitplexor, construction using NAND Gates and truth table. A/D and D/A convertor. L5

10. **TRANSISTOR BIASING :** Transistor biasing (self bias), CE voltage amplifier power amplifier (emitter follower and class B push pull complementary symmetry); OPAMP and its uses as inverting and non-inverting amplifiers, Differentiator and Integrator. L8

11.**Principles of Communications**: Analog modulation and demodulation for AM and FM; digital modulation-basic idea; Radio transmitter and receiver in block diagrams; elements of television system; satellite communication. Optical fibre communication, principle, Step and Graded index fibre, N.A., Advantage of optical fibre communication. Radio-wave spectrum and different modes of radio-wave propagation (qualitative discussion). L12

12. **COMPUTER FUNDAMENTAL :** Computer hardware: basic building blocks, central processing units, memory, hard disc, RAM. ROM, CD-ROM, DVD, pen drive, memory units: bits and bytes, input-output devices, (ii) Computer software: Operating system, Windows /Linux (iii) Programmingin C: basic structure, character set, keywords, idea L5

Paper IV B (Practical)

Full Marks: 35 **Time : 3 Hours**

1. Reports on the experiments are to be written in "Standard" laboratory work books in the classrooms under the guidance of the teachers. Daily work-report recorded in the LWB is to be signed by he teachers regularly. No other laboratory note book than that used in the lab-class will be accepted.
2. Final examination and assessment will be made by a board of examiners consisting of internal examiners and an external examiner on the practical and viva-voce test.

Performance	20 marks
Daily report on the Laboratory workbook	05 marks
Viva voce on the practical	10 marks

List of Practical

1. Young's modulus by flexure method using single length.
2. Construction of a one-ohm coil and measurement of the length wire of one ohm.
3. Study of Zener diode chracterstics and its application as voltage regulator.
4. Band gap measurement for themistor..
5. Study of an OPAMP (741C) circuit for i) inverting, ii) non inverting and iii) adder circuit..
6. Design an IC regulated dc power supply and study of bridge rectifier using bed board.
7. Study of LCR circuit.
8. conversion of ammeter into voltmeter and voltmeter into ammeter.

Books recommended for **3-year Degree General Course i**n Physics

Part-I

1. Physics I & II – Halliday & Resnik (W.E.)
2. College physics (I-IV) volumes – Sinha & Das Sharma (Modern Book Agency)
3. All vol. of physics – Dr. D.P. Roychowdhuri ('Chayan' in old publication.)
4. Optics – A.K. Ghatak.;
5. Classical & Modern optics – Meyer – Arendt (PH I)
6. Electricity & Magnetism – Mahajan & Rangwala (TMG);
7. Electricity and Magnetism – Chatterjee & Rakshit (Central Book Agency) Books Allied (P) Ltd.
8. NCERT Physics Vol. II (Part I & II)
9. Introduction to Electrodynamics – Griffith (PH I)
10. Concepts of Modern Physics – Beiser (TMG);
11. Modern Physics – Mani & Mehta (Affiliated East West Press);
12. Modern Physics – Patil (TMG)
13. Foundation of Electronics – Chatterjee, Rakshit et al.;
14. Digital computer Electronics – Malvino & Brown (TMG)
15. Physics of the atom – Wehr, Richard, Adair (Addison – Wesley world student series)
16. Series by D.C. Tayal (Himalaya Publishing)