VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

T.Y. B.Sc.

Physics

SECTION - I

Paper - VI

MECHANICS

(2005 - 2006)

Frames of reference with linear accelerations, transformation equations for a frame of reference inclined to an inertial frame, transformation equations for a rotating frame of reference, non-inertial frames-fictitious forces, effects of centrifugal and Coriolis forces due to earth's rotation, Foucault's pendulum, time period and orbital speed of a satellite. Ref: DSM – 2.7, 2.9 to 2.14

Angular momentum and torque, angular momentum of a satellite in a orbit round the earth, angular momentum of a system of particles: law of conservation of angular momentum, angular momentum of a system taking centre of mass into consideration, Some examples of the conservation of angular momentum. Euler's theorem, Angular momentum and kinetic energy, the inertia tensor, Euler's equation of motion, torque free motion, Euler's angles, motion of a symmetric top. Ref: TP – 10.1 to 10.7

Constraints, generalised coordinates, D'alembert's priciple, Lagrange's equations, symmetries and laws of conservation, cyclic and ignorable coordinates. Ref: TP – 8.1 to 8.4, 8.6, 8.7

CHAOS:

Prelude, linear and nonlinear systems, A nonlinear electrical system, mathematical model of biological population growth, A model of convecting fluids: the Lorentz model, determination of unpredictability and divergence of trajectories, Summary and conclusions.

Ref: RH – Ch. 1.1 to 1.7

SECTION - II
SOLID STATE PHYSICS

CRYSTAL PHYSICS:

Review of Crystal structure, important planes and directions in a cubic crystal, distribution of atoms in the atomic planes of a simple cubic crystal, separation between lattice planes in a cubic crystal, reciprocal lattice.

Ref: SOP – Ch. 4. II to Vii, XIII to XV, XVII to XXII, XXV

X Ray diffraction, Bragg's law, Bragg's X-ray spectrometer, powder crystal method, rotating crystal method, correction for Bragg's equation.
Ref: SOP – Ch.5. VII to XII

ELECTRICAL PROPERTIES OF MATERIALS:
Introduction, classical free electron theory of metals, drawbacks of classical theory, relaxation time, collision time and mean free path. Ref: SOP – Ch.6 I to IV

MAGNETIC PROPERTIES OF MATERIALS:
Introduction, Magnetic permeability, Magnetization, Diamagnetism, paramagnetism, Weiss theory of paramagnetism, Ferromagnetism, The domain model, Antiferomagnetism, ferrimagnetism.
Ref: SOP – Ch. 9 I To III, IX , XI, XII, XIX, XXVII, XXXI, XXXII

SUPERCONDUCTIVITY:
A survey of superconductivity, an account of the mechanism of superconductors, effects of magnetic field, AC resistivity, critical current, Flux exclusion: The Meissner effect, Thermal properties, Penetration depth, Type I and type II superconductors, potential applications of superconductivity.
Ref: SOP – Ch8. II TO VIII, XII,XIII, XXIV

Note: Examples/problems of relevant topics in each section should be covered.

REFERENCES:

1. DSM : Mechanics by D S Mathur, S. Chand & Co.
2 TP: Introduction to Classical Mechanics by Takwale & Puranik. TMH
3 RH: Chaos and Nonlinear dynamics by Robert C Hilborn OUP.
4 SOP: Solid State Physics by S O Pillai. Wiley Eastern Ltd.

ADDITIONAL REFERENCES:

1 Elements of Mechanics by Gupta,Prakash & Agrawal.
2 Mechanics – Berkley Physics Course. Vol. I, by C. Kittle, W. Knight and M. Rudermann. Tata Mcgraw-Hill Pub.
3 Introduction to Solid State Physics by Kittel J. Wiley & Co.
4 Solid State Physics by A J Dekker.
5 Solid State Physics by Kachava TMH.

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Physics

Paper - VII

ELECTRICITY AND MAGNETISM

ELECTROSTATICS IN DIELECTRICS:

Polarisation, laws of electrostatic field in the presence of dielectrics, energy of the field in the presence of a dielectric, boundary conditions. Ref: BBL(E) - 2.7 to 2.10

Poisson's and Laplace's equations, boundary conditions and uniqueness theorem, solution of Laplace's equation in rectangular, spherical and cylindrical coordinates, method of electrostatic images, images in dielectrics. Ref: BBL(E) - 3.1 3.3 to 3.5, 3.8, 3.11, 3.12

ELECTROMAGNETIC INDUCTION:

Faraday's law for electromagnetic induction, integral and differential form of Faraday's law, self and mutual inductance, energy in magnetic fields, hysteresis. Ref: BBL(E) - 5.2, 5.4, 5.5 to 5.8.

ELECTROMAGNETIC WAVES:

Maxwell's equations, plane waves in a dielectric, the three dimensional wave equation in a dielectric, the pointing vector, energy density and intensity of an electromagnetic wave, radiation pressure, the wave equation in a conducting medium, the continuity conditions, physical significance of Maxwell's equations. Ref: AG – 20.1 To 20.9

PLASMA PHYSICS:

Quasi-neutrality of Plasma, plasma behaviour in a magnetic field, plasma as a conducting fluid – fluid magnetohydrodynamics, magnetic confinement – Pinch effect, instabilities. Ref: BBL(E) - 12.1 to 12.5

SECTION - II
OPTICS

INTERFERENCE:

Haidinger's fringes, Michelson interferometer, types of fringes, determination of wavelength of monochromatic light, determination of the difference in wavelength between two neighbouring spectral wavelengths, determination of refractive index of thin transparent plates, standardization of meter, Fabry-Perot interferometer, visibility of fringes, resolving power of Fabry-Parot interferometer, Lummer and Gehrcke plate, interference filter. Ref: SB(O) – 8.29, 8.32, 8.33, 8.36 to 8.38, 8.40, 8.45 to 8.47, 8.49 and 8.50.

DIFFRACTION:
Diffraction at an opaque circular disc, diffraction pattern due to a straight edge, positions of maximum and minimum intensity, intensity at a point inside the geometrical shadow(straight edge), diffraction due to a narrow wire, Cornu's spiral, Fresnel integrals, diffraction at a straight edge, echelon grating, theory of echelon grating, Michelson stellar interferometer. Ref: SB(O) – 9.11 to 9.14, 9.16 to 9.18, 9.21, 9.48, 9.49, 9.60

HOLOGRAPHY:
Introduction, theory, requirements, some applications. Ref: AG - 18.1 to 18.4.

LASER:
Introduction, spontaneous and stimulated emission, main components of laser, understanding of optical amplification, The resonator, the lasing action, Ruby laser, The He-Ne laser, Einstein's coefficients and optical amplification, population inversion, cavity lifetime, threshold condition. Ref: AG – 23.1, 23.1.1, 23.1.2, 23.1.3, 23.1.4, 23.1.5, 23.2,23.4,23.6,23.6.1,23.6.2,23.6.3

FIBRE OPTICS:
Total internal reflection, the optical fiber, why glass fibers, the numerical aperture, attenuation in optical fibers, single mode and multi mode fibers. Ref: AG – 24.3 to 24.5, 24.7 to 24.9.

Note: Examples/problems of relevant topics in each section should be covered.

REFERENCES:

1. BBL(E): Electromagnetism by B B Laud
2. AG: Optics by A Ghatak
3. SB(O) A textbook of Optics by Subrahmanium and Brijlal S Chand

ADDITIONAL REFERENCES:

1. Electromagnetism by Grant and Philips
2. Optics by Jenkins & White
3. Laser and Non-Linear optics by B B Laud
4. Optics and Atomic Physics by D P Khandelwal

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T.Y. B.Sc.

Physics

Paper - VIII

ATOMIC AND MOLECULAR PHYSICS

Angular momentum: Introduction, Characteristic relations of angular momenta. Ref: CA – 7.1, 7.2

HYDROGEN ATOM: Schrodinger's equation for hydrogen atom, separation of variables, quantum numbers, principal quantum number, orbital quantum number, magnetic quantum number, electron probability density(radial part) Ref: AB – 6.1 to 6.7

ATOMIC SPECTRA: A vector atom model, Quantum numbers associated with vector atom model, coupling scheme, The Pauli exclusion principle, the periodic classification of elements, Some examples of electron configuration with their modern symbolic representation, magnetic dipole moment due to orbital motion of the electron, magnetic dipole moment due to spin, Stern and Gerlach experiment, spin orbit coupling, optical spectra, Zeeman effect, Larmor's theorem, Quantum mechanical explanation of the normal Zeeman effect, Anomalous Zeeman effect, Paschen Back effect, Sterk effect. Ref: RM – 6.12 to 6.28

MOLECULAR SPECTRA: Origin of molecular spectra, nature of molecular spectra, different modes of molecular spectra, factors affecting the line width of molecular spectra, factors affecting the intensity of molecular spectra, Born-oppenheimer approximation, rotation of linear system, Non rigid rotator, The energy of a diatonic molecule, vibrating diatomic molecule as a harmonic oscillator. Ref: RM – 23.1 to 23.7, 23.9 to 23.11.

RAMAN EFFECT: Quantum theory of Raman effect, classical theory of Raman effect, pure rotational Raman spectra, Rotational fine structure, experimental setup for Raman effect. Ref: Ba – Ch.4. Art. 4.1.2, 4.2.1, 4.3.4, 4.3.5, 4.6

SECTION - II
NUCLEAR PHYSICS

RADIOACTIVITY:
ALPHA DECAY: Determination of e/m of Alpha particle, determination of charge of Alpha particle, velocity of Alpha particle, range of Alpha particle experimental measurement of the range of Alpha particle, Alpha particle disintegration energy, Alpha

particle spectra, theory of alpha decay, Gamow's theory of alpha decay. Ref: RM – 31.7 to 31.15

BETA DECAY: The nature of beta particle, determination of e/m of beta particle Kaufmann's experiment, Bucherer's experiment: increase of beta particle mass with velocity, Beta ray spectra, magnetic spectrograph, origin of line and continuous spectra, the neutrino theory of beta decay, Ref: RM-31.16 to 31.22

GAMMA RAYS: Introduction , determination of wavelength of gamma rays, origin of gamma rays, internal conversion. Ref: RM – 31.23 to 31.25,31.27

DETECTORS OF NUCLEAR RADIATION:

Introduction, intrerction between energetic particles and matter, ionization chamber, solid state detectors, proportional counters, the Wilson cloud chamber, Diffusion cloud chamber, bubble chamber, Spark chamber, nuclear emulsion, the scintillation counter, Cerenkov counter. Ref:RM – 29.1 to 29.13.

PARTICLE ACCELERATORS:

Introduction, Van de graff generator, the linear accelerator, Cyclotron, Synchrocyclotron, BetatronRef: RM – 30.1 to 30.4, 30.6 and 30.7

COSMIC RAYS:

Discovery of Cosmic rays, Latitude effect, the East west effect, Altitude effect, primary cosmic rays, secondary cosmic rays , cosmic rays showers, discovery of positron , the meson, Van allen belt, origin of cosmic rays. Ref: RM – 37.1 to 37.11

ELEMENTARY PARTICLES:

Introduction, particlea and anti particles, Anti matter, fundamental interactions, elementary particle quantum numbers, conservation laws and symmetry, the Quark model. Ref: RM – 38.1 to 38.7

Note: Examples/problems of relevant topics in each section should be covered.

REFERENCES:

1. AB - Concepts of Modern Physics by A. Beiser. TMH.
2. RM – Modern Physics by R Murugeshan, K Sivaprasath S Chand XIIth edition
3. Ba – Fundamentals of molecular spectra by Barnwell. TMH.
4. CA – Quantum Mechanics by K K Chopra & G C Agrawal. Krishna Prakashan Media, Meerut.

ADDITIONAL REFERENCES:

1. Basic Quantum Mechanics by A.Ghatak
2. Modern Physics by K. Krane. Wiley Eastern.
3. Introduction to Modern Physics by Ritchmyer , Kennard Cooper. TMH
4. Nuclear Physics by Kaplan. Narosa Publishers
5. Nuclear Physics by S N Ghoshal. S. Chand & Co.
6. Atomic Physics by S N Ghoshal.

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T.Y. B.Sc.

Physics

Paper - IX

RELATIVITY AND COSMOLOGY

SPECIAL THEORY OF RELATIVITY:

Introduction, Galilean transformations, Newtonian relativity, Michelson Morley experiment, The postulates of special theory of relativity. Ref: RR – 1.1, 1.2, 1.3, 1.9

The relativity of simultaneity, derivation of the Lorentz transformation equations, relativistic addition of velocities. Ref: RR – 2.1, 2.2, 2.6

Need to redefine momentum, relativistic momentum, The relativistic force law and dynamics of a single particle, equivalence of mass and energy. Ref: RR – 3.2, 3.3, 3.5, 3.6

The interdependence of electric and magnetic fields, the transformations for E & B, field of a uniformly moving point charge, forces and fields near current carrying wire, forces between moving charges, invariance of Maxwell's equations. Ref: RR – 4.2 to 4.7

Geometric representation of space time: Space time diagrams, simultaneity, length contraction and time dilation, time order and space separation of events, twin paradox. Ref: RR – A-1 to A3, B-1 to B-4.

ASTROPHYSICS AND GENERAL RELATIVITY:

The principle of equivalence, the general theory of relativity, test of general relativity, stellar evolution, nucleosynthesis, white dwarf stars, neutron stars, black holes. Ref: K 15.1 To 15.8.

COSMOLOGY:

The expansion of the universe, the cosmic microwave background radiation, dark matter, cosmology and general relativity, the big bang cosmology, the formation of nuclei and atoms, echoes of big bang, the future of universe. Ref: K 16.1 To 16.8

SECTION - II

STATISTICAL AND THERMAL PHYSICS

Macroscopic and microscopic state: Macroscopic states, microscopic states, phase space, μ-space, γ-space, postulates of equal a priori probabilities, ergodic hypothesis, density distribution in phase space, Liouville's theorem, principle of conservation of density in phase and principle of conservation of extension in phase, condition of statistical equilibrium. Ref: BBL – 4.1 to 4.11

Statistical ensemble: Microcanonical ensemble, canonical ensemble, alternative method for the derivation of canonical distribution, mean value and fluctuations, grand canonical ensemble, alternative method for the derivation of grand canonical distribution, fluctuations in the number of particles of a system in a grand canonical ensemble Ref: BBL – 5.1 to 5.7

Some applications of statistical mechanics: Thermodynamics, statistical interpretation of the basic thermodynamic variables, physical interpretation of α, chemical potential in the equilibrium state, thermodynamic functions in terms of grand partition functions, ideal gas, Gibb's paradox, the equipartition theortem, the statistics of paramagnetism and Curie's law(classical approach), thermal disorder in a crystal lattice. Ref: BBL – 6.3 to 6.12

MB BE FD statistics: Symmetry of wave functions, the quantum distribution functions, the Boltzmann limit of boson and fermion gases, evaluation of partition function, partition function for diatomic molecules, equation of state for an ideal gas. Ref: BBL – 8.1 to 8.6

Note: Examples/problems of relevant topics in each section should be covered.

REFERENCE:

1. RR: Introduction to special relativity by R. Resnick, J. Wiley & Sons.
2. K: Modern Physics by Kenneth Krane. J. Wiley & Sons.
3. BBL: Fundamentals of Statistical Mechanics by B B laud. New Age Int'l.

ADDITIONAL REFERENCES:

1. Concepts of Modern Physics by A. Beiser. TMH 5th Ed.
2. Modern Physics by K Krane. J. Wiley & sons.
3. The special theory of relativity by S. Banerji & A. Banerjee. PHI.
4. Fundamentals of Statistical and thermal Physics by F Reif. Pub: McGraw Hill.
5. Statistical Mechanics by K Haung.Pub: Wiley Eastern Ltd.
6. Statistical Mechanics by Pathria. Pergamon Press.
7. JVN: Elements of Cosmology by J V Narlikar. 1996 University Press

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Physics

CAN COURSE - ELECTRONICS

OP AMP:

Introduction, differential and common mode operation, Op-Amp basics, practical opAmp circuits, opAmp specifications, DC off set parameters, op-amp specifications – frequency parameters, Op-Amp unit specifications.Ref: BN - 14.1 to 14.7

OP-AMP APPLICATIONS

Constant gain multiplier, voltage summing, voltqage buffer, Ref: BN - 15.1 to 15.3

POWER AMPLIFIERS

Introduction, definitions & amplifier types, series fed class A amplifier, transformer coupled class A amplifier, Class B amplifier operation, Class B Amplifier circuits, Amplifier distortion. Ref: BN - 16.1 to 16.6

FEEDBACK AND OSCILLATOR CIRCUITS

Feedback concepts, Feedback connection types, practical Feedback circuits, Feedback amplifier, phase and frequency considerations, oscillator operation, phase shift oscillator, weinbridge oscillator, tuned oscillator, crystal oscillator, unijunction oscillator. Ref: BN – Ch 18

TWO TERMINAL DEVICES

Introduction, Schottky barrier diode, varacter diodes, power diodes, tunnel diodes, photo diodes, IR emitters, liquid crystal displays, solar cells, thermisters. Ref: BN – Ch 20 except 20.7

PNPN DEVICES

Introduction, silicon controlled rectifier, basic SCR operation, SCR characteristics and ratings, SCR construction and terminal identifications, SCR applications, Silicon controlled switch, gate turn off switch, light activated SCR, Shockley diode, DIAC, TRIAC, Unijunction transistor. Ref: BN – 21.1 to 21. 13

MODULATION AND DEMODULATION:

Radio broadcasting, transmission and reception, modulation, types of modulation, amplitude modulation, modulation factor, analysis of AM wave, sideband frequencies in AM wave, power in AM wave, limitations of amplitude modulation, frequency modulation, demodulations, essentials of demodulations, AM radio receivers, types of AM receivers. Ref: VKM – 18.1 to 18.7, 18.9 to 18.13, 18.15, 18.16.

Note: Examples/problems of relevant topics in each section should be covered.

REFERENCES:

1. BN -- Electronic devices and circuit theory by Boylestad & Nashelsky
2. VKM – Principles of Mechanics by V K Mehta. S. Chand & Co.

ADDITIONAL REFERENCES:

1. Integrated Electronics by Millman & Halkias TMH
2. Microelectronic circuits by Sendra and Smith.
3. Microelectronics by Millman & Grabel. TMH
4. Microelectronics by Sandra and Smith.

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T.Y. B.Sc.

Physics

SYLLABUS FOR EXPERIMENTS

GROUP - A

1. Kater's pendulum.
2. Flat spiral spring
3. Stefan's constant.
4. 'Y' by Koenig's method.
5. Temperature coefficient of resistance using Carey-Foster bridge.
6. 'Y' by optical interference method(Newton's rings)
7. Study of coupled oscillator.
8. Resonance pendulum.
9. Absorption spectrum of iodine molecule
10. To determine activation energy of a semiconductor.
11. Computer simulation of GM counter(D)
12. Study of distribution functions(D)

GROUP - B

1. Fabry perot etalon
2. Edser butler plate.
3. Resolving power of grating.
4. Resolving power of prism.
5. Turn table.
6. Hartmann's formula.
7. Diffraction at straight edge.
8. Refractive index of liquid by total internal reflection using gauss eyepiece.
9. Babinet's compensator
10. Refractive index of liquid using Newton's rings
11. λ by Michelson Interferometer(D)
12. Computer simulation of diffraction effects (D)

GROUP - C

1. Hysteresis curve
2. Constant of BG using solenoid.
3. Self inductance by Rayleigh's method.
4. Mutual inductance by Carey-Foster's method.
5. High resistance by leakage.
6. 'L' Owen's bridge.
7. 'L' by Anderson's bridge.
8. Study of transformer.

9. Series resonance.
10. Parallel resonance.
11. Weinbridge oscillator using CRO.
12. Computer simulation of relativistic effects(D)

GROUP - D

1. Basic arithmetic operations using OP Amp.
2. Active filters using Op-Amp (First and second order)
3. Temperature to frequency converter using IC 555
4. OPAMP Integrator / Differentiator.
5. e/m by Thomson's method.
6. UJT characteristics.
7. Negative feedback amplifier.
8. Hartley oscillator.
9. Colpits oscillator.
10. FET amplifier.
11. IC 555 Timer – Square wave generator.
12. Computer simulation of electronic circuits on PC(D)

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