

S. S. Jain Subodh P. G. College, Jaipur (Autonomous)
Assignment March 2026
Programme - M.Sc. (Physics) II Sem
Paper (I) - Electronics

Note: Attempt any 4 questions, selecting at least one question from each unit.

UNIT 1

1. Draw the circuit diagram of an emitter coupled differential amplifier. Explain its working and discuss its different modes of operation.
2. Draw the operational amplifier circuit which can be used to perform addition and subtraction simultaneously and obtain the expression for its output voltage.

UNIT II

3. Draw the circuit diagram of a RC – phase shift oscillator. Describe its functioning and derive the expression for the frequency of oscillations and minimum gain required for sustained oscillations.
4. Draw circuit diagram of a triangle wave generator using a comparator and an integrator and explain its working.

UNIT III

5. What do you mean by Demultiplexer. Write the expression for the data output and also write the truth table for 1:8 Demultiplexer.
6. What is a ROM. Write different types of ROM's and explain each of them briefly.

UNIT IV

7. Draw the circuit diagram of Master – Slave Flip – Flop. Discuss its functioning and explain how to remove the race around condition.
8. What is a Photo-Diode? Write its construction and operation. Draw the characteristics of the photo-diode.

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Assignment March 2026
Programme - M.Sc. (Physics) II Sem
Paper (II) - Atomic & Molecular Physics

Note: Attempt any 4 questions, selecting at least one question from each unit.

Unit –I

1. (a) Write down a detailed note on first and second order Stark Effect.
(b) Write a short note on Degeneracy.
2. (a) What do you mean by Spin-Orbit Interaction? Calculate change in total energy of an atom due to spin orbit coupling.
(b) Calculate the wavelength separation between unmodified wavelength of 6000\AA and the modified lines when an external magnetic field of 6×10^{-2} Tesla is applied in normal Zeeman Effect.

Unit –II

3. (a) Discuss variational method and its use in calculation of ground state energy of hydrogen molecule.
(b) Explain the meaning of Spectroscopic term $^{2S+1}L_J$
4. (a) Explain formation of H_2 molecule on the basis of Heitler London Method.
(b) Calculate energy of Helium atom in ground state and first excited state. Show the energy levels in a diagram.

Unit –III

5. Explain the Spectral Series of Sodium Spectrum. Explain D_1 and D_2 lines of Sodium Spectrum in detail.
6. (a) Explain Raman Effect on the basis of quantum theory. Explain origin of Stoke and Anti – Stoke lines in Raman Spectra.
(b) State and explain Franck – Condon principle for intensity of spectral lines.

Unit –IV

7. What do you mean by Doppler Cooling? Write a detailed note on magneto-optical trap for cooling atoms
8. (a) Discuss magneto – optical trap method of cooling for atoms.
(b) What do you mean by Bose – Einstein Condensation.

S. S. Jain Subodh P. G. College, Jaipur (Autonomous)
Assignment March 2026
Programme - M.Sc. (Physics) II Sem
Paper (III) - Classical Electrodynamics –II

Note: Attempt any 4 questions, selecting at least one question from each unit.

Unit I

1. With the help of appropriate explanations, discuss frequency dispersion in dielectrics and conductors. Define a dissipative medium.
2. Explain wave superposition in one dimension with suitable expressions. Define and explain the causal connection between D and E.

Unit II

3. Derive the basic MHD equations used in magneto hydrodynamics and discuss the pinch effect with suitable explanation.
4. With suitable explanation, discuss the instabilities of a pinched plasma column and define the Debye shielding distance.

Unit III

5. Explain the invariance of electric charge and show that electrodynamics is covariant. Hence derive the Lorentz transformation of electromagnetic fields.
6. Discuss the Liénard–Wiechert potentials for a moving point charge and explain Larmor's formula for radiation from an accelerating charge.

Unit IV

7. Discuss the origin and physical significance of the radiation reaction force based on energy conservation. Explain the Abraham–Lorentz formulation of the self-force acting on an accelerating charge.
8. Explain the mechanisms responsible for line broadening and energy level shifts of an oscillator. Discuss the processes of scattering and absorption of radiation by an oscillator.

S. S. Jain Subodh P. G. College, Jaipur (Autonomous)
Assignment March 2026
Programme - M.Sc. (Physics) II Sem
Paper (IV) - Numerical Methods

Note: Attempt any 4 questions, selecting at least one question from each unit.

Unit – I

1. a) Discuss different sources which give rise to error in numerical methods.
- b) Given that $= \frac{5xy^2}{z^3}$. Find the relative error at $x = y = z = 1$ when the errors of x, y, z are 0.001
- c) Derive Hermit's Interpolation formula.

2. a) The following table of x_i and $f(x_i)$ is given. Find the cubic splines for this table-

x	1	2	3	4	5
$f(x)$	30	15	32	18	25

- b) A matrix given:-

$$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$

Find the characteristic equation, Eigen Values and Eigen Vectors.

UNIT – II

3. a) Derive the general formula for numerical integration. Deduce Trapezoidal and Simpson's $\frac{1}{3}$ rule.
- b) Using modified Newton's method find the real root of the equation $f(x) = x^3 - x^2 - x + 1 = 0$ Choose $x_0 = 0.8$
4. a) Discuss the Newton's method for the solution of non-linear equation in the case of complex roots.
- b) Using Trapezoidal and Simpson's rule evaluate the integral $I = \int_0^{-1} \frac{dx}{1+x}$
Correct to three decimal places with $h = 0.5$

Unit – III

5. a) Explain Predictor-Corrector method. Obtain expressions for Predictor-Corrector formulae using forward differences.
- b) Find the least squares approximations to \sqrt{x} on $[0, 1]$ of degree one, two and three.

6. a) Given $\frac{dy}{dx} = y - x$
Where $y(0) = 2$, find $y(0.1)$ and $y(0.2)$ correct to four decimal places by Runge-Kutta method.
- b) Explain the Runge-Kutta method for solving differential equations.

Unit – IV

7. a) Describe the differences between Poisson and Normal Distribution.
- b) Two dice are thrown. Find the probability
- To get a sum of ten
 - To get a sum greater than ten
8. a) Explain random variable distribution.
- b) Write short note on –
- Elementary Probability Theory
 - Binomial Distribution

S. S. Jain Subodh P. G. College, Jaipur (Autonomous)
Assignment March 2026
Programme - M.Sc. (Physics) IV Sem
Paper (I)- Introductory Quantum Field Theory

Note: Attempt any 4 questions, selecting at least one question from each unit.

Unit I

1. Define scalar and vector fields and discuss their physical significance. Explain the Euler–Lagrange equations in field theory and describe the formulation of the Lagrangian density for the electromagnetic field.
2. Explain the principle of second quantization for systems of identical bosons. Describe in detail the second quantization of the real Klein–Gordon field and the complex Klein–Gordon field, highlighting their physical interpretation and differences.

Unit II

3. Explain the occupation number representation for fermions, including how states are described and the role of the Pauli exclusion principle. Discuss the concept of the fermion propagator, its mathematical formulation, and its significance in describing the propagation of fermions in quantum field theory.
4. Explain the second quantization of the Dirac field, including the quantization of spin- $\frac{1}{2}$ particles and the creation and annihilation operators. Discuss electromagnetic (EM) interactions in this framework and the principle of gauge invariance in quantum electrodynamics.

Unit III

5. Explain the concept of the S-matrix and its perturbative expansion in quantum field theory. Discuss Wick's theorem, including its role in simplifying time-ordered products and computing scattering amplitudes.
6. Explain Feynman diagrams for basic quantum processes, illustrating particle interactions and exchanges. Discuss the Feynman rules of quantum electrodynamics (QED) for constructing these diagrams and calculating amplitudes.

Unit IV

7. Explain the concepts of Coulomb scattering and Bhabha scattering, including their physical principles, interaction mechanisms.
8. Explain Moller scattering and Compton scattering, including their basic physical principles and interaction mechanisms.

S. S. Jain Subodh P. G. College, Jaipur (Autonomous)
Assignment March 2026
Programme - M.Sc. (Physics) IV Sem
Paper (II) - Solid State Physics

Note: Attempt any 4 questions, selecting at least one question from each unit.

Unit –I

1. What is the difference between dispersive and non-dispersive medium. Deduce the dispersion relation for one dimensional monoatomic lattice
2. Write short notes on the following:-
 - (a) Interaction of phonons with photons.
 - (b) Thermal expansion and thermal conductivity.

Unit –II

3. (a) Derive expressions for the density of charge carriers in conduction band and valence bands of a semiconductor and hence deduce the Law of Mass – Action. .
(b) What are Line Defects? Explain different types of such defects and define the terms burger vector and slip plane.
4. Explain the optical transitions in semiconductors and deduce the Schockely – Read theory for generation and recombination of charge carriers.

Unit –III

5. Discuss quantum theory of ferromagnetism. Define Curie temperature.
6. Discuss the domain theory of ferromagnetism materials.

Unit –IV

7. (a) What is Flux Quantization? Obtain an expression for fluxoid.
(b) Discuss the results of BCS Theory and also discuss cooper pairs.
8. (a) What are DC and AC Josephson Effect? Explain Quantum Mechanical Theories on these effects.
(b) Write short notes on Ultrasonic Attenuation in Superconductors.

S. S. Jain Subodh P. G. College, Jaipur (Autonomous)
Assignment March 2026
Programme - M.Sc. (Physics) IV Sem
Paper (III) - Nuclear Physics –II

Note: Attempt any 4 questions, selecting at least one question from each unit.

UNIT – I

1. Describe the main assumptions of the Nuclear Shell Model. Derive the energy level scheme for a nucleus using a spin – orbit coupled potential
2. Explain the concept of magic numbers and how they are predicted by the Shell Model.

UNIT – II

3. Describe the types of collective excitations in deformed nuclei.
4. Explain the Nilsson Model for single particle states in deformed nuclei.

UNIT – III

5. How does the Fermi's theory of β decay explain the Fermi and Gamow – Teller transitions?
6. Discuss the internal conversion process and how it competes with gamma – ray emission.

UNIT- IV

7. Write in detail the theories of nuclear reactions. Describe in detail the partial wave analysis of reaction cross section, compound nucleus formation and breakup. Explain statistical theory of nuclear reactions.
8. How do angular distributions of emitted particles help in identifying the mechanism of nuclear reaction?

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Assignment March 2026
Programme - M.Sc. (Physics) IV Sem
Paper (IV) - Microwave Electronics - II

Note: Attempt any 4 questions, selecting at least one question from each unit.

Unit –I

1. Explain the avalanche transit-time phenomenon in microwave semiconductor devices. Using the small-signal approximation, derive the expression for the impedance of the avalanche region of a Read diode, clearly stating the assumptions involved.
2. Describe the construction and principle of operation of a directional coupler. Explain its coupling mechanism, scattering parameters, and important performance characteristics such as directivity and isolation.

Unit –II

3. What is meant by an abrupt p–n junction? Derive an expression for the junction capacitance per unit area of an abrupt junction diode and discuss its dependence on applied bias voltage.
4. State the Manley–Rowe relations applicable to parametric devices. Using these relations, show that the maximum power gain of an up-converter is given by where ω_p is the pump frequency and ω_s is the signal frequency. State the physical significance of this result.

Unit –III

5. What is a Huygens' source? Derive expressions for the electric field, magnetic field, and radiation intensity produced by a Huygens' source. Hence, obtain an expression for its directivity and comment on its radiation characteristics.
6. (a) Define the radiation pattern of an antenna and explain its importance in antenna analysis.
(b) What is meant by magnetic current? Explain its role in aperture radiation.
(c) Discuss the radiation mechanism of a microstrip antenna with the help of suitable diagrams.

Unit –IV

7. Explain the concept of synchronous satellites. Describe various satellite orbits and discuss the fundamental aspects of satellite communication link design, including power and noise considerations.
8. Define a Line-of-Sight (LOS) microwave communication system. Explain in detail:
(a) Ionospheric propagation and its effect on microwave communication.
(b) Eclipse effect in satellite communication systems.