



Re-Accredited 'B++' 2.86 CGPA by NAAC

VEER NARMAD SOUTH GUJARAT UNIVERSITY

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વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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તા.૨૬-૦૯-૨૦૨૫નાં No.: GAD/NT/GIA/Emp. Notice/25862/2025 લેબોરેટરી

આસિસ્ટન્ટ કમ ટાઈપીસ્ટ (ભૌતિકશાસ્ત્ર) સંવર્ગની સ્પર્ધાત્મક પરીક્ષા સંદર્ભે Detailed અભ્યાસક્રમની અગત્યની સૂચના

લેબોરેટરી આસિસ્ટન્ટ કમ ટાઈપીસ્ટ (ભૌતિકશાસ્ત્ર) માટે સંબંધિત વિષય અને તેની ઉપયોગીતા અંગેના પ્રશ્નો:

PART: B

TOTAL MARKS:120

1. Vector Analysis: (10 Questions, 10 Marks)

Dot or scalar product, Cross or vector product, Triple product, reciprocal sets of vectors. Ordinary derivatives of vectors, space curves, continuity and differentiability, differentiation formulae, Partial derivatives of vectors, differentials of vectors, differential geometry. The vector differential operator ∇ . the gradient, the divergence and the curl, formulae involving ∇ , invariance Ordinary integrals of vectors, line integrals, surface integrals and volume integrals, The divergence theorem of Gauss, Stokes' theorem, Green's theorem in the plane

2. Atomic & Molecular Spectroscopy: (10 Questions, 10 Marks)

Basic spectroscopy, electromagnetic spectrum, Sources of radiation their utility and limitations-conventional sources for UV, visible and infrared rays, sources for shorter wavelength radiations (X-ray tubes) radioactivity, x-rays and x-rays Laser (He, Ne, Argon ion, dye lasers, semiconductor lasers).

3. Mathematical Physics: (10 Questions, 10 Marks)

First and second order differential equations: Separable equation, exact equation, linear equation, Bernoulli's equation, Clairaut equation, Homogeneous and inhomogeneous forms, undetermined coefficients method, Variation of parameter method, change of variable method, General theory of series solutions of linear differential equation, Legendre's differential equation, Bessel's differential equation, Schrodinger equation for a one dimensional quantum mechanical harmonic oscillator, Associated Legendre's differential equation Graphical approach, dropping small terms and iterating approach, WKB method

Introduction, Solution by Taylor's Series, Picard's Method of Successive Approximations, Euler's Method, Error Estimates for the Euler Method, Modified Euler's Method, Runge-Kutta Methods, Predictor-Corrector Methods, Adams-Moulton Method, Milne's Method, Cubic Spline Method, Simultaneous and Higher-order Equations, Some General Remarks, Boundary-value Problems, Finite-difference Method, Cubic Spline Method, Galerkin's Method

4. Classical Mechanics: (10 Questions, 10 Marks)

Reduction of two body problem to one body problem; equation of motion and first integrals; equivalent one-dimensional problem; classification of orbits; differential equation for the orbit; power law potentials; Bertrand's theorem; Kepler's laws; Scattering in a central force field; Rutherford scattering cross section, Independent coordinates of a rigid body; Orthogonal transformations; transformation matrix; Euler-angles; Euler theorem; angular momentum; kinetic energy; moment of Inertia tensor; principal axis transformation; Euler's

and Lagrangian treatment of rigid body motion; force free motion of a symmetrical top; motion of a heavy symmetrical top with one point fixed, Eigen-value equation and principal axis transformation; normal modes and normal coordinates for small oscillations; examples: Free vibrations of a linear tri-atomic molecule, coupled pendulums, double pendulum. Hamilton's Equations of Motion: Legendre transformation and Hamiltonian function; canonical equations of motion; examples; ignorable coordinates and conservation theorems; Cyclic coordinates and Routh's procedure; modified Hamilton's Principle.

5. Electronics: (15 Questions, 15 Marks)

The half-wave rectifier, the transformer, the full-wave rectifier, the bridge rectifier, the choke input filter, the capacitor input filter clippers and limiters, clampers, The Zener diode, the loaded Zener regulator Bipolar Junction Transistors: The unbiased transistor, the biased transistor, transistor currents the CE connection, the base curve, collector curves

Review of Thevenin, Norton and Superposition theorems, Mesh and Node circuit analysis, T-Network analysis, π -Network analysis, conversions between T-Network section and π -Network section, Bridged-T network, Scaling and Averaging amplifier. Instrumentation Amplifier, Voltage-to-Current converter with floating and grounded load, Current-to-Voltage converter, Integrator and Differentiator circuit, First order Low pass, High pass, and Band pass filters. Phase shift oscillator, Square wave generator, Triangular wave generator, Saw tooth wave generator.

Standard Gate Assemblies, Arithmetic Functions, Digital Comparator, Parity Checker-Generator, Multiplexer, De-multiplexer, Encoder, Decoder, Digital to Analog Converter, Analog to Digital Converter

6. Solid State Physics and Crystal Growth & Characterization: (15 Questions, 15 Marks)

Crystal, Single Crystal, Poly Crystals, Amorphous, Importance of Single Crystal, Applications of Single Crystal, Crystal Structure, Crystal Structure determination- Bragg's law. Experimental methods of X-Ray Diffraction, Reciprocal Lattice. Perfect and Imperfect Crystals, Point Imperfection, Concentration of Point Imperfection, Line Imperfections, Berger Vector and Berger circuit, Presence of Dislocations, Energy of a Dislocation, Slip Planes and Slip Directions, Surface Imperfections, Effect of Crystal Imperfections

Crystal growth, Crystal growth techniques, The chemical physics of crystal growth, Crystal growth from solution techniques, vapour growth techniques, How to start crystal growth, Advantages and disadvantages of crystal growth methods, Nucleation, classical theory of nucleation, Gibbs Thomson equation for vapour, Modified Thompson's equation for melt, Gibbs Thomson equation for solution, Energy of formation of a nucleus, Spherical and cylindrical nucleus, Cap shaped and disc shaped nucleus

7. Nuclear Properties and Radioactivity: (10 Questions, 10 Marks)

The nuclear radius, the distribution of nuclear charge, the distribution of nuclear matter, mass and abundance of nuclides, nuclide abundances, separated isotopes, laser isotope separation, nuclear binding energy, nuclear angular momentum, nuclear electromagnetic moments, nuclear excited states, The deuteron, binding energy, spin and parity, magnetic dipole moment, electric quadrupole moment.

The radioactive decay law, production and decay of radioactivity, growth of daughter activities, series of decays, types of decays, α -decay, β -decay, γ -decay, spontaneous fission,

nuclear emission, branching ratios and partial half-lives, natural radioactivity, radioactive dating, units for measuring radiation, successive disintegrations.

8. Measurement and Industrial Instrumentation: (15 Questions, 15 Marks)

The Functional elements of an Instrument, Input Output configuration of measuring instruments and instrument systems. Dynamic characteristic: Generalized mathematical model of measurement system. Operational transfer function. Sinusoidal transfer function. Zero, first and second order instruments, frequency, ramp and step responses of first and second order instruments.

Pressure measurement: Dynamics response consideration, Bourdon tube pressure gage. Diaphragm and Bellows gages. Transducer: The variable resistance transducer, The Linear Variable Differential Transformer (LVDT), Capacitive Transducer, Piezoelectric transducer, Photoelectric effect, Photoconductive transducer, Strain gauge transducer. Digital Displacement transducers, Flow measurement: Introduction, Flow obstructions methods, hot wire and hot film anemometers. Magnetic flowmeters, Laser Doppler anemometer

Introduction: Bio potential, cardiovascular system, Electro Cardiogram (ECG), Blood pressure measuring instruments. Doppler Sonography, Computed Tomography imaging (CT scan, CAT scan), Magnetic Resonance imaging (MRI), Specialized MRI Scans, Biofeedback

9. Thin Film Technology and Semiconductor Device: (15 Questions, 15 Marks)

Introduction: Thin and thick films processing and technology, Advantages and applications of thin films. Thin films growth process, Thin film deposition process, Physical vapour deposition (PVD): Thermal evaporations, Sputtering Yield, Sputtering systems: DC diode Sputtering, RF diode Sputtering, Magnetron Sputtering, Ion beam Sputtering, ECR plasma Sputtering, Electron beam evaporation, Pulsed Laser deposition (PLD). Chemical vapour deposition (CVD) process: Decomposition reactions, Reduction reactions, Chemical transport reactions and polymerization. Major advantages of CVD, Spray Pyrolysis and Spin Coating systems.

Depletion region and depletion capacitance, Abrupt and linearly graded junctions, Current-Voltage characteristics, Ideal case- Shockley equation, Generation and recombination. Diffusion capacitance, Junction breakdown, Thermal instability, Tunneling effect, Avalanche multiplication, Terminal function, Optical absorption: Photon absorption coefficient, Electron Hall pair generation, Solar cell: PN Junction solar cell, Conversion efficiency and solar concentration, Heterojunction solar cell, Amorphous silicon solar cell, Photo-detectors, PIN photodiode, Light emitting diode, Laser diode

Metal-Semiconductor Contact, Energy band relation, Schottky effect, Ohmic contact, Heterojunction, Electronics and Microelectronics, Classification of Semiconductor Devices. Depletion and Enhancement MOSFET, NMOS, Physical behavior of NMOS, Volt-Ampere Characteristics, Comparison of NMOS, for NMOS, Small Signal model of NMOS, NMOS amplifier with small signal analysis, NMOS as analog Switch, CMOS devices, CMOS small signal model, BIFET-BIMOS and BICMOS circuits.

10. Quantum Mechanics: (10 Questions, 10 Marks)

3D Problems in Cartesian Coordinates: General Treatment: Separation of Variables, The Free Particle, The Box Potential, The Harmonic Oscillator, 3D Problems in Spherical Coordinates: Central Potential: General Treatment, The Free Particle in Spherical Coordinates, The Spherical Square Well Potential, The Isotropic Harmonic Oscillator, The Hydrogen Atom, Effect of Magnetic Fields on Central Potentials.

Many-Particle Systems: Schrödinger Equation, Interchange Symmetry, Systems of Distinguishable Non-interacting Particles, Systems of Identical Particles: Identical Particles in Classical and Quantum Mechanics, Exchange Degeneracy, Summarization Postulate, Constructing Symmetric and Anti-symmetric Functions, Systems of Identical Non-interacting Particles. The Pauli Exclusion Principle, The Exclusion Principle and the Periodic Table

Time-Independent Perturbation Theory: Non-degenerate Perturbation Theory, Degenerate Perturbation Theory, Fine Structure and the Anomalous Zeeman Effect, The Variational Method, The Wentzel-Kramers-Brillouin Method: General Formalism, Bound States for Potential Wells with No Rigid Walls, Bound States for Potential Wells with One Rigid Wall, Bound States for Potential Wells with Two Rigid Walls, Tunneling through a Potential Barrier