S ARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

SYLLABUS EFFECTIVE FROM: 2018-19
Syllabus for M.Sc. (Applied Physics) Semester II

Course Code: PT02CAPC01
CLASSICAL MECHANICS AND QUANTUM MECHANICS

Unit: 1

Constrained Motion: Constraints, Classification of constraints, Principle of virtual work, D'Alembert's principle and its application.
Lagrangian formulation: - limitations of Newtonian formulation, degrees of freedom, generalised coordinates and velocities, Derivation of Lagrange's equation, derivation of Lagrange's equation from Hamilton's principle, simple application of Lagrange's equation, Cyclic coordinates , Symmetry and conservation theorems.
Phase Space and the motion of the system Hamiltonian, Canonical transformations, Equations of Canonical transformations, Canonical transformations for the Harmonic Oscillator.

Unit: 2
Poisson brackets and canonical invariants, equations of motion, Infinitesimal CT and conservation theorems in the Poisson bracket formulation, Hamilton Jacobi theory, Application to harmonic oscillator problem.
Types of equilibrium, Theory of Small Oscillations, Secular equation, eigenvectors and eigen-frequencies, Orthogonality of eigenvectors; Normal coordinates; coupled Oscillation, Linear triatomic molecule, Small oscillations of particles on string, Introduction to nonlinear oscillations.

Unit: 3 : The Hilbert Space and Wave Functions, Dirac Notation, Operators: Hermitian Adjoint, Projection Operators, Commutator Algebra, Uncertainty Relation between Two Operators, Inverse and Unitary Operators, Eigenvalues and Eigenvectors of an Operator, Matrix Representation of Kets, Bras and Operators, Change of Bases and Unitary Transformations, Representation in Continuous Bases, Parity Operator.

Unit: 4
Quantum theory of angular momentum and its eigenvalue spectrum. Matrix representation of angular momentum operators, spin angular momentum, Pauli matrices and their properties, total wave function, non-relativistic Hamiltonian including spin. Addition of angular momenta, definition of Clebsch-Gordan coefficients, Phase convention, spin-wave function for a system of two spin-1/2 particles, Identical particles with spin, addition of spin and orbital angular momenta.

Books:

1. Classical Mechanics – System of particles and Hamiltonian Dynamics, by Greiner :Springer International Ed. 2006

2. Classical Mechanics, 3rd Ed by Goldstein, Pole & Safko, Pearson Education, Pte. Ltd, Indian Branch, Delhi, India, 2002.
3. Classical Mechanics, by V. B. Bhatia; Narosa
4. Introduction to Classical Mechanics by R. G. Takwaleand P. S. Puranik; TMH
5. A text book of Quantum Mechanics, by P.M. Mathews and K. Venkatesan (TMH)
6. Introduction to Quantum Mechanics, by David J. Griffiths.
7. Quantum Mechanics by Ghatak&Loknathan; McMillan India Publication
8. Quantum Mechanics by G. Aruldas, Prentice-Hall India, Pvt., Ltd.
9. Quantum Mechanics Concepts and Applications by Nouredine Zettili, John Wiley and Sons, Ltd., Publication

Course Code: PT02CAPC02
ELECTRODYNAMICS

Unit: 1

Applications of Electrostatics: Applications Involving Charged Particles Moving in a Magnetic Field-The Hall Effect, The Biot–Savart Law, The Magnetic Force Between two Parallel Conductors, Ampère's Law, The Magnetic Field of a Solenoid, Magnetic Flux, Gauss' law of electrostatics, field due to linear, spherical and cylindrical charge distribution curl of electrostatic field, Electrostatic potential, Gauss's Law in Magnetism, Displacement Current and General Form of Ampère's Law, Magnetism in Matter-The Magnetic Field of the Earth, Faraday's Law of Induction-Induced emf and Electric Fields-Generators and Motors-Eddy Currents.

Unit: 2

Maxwell's equations in matter, Continuity equation, Poynting theorem – Momentum conservation, Electromagnetic Waves in Vacuum: Wave equation for E and B fields, Monochromatic plane waves – Energy & momentum in electromagnetic waves, Polarization of electromagnetic waves: linear and circular polarization. Electromagnetic waves in matter: Propagation in linear media- Boundary conditions Reflection and Refraction – Snell's law. Reflection and Transmission at normal and oblique incidence – Fresnel's equations. Total internal reflections, EM waves in isotropic linear conducting media – Reflection at conducting surface.

Unit: 3

Wave Guides: Bounded waves, TE,TM and TEM waves, Rectangular and cylindrical wave guides, Resonant cavities, Dielectric wave guides (Optical fibers)-HE modes.

Transmission Lines: Distributed line parameters, transmission line equations, Input Impedance, SWR and Power, Smith chart, some applications of transmission lines, microstrip transmission line.

Unit: 4

Electromagnetic Radiation: Electromagnetic potentials Scalar and vector potentials Gauge transformations Gauge conditions (Lorentz and Coulomb gauges). Retarded Potentials

Radiations from extended sources: Electric and Magnetic dipole radiation, Center-fed linear antenna- Hertzian dipole antenna – Small loop antenna.

Radiation from Moving point charges: Lienard-Wiechert potentials- Fields of a moving point charge- Power radiated by a point charge (Larmor formula), Radiation from a slowly moving charges, Radiation from relativistically moving charges, Larmor's generalization to relativistic case – Synchrotron radiation – Bremsstrahlung radiation.

Basic Text & Reference Books:

1. Classical Electrodynamics by J D Jackson, 2nd Ed; Wiley Eastern Ltd. 1975.
2. Introduction to Electrodynamics by David J Griffiths, 3rd Ed Prentice Hall, India, 2002.
3. Classical electromagnetic Theory by Jack Vanderlinde, John Wiley & sons,Inc.1993.
4. Elements of Electromagnetics by Sadiku 2ndEd.OxfordUniv.Press. Inc. 1995.
5. Classical Electrodynamics by Griener, Springer Verlag, New York, Inc. 1998.

Course Code: PT02CAPC03
ELEMENTS OF APPLIED PHYSICS

Unit: 1

Introduction of vacuum, Applications for Vacuum Pumps, Classification of vacuum pumps, Rotary pump, Diffusion pump, Molecular drag pump, Gettering and ion pumping, Sputter ion pump, measurement of pumping speed: constant pressure method, constant volume method. Classification of vacuum gauges: McLeod gauge, Thermal conductivity gauge, Thermocouple gauge, Hot cathode ionization gauge, Bayard-Alpert gauge, Cold cathode ionization gauge, Penning gauge, Magnetron gauge.

Unit: 2

X-ray Diffraction: X-ray sources, Production of X-rays, continuous X-rays, characteristics X-rays, X-ray filters, X-ray absorbers, Scattering by electrons, atom and unit cell, Electron Diffraction: Introduction to electron diffraction, Transmission Electron microscopes, Neutron Scattering: Slow neutron scattering in solid, Elastic Scattering, Cross – section, Coherent Scattering.

Unit - 3

Thermal Analysis and its applications: Thermo gravimetric analysis, Differential thermal analysis and Differential scanning calorimetry, X-Ray Photoelectron Spectroscopy Surface Analysis Technique, X-ray fluorescence spectroscopy, UV-Visible spectroscopy, atomic absorption spectroscopy.

Unit: 4

Ionization Chamber, Proportional Counter, Geiger-Mueller Counter, Scintillation detector: organic scintillator, Inorganic scintillator, Light guides, Photomultiplier tubes, Scintillation Spectrometer, Energy resolution of a scintillation spectrometer,
Semiconductor detectors: Diode detector, Diffused junction detector, Surface barrier detector, Ion implanted layer detectors, Fully depleted detectors, Lithium doped germanium detector [Ge(Li)], High purity germanium detector (HPGe), Cherenkov Detector, Photographic emulsion, Cloud Chamber, Bubble Chamber, Spark Chamber.

Books:

1. Vacuum Science and Technology V.V. Rao, T.B. Ghosh and K.L. Chopra Allied Publishers Limited (India)
2. Elements of X-ray diffraction Cullity and Stock
3. An introduction to lattice dynamic L.S Kothari
4. Biomedical instrumentation & measurements L. Cromwell
5. Instrumental method of analysis Willard
6. Fundamentals of Nuclear Physics. Jagdish Varma, Roop Chand Bhandary, D.R.S. Somayajulu.
7. Device Materials and Fabrication Techniques

Course Code: PT02EAPC02
Electronics Devices & Photovoltaics

Unit: 1

Contact between materials and pn Junctions, Contact between two materials Metals Semiconductors contacts, I/V characteristics, thermoelectric effects, The pn Junction – equilibrium conditions, zero bias, forward bias and reverse bias, The effect of temperature on diode characteristics, diode equivalent circuits, properties of the depletion layer, abrupt junction, junction potential, width of depletion layer and depletion layer capacitance, reverse breakdown mechanism.

Unit: 2

Graded junctions, practical pn junction , Bipolar junction Transistor -emitter efficiency and base transport factor, d.c. characteristics of a transistor, C-B characteristic, distribution of excess charge in base, variation of current gain with collector current, common emitter characteristics, transistor breakdown voltages, The Ebers-Moll model, charge control of a transistor, measurement of _B and _C.

Unit: 3

The hybrid _ equivalent circuit of BJT and equivalent circuit of FET, light absorption in semiconductors, working principle LDR, photo-diode, photo-transistor and LED, liquid crystal display devices. IC operational amplifiers, frequency compensation, op-Amp switching application, op-Amp inverter, precision rectifier, peak clipper, Schmitt trigger, UTP, LTP and adjustment, comparator, monostable, astable multivibrator.

Unit: 4

Introduction to the photovoltaic systems, merits and limitations of solar PV systems, prospects of solar PV systems-principle of a photovoltaic cell, V-I characteristics of a solar cell-Inter connections of solar cells, efficiency of solar cell and its spectral response, -Configuration of a solar PV systems, PV cell technology, Structures of solar cells-M-S solar cells, MIS solar cells, solid – liquid junction solar cells, comparison of p-n junction, Schottky junction, M-S, M-I-S solar cells.

Basic Text & Reference Books:

1 Electronic Devices and Components, by J. Seymore (Longmann Scientific & Technical).

2 Integrated Electronics, by K. R. Botkar, (Khanna Publishers.)

3 Integrated Electronics: Analog and Digital Circuits Systems, by J. Millman and C. C. Halkias (Tata McGraw -Hill Publishing Company Ltd.).

4 Solid State Pulse Circuits, by David A. Bell (Prentice Hall of India Pvt. Ltd).

5 Energy Technology (Non conventional, Renewable and conventional), by S. Rao and Dr. P. B. Parrulkar (Khanna Publishers.)

Course Code: PT02EAPC01
FUNDAMENTALS OF MATERIALS SCIENCE

Unit 1: Introduction to Materials and Properties

Introduction to Materials & Materials Science, types of materials, levels of structure, structure-property – processing relationship, properties of materials (Mechanical properties stress-strain curves, strength and modulus under various modes of deformation, flexural strength, hardness, impact strength etc.) processing of materials, environmental effect on materials behavior, Materials selection criteria.

Unit 2: Physics of polymers & Polymeric Materials

Macromolecular concepts, types of polymers, structural feature of polymers, correlation between structure and properties of various polymers, polymerization reactions, polymerization techniques, polymer blends, molecular weight concept, crystallinity in polymers, electrical and thermal properties of polymers, conducting polymers.

Unit 3: Ceramic Materials

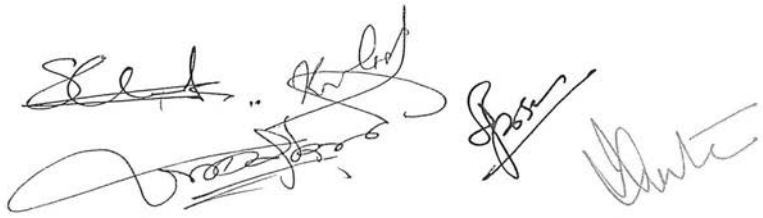
Various types of ceramics, properties of ceramics, oxide-non oxide ceramics, phase diagrams, properties and synthesis of ceramic powders, sintering of ceramics, principles of main fabrication techniques, and applications of traditional and advanced ceramics, electroceramics.

Unit 4: Metals and Alloys

Fe-Fe_3C phase diagram, pearlite, bainite, martensite, cementite, heat treatments processes, classification of steels and their applications. Aluminium alloys, magnesium alloys, copper alloys, nickel, cobalt, zinc alloys, titanium alloys, refractory metals.

Reference Books:

1. The Science and Engineering of Materials, Donald R. Askeland PWS-Kent Publishing
2. Polymer Science, V R. Gowarikar, N. V. Vishwanathan and J. Sreedhar, Wiley Publications
3. Principles of Polymer Science, P. Bahadur and N. V. Sastry, Narosa Publishers, New Delhi
4. Callister's Materials Science and Engineering, William D. Callister, Jr, R. Balasubramanian
5. Physical Metallurgy: Principles and Practice, V. Raghavan, PHI Learning Publishers
6. Science of Engineering Materials: Manas Chanda, Macmillan Publishers
7. Ceramic Hardness, Ian McColm, Springer Publications
8. Physics of polymers by Strobl, Gert R., Springer Publications



Course Code: PT02CAPC04

EXPERIMENTAL METHODS-III

Sr. No.	Title of Experiment
1	Determine Hall Coefficient using Hall Effect
2	Solar Cell I-V Characteristic in Series and Parallel combination on Solar Panel
3	Determination of maximum power point and solar cell efficiency
4	Determination of semiconductor magneto-resistance
5	Measurement of Curie temperature of ferroelectric materials
6	Determination of compressibility of nanofluids with variation of nanoparticles at different temperature
7	Characteristics of Photo-sensors.

Course Code: PT02CAPC05

EXPERIMENTAL METHODS-IV

Sr. No.	Title of Experiment
1	Measurement of Op-Amp characteristics
2	IC-555 Timer circuit
3	Uni-junction Transistor characteristic
4	He-Ne LASER diffraction studies
5	Error estimation and least-square fitting
6	To study thermal and electrical conductivity of metals at constant temperature gradient and determination of Lorentz number.
7	Optical Fiber characterization and Transmission

Course Code: PT02CAPC06

COMPREHENSIVE VIVA

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Sardar Patel University
Near Bus Depot, opp Shastri ground, Vallabh Vidyanagar - 388120

No. SPU/IICISST/M.Sc./2018-19/452 Date: 15/9/2018

Inclusion in the committee for

M.Sc. Applied Physics Semester –I & II Syallabi

This has reference to the meeting of Ad-hoc Board of Studies in Interdisciplinary Science and Technology held on 15th September 2018, Saturday at 12.00 p.m. in the New IICISST building, Sardar Patel University, Vallabh Vidyanagar. It has been resolved that the following committee be formed to finalize syllabus for M.Sc. Applied Physics (Sem-I & II).

i. Prof. Sunil H. Chaki, Professor, Dept. of Physics, SPU (Convener)
ii. Prof. P. C. Vinodkumar Professor& HEad, Dept. of Physics, SPU (Member)
iii. Dr. B. S. Chakraborty, Professor & Head, Department of Applied Physics, M.S. University, Baroda (Member)
iv. Prof. Kirit N. Lad, Professor, Dept. of Physics, SPU (Member)
v. Dr. Arun Anand, Department of Applied Physics, M.S. University, Baroda (Member)

Prof. R. B. Subramanian
Director, IICISST
DIRECTOR, IICISST
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