## COURSEWISE SCHEME - II[ND] SEMESTER

1. Course Code :
2. Course Name : **M.Sc. Physics**
3. Total Subject : **4**
4. Compulsory Subject : **4**
5. Optional Subject : **0**

7. Maximum marks : **500**
8. Minimum Passing percentage : **36**

| Sub. code | Subject Name | Theory | | | | | | | | | Practical | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Paper | | | | | CCE | | Total Marks | | | | | |
| | | 1st | 2nd | 3rd | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. |
| **Compulsory** | | | | | | | | | | | | | | |
| | Quantum Mechanics – II | 85 | 0 | 0 | 85 | 31 | 15 | 5 | 100 | 36 | 0 | 0 | 100 | 36 |
| | Statistical Mechanics | 85 | 0 | 0 | 85 | 31 | 15 | 5 | 100 | 36 | 0 | 0 | 100 | 36 |
| | Electro Dynamics and Plasma Phy. | 85 | 0 | 0 | 85 | 31 | 15 | 5 | 100 | 36 | 0 | 0 | 100 | 36 |
| | Atomic and Molecular Physics | 85 | 0 | 0 | 85 | 31 | 15 | 5 | 100 | 36 | 0 | 0 | 100 | 36 |
| | **Practical – I** General Physics based | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 18 | 50 | 18 |
| | **Practical – II** Electronics Based Practical | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 18 | 50 | 18 |

# Department of Higher Education Govt. of M.P.

Semester Wise Syllabus for Post Graduate Classes
As recommended by Central Board of Studies and
Approved by H.E. The Governor of M.P.

CLASS - M.Sc.
SEMESTER - II

SUBJECT - PHYSICS
PAPER – I

MM – 85

## 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 equation), 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.** **SUBJECT - PHYSICS**
**SEMESTER - II** **PAPER – II**

**MM – 85**

## 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 –IV

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.

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 Physics

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**CLASS - M.Sc.** **SUBJECT - PHYSICS**
**SEMESTER - II** **PAPER - III**

**MM – 85**

## ELECTRODYNAMICS AND PLASMA PHYSICS

### Unit – I

Review of Basics *of* electrostatics and magnetostatics (electric field, Gauss's law, 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 equations in 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 non-uniform 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

Domain of Magnetohydrodynamics and plasma Physics : Magneto-hydrodynamic 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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**SEMESTER - II**

**SUBJECT - PHYSICS**
**PAPER – IV**

**MM – 85**

## ATOMIC AND MOLECULAR PHYSICS

### UNIT -I

Quantum states of one electron atom. Atomic orbitals. Hydrogen spectrum, Paulis principle, Spectra of alkali elements, Spin orbit interaction and line structure of alkali Spectra . 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, hyperfine structure (qualitative), line broadening mechanisms(general ideas).

### UNIT - II

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 vibrational spectra, Techniques and instrumentation, Photo electron spectroscopy, elementary idea about photoacoustic spectroscopy and Mossbauer 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.

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 |
| 9. | J.M. Halian | Modern Spectroscopy |