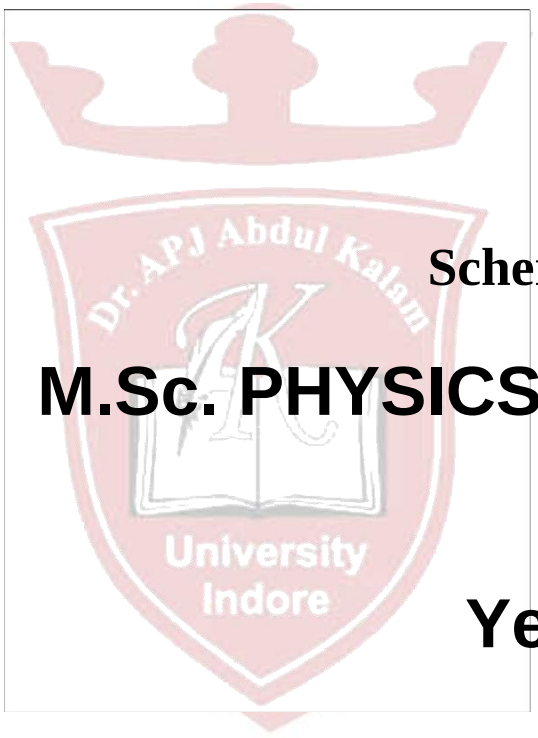
Dr.A.P.J. Abdul Kalam University, Indore

Department Of Physics



Scheme and syllabus

M.Sc. PHYSICS Academic

Year 2016-17

(...Nurturing Talents to Success)

Scheme

Marks Distribution for M.Sc. Physics –I and II Seme ster

Year 206-17

M.Sc. -I SEMESTER (PHYSICS)

Paper	Subject Code	Paper Title	Max. Marks		
			End sem	CCE	Total
I	MSP101T	MATHEMATICAL PHYSICS	85	15	100
II	MSP102T	CLASSICAL MECHANICS	85	15	100
III	MSP103T	QUANTUM MECHANICS- I	85	15	100
IV	MSP104T	ELECTRONIC DEVICES	85	15	100
V	MSP105P	LAB A	-	-	50
VI	MSP106P	LAB B	-	-	50
		TOTAL	**500**		

M.Sc. II SEMESTER (PHYSICS)

Paper	Subject Code	Paper Title	Max. Marks		
			End sem	CCE	Total
I	MSP201T	QUANTUM MECHANICS -II	85	15	100
II	MSP202T	STATISTICAL MECHANICS	85	15	100
III	MSP203T	ELECTRODYNAMICS AND PLASMA PHYSICS	85	15	100
IV	MSP204T	ATOMIC AND MOLECULAR PHYSICS	85	15	100
V	MSP205P	LAB A	-	-	50
VI	MSP206P	LAB B	-	-	50
		Total	**500**		

Class: M.Sc. Physics
Max. Marks: 85+15 = 100
Semester: I
Subject: Physics –I

Title of Paper: Mathematical Physics

Unit -I

Differential equations: Recursion relation, generating functions and orthogonality of Bessel functions of first and second kind, Hermite, Legendre, Associate Legcndre and Laguerre Polynomials.Curvilinear co-ordinate system with specific cases of Cartesian,Cylindrical, and Spherical coordinate systems.

Unit -II

Integral transforms. Fourier integral. Fourier transform and inverse Fourier transforms. Fourier transform of derivatives. Convolution theorem. Elementary Laplace transforms. Laplace transform of derivatives. Application to a damped harmonic oscillator.

Unit -III

Green's functions: Non-homogenous boundary value problems, Green's function for one dimensional problems, eigen function expansion of Green's function, Fourier transform.method of constructing Green's function, Green's function for electrostatic boundary value.problems and quantum-mechanical scattering problem.

Unit -IV

Complex variables: Analyticity of complex functions. Cauchy Riemann equations. Cauchy theorem. Cauchy integral formula. Taylors, Maclaurin, Laurent series & mapping.Theorem of residues. Simple cases of contour integration. Jordan's lemma Integralsinvolving multiple valued unctions(Branch points).

Unit .V

This unit will have a short *note* question covering all the four units. The students will have to answer any two questions out of the four.

Books Recommended:

1. L. A. Pipes Mathematics of Engineers and Physicists
2. Arfken Mathematical Methods for Physicists
3. P.K. Chattopadhyay Mathematical Physics
4. H.K.Dass Mathematical Physics
5. Ghatak, Goyal & Guha Mathematical Physics
6. M.R Spiegel (Schaum Series) Complex variable & Laplace Transform

Class: M.Sc. Physics
Max. Marks: 85+15 = 100
Semester: I
Subject: Physics -II

Title of Paper: Classical Mechanics

Unit - I

Newtonin mechanics of one and many particles systems: Conservation laws, Constrains their classification, Principle of virtual work; D'Almbert's principle in generalized coordinates, The Lagrange's equation from D'Almbert's principle. Con figuration space,Hamilton's principle deduction from D'Almberts principle, Generalized momenta and Lagrangian formulation of the conservation theorems, Reduction to the equivalent one body problem; the equation of motion and first integrals, the differential equation for the orbit.

Unit - II

The equat ions of canonical transformation and generating functions; The Hamilton- Jacobi Action and Angel variables. Poisson.s brackets; simple algebraic properties of Poisson.s brackets. The equation of motion in Poisson.s Brackets notation. Poisson theorem; principle of least action. The Kepler problem, Inverse central force field, Rutherford scattering.

Uni t - III

Theory of small oscillations, Equations of motion, Eigen frequencies and general motion, normal modes and coordinates, Applications to coupled pendulum and linear bistable molecule. Rotating coordinate systems. Acceleration in rotating frames. Coriolis force and its terrestrial astronomical applications, Elementary treatment of Eulerian coordinates and transformation matrices. Angular momentum inertia tensor. Eularequations of motion for a rigid body. Torque free motion for a rigid body.

Unit - IV

Symmetries of space and time. Invariance under galilion transformation, Covariant fourdimensional formulation, 4 -Vectors and 4 - scalers. Relativistic generalization of Newton's laws, 4 - momentum and 4 - force, variance under Lornetz transformation relativistic mechanics. Covariant Lagrangian, covariant Hamiltonian, Examples.

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Unit -V

This unit will have a short note question covering all the tour units. The students will have to answer any two questions out of the four.

Books Recommended

1. H.Goldstein (Addison Wesley) Classical Mechanics
2. N.C.Rana & P.S.Jog Classical Mechanics
3. Landu & Lifshitz (Pergamann Press) Classical Mechanics
4. A. Sommarfield (Academic Press) Classical Mechanics
5. R.G.Takwale & P.S. Puranik Introduction to Classical Mechanics

Class: M.Sc. Physics
Max. Marks: 85+15 = 100
Semester: I
Subject: Physics –III

Title of Paper: Quantum Mechanics- I

Unit . I

Basic Postulates of quantum Mechanics, equation of continuity, Normality, orthogonality and closure properties of eigen functions, expectation values and Ethrentest theorems, solution of Schrodinger equation for one dimensional (a) potential well (b) potential step and (c) Potential barrier.

Unit . II

Linear vector space, concept of Hibert space, bra and ket notation for state vector, representation of state vectors and dynamical variables by matrices and unitary transformation (Translation and rotation), creation and annihilation operators, matrices for x and p. Heisenberg uncertainty relation through operators (Schwartz inequality).

Unit -III

Solution of Schrodinger equation for (a) linear harmonic oscillator (b) hydrogen - like atom (c) square well potential and their respective application to atomic spectra, molecular spectra and low energy nuclear states (deutron).

Unit - IV

Angular momentum in quantum mechanics, Eigen values and Eigen function of L2 and Lz in term of spherical harmonics, commutation relation. Time independent perturbation theory. Non-degenerate and degenerate cases.

Unit -V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

Text Books and reference-book:

1. L I Schiff, Quantum Mechanics
2. S Gasiorovvicz, Quantum Physics
3. B Craseman and J D Powell Quantum Mechanics
4. A P Messiah Quantum Mechanics
5. J. J. Sakurai Modern Quantum Mechanics
6. Mathews and Venkatesan Quantum Mechanics

Class: M.Sc. Physics
Max. Marks: 85+15 = 100
Semester: I
Subject: Physics –IV

Title of Paper: Electronic Devices

Unit . I

Transistors: JFET, BJT, MOSFET and MESFET, structure derivations of the equations for I-V characteristics under different condition, microwave devices, tunnel diode,transfer electron devices (Gunn diode), avalanche transits time devices, Impatt diodes and parametric devices. Unit - II

Photonic devices: radiative and non-radiative transitions, optical absorption, bulk and. Thin film photo conductive devices (LDR), diode Photo detectors, Solar cell (open circuit voltage and short circuit current, fill factor), LED (high frequency limit, effect of surface and indirect recombination current, operation of LED), semi-conductors; diode lasers (conditions for population inversion in active region, light confinement factor, optical gain and threshold current for lasing. Unit - III

Memory Devices: Read Only Memory (ROM) and Random Access Memory(RAM).Types of ROM: PROM, EPROM, EEPROM and EAPROM, Static and dynamic RAMs (SRAM & DRAM), characteristics of SRAM and DRAM.Hybrid Memories : CMOS and NMOS memories, Nonvolatile RAM, ferro-electric memories, charge coupled devices (CCD), storage devices: Geometry and organization of magnetic (FDD & HDD) and Optical (CD-ROM, CD-R, CD-R/W, DVD) Storage devices.

Unit - IV

Electro-optics, Magneto-optic and Acousto-optic effects, materials properties related to get these effect,important ferro electric, l iquid crystal and polymeric materials for these devices, piezoelectric, electrostrictive and magnetostrictive effects. Important materials for these properties and their applications in sensors and actuator devices, acoustic delay lines, piezoelectric resonators and filters, high frequency piezoelectric devices-surface,

acoustic wave devices,

Unit - V

This unit will have a short note question covering all the four units. ’The students will have *to* answer any two questions out of the four.

Text books and reference books:

1. SM Sze Willey (1985) Semiconductors devices - physics technology

2. MS tyagi Introduction to semiconductors devices

3. M Sayer and A Manisingh Measurement instrumentation and experimental design in physicsandengineering

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DEPARTMENT OF PHYSICS

Class: M.Sc. Physics
Max. Marks: 50
Semester: I
Subject: Physics –LAB -A
Title of Paper: General

LIST OF EXPERIMENTS

General

1. To study characteristic of THERMISTOR.
2. To Study Band Gap Energy BY Four Probe Method.
3. Study of Unijuction Transistor Characteristic UJT.
4. Study of Field Effect Transistor Characteristic FET.
5. Study of Ordinary and Extra-Ordinary rays of calcite Prism.
6. To find the Wavelength of a He-Ne Laser by using grating.
7. To find the Dielectric constant of a material by using a parallel plate condenser.

Class: M.Sc. Physics
Max. Marks: 50
Semester: I
Subject: Physics –LAB -B
Title of Paper: Electronics

Electronics

1. To Study the MULTIVIBRATOR CIRCUITS.
2. To study the MODULATION and DEMODULATION Circuit.
3. To study the Integrating and differentiating Circuits.(CR)
4. To study the CLIPPING, CLAMPING Circuits.
5. To study the IC Regulated Power Supply.

Class: M.Sc. Physics
Max. Marks: 85+15 = 100
Semester: II
Subject: Physics –I

Title of Paper: Quantum Mechanics .II

Unit - I

Approxmination method for bound states : Rayleigh- Schrodinger Perturbation theory of non-degenrate and degenrate levels and their application to perturbation of an oscillator, normal helium atom and first order stark effect in hydrogen. Variation method and its application to ground state helium, W K B Approximation method, connection formulae, ideas on potential barrier with applications to theory of alpha decay.

Unit - II

Time dependant perturbation theory: Methods of variation of constants and transition probability, adiabatic and sudden approximation, wave equation for a system of charged particles under the influence of external electromagnetic field, absorption and induced emission, Einstein.s A and B coefficients and transition probability.

Unit- III

Theory of Scattering, Physical concepts, scattering amplitude, scattering cross section. Born Approximation and partial waves, scattering by perfectly rigid sphere, complex potential and absorption, scattering by spherically symmetric potential, identical particles with spin, Pauli's spin matrices.

Unit- IV

Schrödinger.s relativistic equation (Klein-Gordon e quation), Probability and current density, Klein - Gordon equation in presence of electromagnetic field, hydrogen atom, short comings of Klein-Gordon equation, Dirac.s relativistic equation for free electron, Dirac.s Matrices. Dirac.s relativistic equation in electromagnetic field, negative energy states and their interpretation hydrogen atom, hyperfine splitting.

Unit - V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

Text Books and reference book:

1. LI Schiff Quantum Mechanics

2. S Gasiorowicz Quantum Physics

3. B Craseman and J J Powell Quantum Mechanics (Addison Wessley)

4. A .Messiah Quantum Mechanics

5. J.J. Sakurai Modern Quantum Mechanics

6. Mathews and Venkatessan Quantum Mechanics

7. A .K.Ghatak and Loknathan Quantum Mechanics

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Class: M.Sc. Physics
Max. Marks: 85+15 = 100
Semester: II
Subject: Physics –II

Title of Paper: Statistical Mechanics

Unit – I

Foundation of statistical mechanics, specification of states of a system contact between statistics and thermodynamics, classical ideal gas entropy of mixing and Gibb.s paradox.Microcanonical ensemble, phase space, trajectories and density of states, Liouville theorem, canonical and grand canonical ensembles, partition function, calculation of statistical quantities, energy and density fluctuations.

Unit-II

Statistics of ensembles, statistics of indistinguishable particles, density matrix, Maxwell -- Boltzmann, Fermi Dirac and Bose- Einstein statistics, properties of ideal Bose gases, Bose . Einstein condensation, properties of ideal Fermi gas, electron gas in metals, Boltzman transport equation.

Unit-III

Cluster expansion for a classical gas, virial equation of state, mean field theory of Ising model in 3,2 and 1 dimension. Exact solution in one-dimension. Unit .V

Thermodynamics fluctuation spatial correlation Brownian motion, Langevin theory, fluctuation dissipation theorem, the Fokker-Planck equation, Onsager reciprocity relations Unit . V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

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Text Books and reference book:

1. F Reif Statistical and thermal Physics
2. K Huang Statistical Mechanics
3. R K Pathria Statistical Mechanics
4. R Kubo Statistical Mechanics
5. Tandan Statistical Physic

Class: M.Sc. Physics
Max. Marks: 85+15 = 100
Semester: II
Subject: Physics –III

Title of Paper: Electrodynamics And Plasma Physics

Unit . I

Review of Basics of electrostatics and magnetostatics (electric field, Gauss.slaw, Laplaces and Poisson equations, method of images, Biot-Sawart law, Ampere law, Maxwell's equations, scalar and vector potentials, gauge transformation, Lorentz gauge, Coulomb Gauge, Solution of Maxwell equationsin conducting media radiations by moving charges, retarded potentials, Lienard Wiechrt potentials, fields of charged particles in uniform motion, fields of arbitrarily moving charge particle.

Unit-II

Fields of an accelerated charged particles at low velocity and high velocity, angular distribution of power radiated, Review of four vector and Lorentz transformation in 4-dimensional spaces, Invariance of electric charge, relativistic transformation properties of E and H fields. Electromagnetic fields tensor in 4- dimensional Maxwell equation, Four Vector current and potential and their invariance under Lorentz transformation, covariance of electrodynamics. Langragian and Hamiltonian for a relativistic charged particle jn External EM field; motion of charged particles in electromagnetic fields, uniform and nonuniform E and B fields. Unit -III

Elementary concept of occurrence of plasma. Gaseous and solid state plasma. Production of gaseous and solid state plasma. Plasma parameters. Plasma confinement pinch effect instability in a pinched- plasma column. Electrical neutrality in a plasma. Debye screening distance. Plasma oscillations: Transverse oscillations and longitudinal oscillations. Unit . IV

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Domain of Magnetohydrodynamics and plasma Physics : Magnetohydrodynamic equations, magnetic hydro-static pressure hydrodynamic waves: Magneto-sonic and Alfven waves, particle orbits and drift motion in a plasmas, Experimental study of Plasma, the theory of single and double probes.

Unit - V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

Text Books and reference book:

1. Bitteneerort Plasma Physics 2. Chen Plasma Physics

3. Gupta, Kumar, Singh Electrodynamics; 4. Sen Plasma state and matter

5. Jackson Classical electrodynamics 6. Pamolsky & Philips Classical electricity and Magnetism

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Class: M.Sc. Physics
Max. Marks: 85+15 = 100
Semester: II
Subject: Physics –IV

Title of Paper: Atomic and Molecular Physics

UNIT -I

Quantum states of one electron atom spectral terms of equivalent and non equivalent electron . Atomic orbitals. Hydrogen spectrum, Paulis principle, Spectra of alkali elements, Spin orbit interaction and line structure of alkali Spectra (derivation) . Methods of molecular quantum mechanics, Thomas Fermi statistical model, Hartree and Hartree fock method, Two electron system. Interaction energy in L-S and J-J coupling. UNIT - II

Hyperfine structure (qualitative), line broadening mechanisms(general ideas). Types of molecules. Diatomic linear. Symmetric top, asymmetric top and spherical top molecules. Rotational spectra of diatomic molecules as a rigid rotator, Energy level and Spectra of non-rigid rotator, intensity of rotational lines.

UNIT- III

Vibrational energy of diatomic molecule, diatomic molecule as a simple harmonic oscillator, Energy levels and spectrum, Morse potential energy curve, Molecules as vibrating rotator, Vibration spectrum of diatomic molecule PQR branches, IR spectrometer(qualitative).

UNIT-IV

Introduction to ultraviolet, visible and infra-red spectroscopy, Raman spectroscopy: Introduction, pure rotational and vibration spectra, Techniques and instrumentation, Photo electron spectroscopy, elementary idea about photoacousticspectroscopy and Moss Bauer spectroscopy(principle).

UNIT-V

This unit will have a short note question covering all the four units. The students will have to answer any two questions out of the four.

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Text and reference Books:

1. H.E. White Introduction to atomic spectra
2. C.B. Banwell Fundamental of molecular spectroscopy
3. Walker and Strnghem Spectroscopy vol. I, II and 111
4. G.M.Barrow Introduction to molecular spectroscopy
5. Herzberg Spectra of diatomic molecules
6. Jeanne L and McHale Molecular Spectroscopy
7. J.M.Brown Molecular Spectroscopy
8. P.F.Bemath Spectra of atoms and molecules



DEPARTMENT OF PHYSICS

Class: M.Sc. Physics
Max. Marks: 50
Semester: II
Subject: Physics – **LAB A**
Title of Paper: Electronics

1. To study gates and verify their truth tables
2. To verify the De-Morgan's theorem.
3. To Convert universal Gates to other basic gates
4. To study Binary to Decimal decoder
5. To study Half Adder & Full Adder.
6.

Class: M.Sc. Physics
Max. Marks: 50
Semester: II
Subject: Physics – **LAB B**
Title of Paper: Electronics

1. To find Ultrasonic velocity in a liquid by using Ultrasonic Interferometer.
2. To find the Activation Energy (in eV) of KCl by using Thermo-Luminescence method.
3. To find the Frequency of Mono Atomic and Diatomic Lattice.
4. To study the Harmonic Components of a given square wave source.
5. To find the charge of an electron 'e' by Millikon's oil drop method.
6. To study the magnetic field as a function o the resonance frequency by using Electron Spin Resonance set up.

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