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B.A./B.Sc. III year Mathematics

PAPER – First

Linear Algebra and Linear Programming

Note: There shall be three sections A, B and C in this paper. Questions within all the three sections shall carry equal marks. Section A will be compulsory and objective in nature having ten questions. Marks allotted to this section shall be 10. Questions in section B will be short answer type of 20 marks. Candidates will have to attempt four out of eight questions selecting at least one question from both parts (viz. Linear Algebra and Linear Programming). Questions in section C will be of descriptive nature of 20 marks. Candidates will have to attempt any two out of four questions. The number of questions for framing of question paper shall be 80% from Linear Algebra, 20% from Linear Programming . The question paper be framed proportionately from the whole syllabus

Linear Algebra

Vector spaces: Vector space, sub spaces, Linear combinations, linear spans, Sums and direct sums, Linear dependence, Bases and dimensions, Dimensions and subspaces, Coordinates and change of bases.

Linear Transformations: Linear transformations, rank and nullity, Operations with linear transformations, Linear operators, Algebra of linear operators, Invertible linear operators, Matrix of linear transformation, Matrices and linear transformation, Matrix of linear operator, Change of basis, similarity.

Linear Functional: Linear functional, Dual space and dual basis, Double dual space, Annihilators, Transpose of linear transformation, Bilinear, Quadratic and Hermitian forms, quadratic form.

Linear programming: Programming, Graphical Linear method, Simplex method, the dual of a linear programming problem.

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PAPER – Second

Analysis

Note: There shall be three sections A, B and C in this paper. Questions within all the three sections shall carry equal marks. Section A will be compulsory and objective in nature having ten questions. Marks allotted to this section shall be 10. Questions in section B will be short answer type of 20 marks. Candidates will have to attempt four out of eight questions selecting at least one question from both parts (viz. Real Analysis and Complex Analysis). Questions in section C will be of descriptive nature of 20 marks. Candidates will have to attempt any two out of four questions. The number of questions for framing of question paper shall be 60% from Real Analysis, 40% from Complex Analysis. The question paper be framed proportionately from the whole syllabus

Real Analysis: Continuity of functions, Properties of continuous functions, Types of discontinuities, Uniform continuity, Differentiability, Taylor's theorem with various forms of remainders, Riemann integral-definition and properties, Condition of integrability, Convergence and uniform convergence of improper integrals. Point wise convergence, Uniform convergence, Test of uniform convergence, Convergence and uniform convergence of sequences and series of functions.

Complex Analysis: Functions of complex variable, Harmonic functions, Cauchy and Riemann equations, Analytic functions, Complex integration, Cauchy's theorem, Cauchy's integral formula, Taylor's series, Laurent's series, Liovelle's theorem, Poles and singularities, Residues, Residue theorem and its applications in the evaluation of integrals.

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PAPER – Third

This paper shall consist of any one of the following four option M.M.: 50

a) Numerical Analysis

b) Mathematical Statistics

c) Spherical Trigonometry and Astronomy

d) Principal of Computer Science and Information Technology

Note-(1). The choice for selecting the optional paper will be subject to the approval of the Head of Department, depending upon availability of resources and will be as per combinations available at the respective centers.

Note-(2).candidates offering Statistics as one of the optional subjects in B.A./ B.Sc. I& II shall not be allowed to offer paper III(a) and III(b).

Note-(3). Simple Calculators (Non-Programmable) be allowed to the examinees during examination of paper III(a).

Note-(4). Note-(3) should invariably be printed as instruction in the question paper III(a).

Note-(5). Candidates offering Computer Science and Information Technology as one of the optional subject in B.A./B.Sc I &II shall not be allowed to offer paper III(d)

Paper-III (a)

Note: There shall be three sections A, B and C in this paper. Questions within all the three sections shall carry equal marks. Section A will be compulsory and objective in nature having ten questions. Marks allotted to this section shall be 10. Questions in section B will be short answer type of 20 marks. Candidates will have to attempt four out of eight questions. Questions in section C will be of descriptive nature of 20 marks. Candidates will have to attempt any two out of four questions. The question paper be framed proportionately from the whole syllabus.

Numerical Analysis

Finite difference, Difference operators, Newton's interpolation formula, divided differences, Interpolation with unequal interval of arguments, Lagrange's formula, Sterling and Bessel formula (application only).

Numerical differentiation, Numerical integration, Simpson's rule, Trapezoidal rule and their accuracy, Numerical solution of algebraic equations in two unknown quantities, Regula Falsi, Newton Raphson, Graff's root squaring method. Numerical method of matrix inversion, determination of Eigen values and Eigen vectors.

Mathematical Statistics

Elements of the theory of probability, Addition and Multiplication theorems, Expectations, Moments, m.g.f. (definition and application to Binomial and Poisson's distributions), Skewness, Kurtosis, Binomial, Poisson's and normal distributions, Interpolation (Newton's and Lagrange's formula). Simple random sampling, Association of attributes, Yule's coefficient of association, Consistency of data, Curve fitting, Correlation, Regression lines and rank correlation coefficient. Chi square test, test of significance based on "t" and "z" test.

Spherical Trigonometry and Astronomy

Spherical Trigonometry: Fundamental formulae of spherical trigonometry, (excluding circles and areas), Solutions of right angled triangles, Latitudes and Longitudes on the surface of the earth.

Astronomy: Celestial sphere, Diurnal motion, Twilight, Atmospheric refraction, Meridian circle, planetary motions, Time planetary phenomenon, Precession and notation.

Principles of Computer Science and Information Technology

Introduction to computers: Information processing and the electronic digital computers, Information Technology, Use of computers, Computers and human beings, Generations and types of computers, Microcomputer, Input output devices, Storages devices.

Data storage and data manipulation: Storage of bits, Main memory, Coding information of storage, Storing integers, Storing functions, Communication errors, The central processing unit, Programme execution, Arithmetic/Logic instructions, Computer-Peripheral communication.

Computer Languages: Characteristics of programming languages, Machine languages, Assembly languages, High level languages, Fifth generation languages, Object oriented and visual programming.

Data communications and networks: Communications, Computers and communications, Telephone related communications, New technologies in modem, Communications protocols, Communication channels, Types of connections, Types of networks, Local area networks, Transmission models, Data encoding and decoding.

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B.A./B.Sc. III year Physics

PAPER – First

Quantum Mechanics and Relativity

Note: This question paper has three sections. Section- A consists of fourteen objective type questions, each carrying ½ Mark. All questions in this section are compulsory; Section-B consists of ten short answer type questions carrying 2 Marks each. Attempt any seven questions from this Section. Section-C consists of six long answer type questions carrying 4 Marks each. Attempt any three questions from this section. Questions are to be attempted sequentially as far as possible. All the symbols used have their usual meanings.

Unit-I Origin of quantum theory, failure of classical Physics to explain the phenomena such as black body spectrum, Photoelectric effect,its characteristics and Einstein's explanation, Planck's constant and particle nature of light, Compton effect.

Unit-II De Broglie's hypothesis of matter waves, Davisson and Germer experiment, G. P. Thomson experiment, Taylors experiment, Group velocity and wave velocity, wave particle duality, , Principle of Complementarity, uncertainty principle, Heisenberg gamma ray microscope , Single slit experiment.

Unit -III Schrodinger's equation, Postulatory basis of quantum mechanics, Operators, Expectation values, Importance of wave function, Probability interpretation.

Unit -IV Applications of Schrodinger's equation to particle in one-dimensional box, Harmonic oscillator, transmission across a potential barrier, potential well of both finite and infinite depths, Potential step.

Relativity

Unit -V Michelson Morley experiment, Galilean Invariance, Postulates of special theory of relativity, Lorentz transformations, Relativity of simultaneity, length contraction, time dilation, law of addition of velocities , variation of mass with velocity, mass energy equivalence, relativistic kinetic energy.

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PAPER – II

Modern Physics

Note: This question Paper has three Sections. Section-A consists of fourteen objective type questions, each carrying ½ Mark. All questions in this section are compulsory, Sections –B consists of ten short answer type questions carrying 2 Marks each. Attempt any seven questions from this Section. Section-C consists of six long answer type questions carrying 4 Marks each. Attempt any three questions from this section. Questions are to be attempted sequentially as far as possible. All the symbols used have their usual meanings.

Unit-I Electronic specific charge 'e/m', Thomson's model, Rutherford's atomic model, Bohr's model and spectra of hydrogen atom, fine structure and other shortcomings. Sommerfeld's model, Stern Gerlach experiment, Bohr Megneton, Larmor's precession, vector atom model and spatial quantization and electron spin.

Unit-II Optical Spectra, spectral notations L-S, J-J coupling, selection rules and intensity rules , Explanation of structure of sodium D line. Normal Zeeman effect, X-ray spectra (characteristic and continuous), Moseley's law.

Unit-III Luminescence, Spontaneous and induced emissions, Metastable states, Einstein A and B coefficients, Spatial & temporal coherence, optical pumping, population inversion. Conditions of lasing action. Idea of Laser and Maser. Examples of Laser (Ruby Laser, He-Ne Laser, semiconductor Laser) and some applications, Molecular spectra. Rotational, vibrational and electronic energies of a diatomic molecule, Gross features of electronic band spectra, Brief idea of Raman effect.

Unit-IV Structure of nucleus ;Charge, shape, mass, energy, spin, angular momentum, mass defect, Packing fraction and binding energy. Liquid drop model and semi empirical mass formula, Kinematics of nuclear reactions, Basic idea of nuclear fission and fusion, General idea of elementary particles and their classification

Unit-V Artificial nuclear transmutation, Particle accelerators; Van de Graaff generator, Cyclotron. Linear accelerator Particle detectors; Ionization chamber, Proportional counter and G.M. Counter. Radioactivity (Brief idea of decay), Soddy displacement law. Law of radioactive disintegration, half-life and mean life. Radioactive dating (Specially Carbon Dating).

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PAPER – Third

Electronics and Solid State Devices

Note: This question Paper has three Sections. Section-A consists of sixteen objective type questions, each carrying ½ Mark. All questions in this section are compulsory, Sections –B consists of ten short answer type questions carrying 2 Marks each. Attempt any seven questions from this Section. Section-C consists of six long answer type questions carrying 4 Marks each. Attempt any three questions from this section Questions are to be attempted sequentially as far as possible. All the symbols used have their usual meanings.

Unit -I Network analysis and Network theorems Characteristics of S.H.M., S.H.M. in mechanical and electrical systems, Addition of SHM(s), Non-linear (an harmonic) oscillator, Damped harmonic oscillator, Quality factor, applications in moving coil galvanometers, oscillations of a system with two degrees of freedom, Lissajous figures, Composition of two SHM(s) of frequency ratio 2:1.

Unit-II Solid State Devices Electronic Devices: General idea of diode, triode, tetrode, pentode and their characteristics, limitations. Semiconductor Devices, p-n junction semiconductor diodes; Point contact, Zener, Varactor, tunnel diode, photo diodes, light emitting diode. Junction Transistors, Transistor operation, Characteristic Curves, common emitter, common base and common collector configurations, current amplification, Field effect transistor MOSFETS, UJT, Four layer semiconductor devices (SCR, thyristor), thermistor.

Unit -III Rectifiers, Power supplies and Digital electronics HW, FW and bridge rectifiers, Filter circuits (Series L., Shunt C., L-Section, π-Section). Unregulated PS, Regulated PS, Voltage regulation by Zener diode, Voltage multipliers, Binary, Decimal, Hexa decimal and Octal number systems and interconversions. BCD, GREY, EXCESS-3 codes, Logic gates & Boolean Algebra.

Unit-IV Transistor Amplifiers Classification, Basic Amplifier, Load line, Transistor biasing Transistor equivalent circuits (h Parameters). Single stage transistor amplifier, (common emitter, common base) FET amplifiers, R.C. coupled transistor amplifier, Impedance coupled & Transformer coupled amplifier, Noise and distortion in amplifiers, power amplifiers (class A, push pull, class B and class C) Decibel, Frequency response, Bandwidth.

Unit-V Feed back Amplifiers and Oscillators Classifications, Negative feed back and its advantages, Feed back amplifiers (Voltage and current) positive feed back oscillators (RC phase shift and Wien bridge , Hartley, Colpitt, Tuned collector, Tuned base) Oscillators, Negative resistance (Tunnel diode oscillator), Crystal oscillators, Stability. Relaxation Oscillators- Multivibrators (astable, monostable and bistable), Schmitt Trigger, Sawtooth generator, Blocking oscillator.

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B.A./B.Sc. III year Chemistry

PAPER – First

Inorganic Chemistry

Hard and Soft Acid-Base Theory: Classification of acids and bases as hard and soft. Pearson's Hard and Soft Acid Base (HSAB) concept, acid base strength and hardness and softness. Limitations of HSAB principle. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness. Applications of HSAB principle.

Metal-Ligand Bonding in Transition Metal Complexes: Limitations of valence bond theory(VBT), Crystal Field Theory (CFT); crystal field splitting in octahedral and tetrahedral complexes, tetragonal distortion from octahedral geometry (Jhon Teller distortion), crystal field splitting in square planar complexes, crystal field splitting energy (CFSE), 10Dq, factors affecting 10Dq ($\Delta 0$, Δt). Magnetic properties (high spin and low spin) and colour of coordination complexes

Magnetic Properties of Transition Metal Complexes:Types of magnetic behaviour, methods of determining magnetic susceptibility; Gouy's and Quincke's methods, spin only formula, correlation of μs and μeff values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

Electronic Spectra of Transition Metal Complexes:Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states (Russel Saunder's coupling), spectrochemical series. Orgel energy level diagram for d1 , d4 , d 6 and d 9 configuration in octahedral and tetrahedral fields, discussion of the electronic spectrum of [Ti(H2O)6] 3+ complex ion.

Thermodynamic and Kinetic Aspects of Coordination Compounds. 05 hrs A brief outline of thermodynamic and kinetic stability of metal complexes and factors affecting the stability of coordination compounds. Substitution reactions in square planar complexes, trans effect, application of trans effect, theories of trans effect.

Organometallic Chemistry Definition, nomenclature and classification based on nature of metal-carbon bond. Metal carbonyls. Mononuclear carbonyls, nature of bonding, structure and preparation. EAN and 18-electron rule. General methods of preparation of organometallic compounds and a brief account of metal-ethylenic complexes, Zeise's salt structure

Bioinorganic Chemistry Role of metal ions in biology, essential and trace elements in biological systems, toxic elements, elementary idea of structure and oxygen binding mechanism in metallo-porphyrins with special reference to haemoglobin and myoglobin. Role of sodium and potassium ions in biological system-mechanism of transport across cell membrane, biochemistry of magnesium and calcium.

Inorganic Polymers of Silicon and Phosphorus Inorganic polymers- Classification, comparison with those of organic polymers. Synthesis, structure and applications of Silicones. Phosphazenes, structure and nature of bonding in triphosphazenes.

PAPER – Second

Organic Chemistry

Spectroscopy: Nuclear magnetic resonance (NMR) spectroscopy; Proton magnetic resonance (1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin spin splitting and coupling constants, areas of signals, interpretation of pmr spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone, Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

Organo-metallic Compounds: Organo-magnesium compounds; the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds; formation and chemical reactions.

Organo-sulphur compounds: Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acid, sulphonamides and sulphaguanidine.

Heterocyclic compounds Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechnism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction of condensed five- and six membered heterocycles. Preparation and reactions of quinolene and isoquinolene with special reference to Fischer-Indole synthesis, Skraup's synthesis and Bischler-Napieralski synthesis. Mechnaism of electrophilic substitution reactions of quinolene and isoquinolene.

Carbohydrates: Classification and nomenclature. Monosaccharides, mechanism of osazone formation, inter conversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation. General study of disaccharides (structure determination not required). General introduction of structure of ribose and deoxyribose.

Amino Acids, Peptides, Proteins and Nucleic Acids Classification, structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α -amino acids. Nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Levels of protein structure. Protein denaturation/renaturation. Nucleic acids: introduction, constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

Fats, Oils and Detergents: Natural fats and common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value and acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.

Synthetic Polymers Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step-growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubber.

Synthetic Dyes: Colour and constitution (electronic concept), classification of dyes. Synthesis and uses of Methyl orange, Malachite green, Phenolphthalein, Fluorescein, Alizarin and Indigo.

Natural Products: Classification, extraction and general methods of structure determination of terpenoids (limonene, citral) and alkaloids (nicotine, cocaine).

PAPER – Third

Physical Chemistry

Elementary Quantum Mechanics Black-body radiation, Plank's radiation law, photoelectric effect, Bohr's model of hydrogen atom (no derivation) and its defects. Compton effect, de Broglie hypothesis, Heisenberg's uncertainty principle, operator concept, Hamiltonian operator, Schrödinger wave equation and its importance, physical interpretation of the wave function.

Spectroscopy: Introduction; electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation. Degrees of freedom, types of energies in linear and non-linear molecules, derivation and applications of Maxwell-Boltzmann distribution law.

Rotational spectrum Diatomic molecules, energy levels of a rigid rotor (semi- 18 classical principle), selection rules, special intensity, determination of bond length, qualitative description of non-rigid rotor, isotopic effect. Vibrational spectrum Infrared spectrum, energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of harmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups. Raman spectrum, concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules. Electronic spectrum Concept of potential curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Frank-Condon principle, Qualitative description of σ, π, and n M.Os, their energy levels and the respective transitions.

Photochemistry Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry; Grothuss-Drapper law, Lambert's law, Lambert Beer's law, Stark Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, nonradiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).

Physical Properties and Molecular: Structure 06 hrs Optical properties and their relation with chemical constitution, polarization, Clausius Mossotti equation, orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and its application in determining the structure of molecules.

Solutions and Colligative Properties Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solutions, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular mass determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular mass from osmotic pressure. Elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

Thermodynamics III Statement and concept of residual entropy, third law of thermodynamics, unattainability of absolute zero, Nernst heat theorem. Evaluation of absolute entropy from heat capacity data.

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