

S.S Jain Subodh PG (Autonomous) College, Jaipur
Academic Year 2023-24
M.Sc. II Sem
Subject-Physics
Paper I- Electronics
Assignment

Note: Attempt any two questions

UNIT 1

- Q 1 What is a Differential Amplifier? Draw the circuit diagram of an emitter coupled differential amplifier. Explain its working and discuss its different modes of operation.
- Q 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

- Q 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.
- Q 4 Draw circuit diagram of a triangle wave generator using a comparator and an integrator and explain its working.

UNIT III

- Q 5 Draw the detailed block diagram of a 4-bit adder that can also be used as a Subtractor and explain its operation as an adder as well as subtractor with the help of suitable examples.
- Q 6 What is a ROM. Write different types of ROM's and explain each of them briefly.

UNIT IV

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

S.S Jain Subodh PG (Autonomous) College, Jaipur
Academic Year 2023-24
M.Sc. II Sem
Subject-Physics
Paper II- Atomic and Molecular Physics
Assignment

Note: Attempt any two questions

Unit –I

- Q.1 (a) Explain normal and abnormal Zeeman effect quantum mechanically.
(b) What do you mean by Spin – Orbit interaction? Calculate energy change in s, p, d, f states due to it.
- Q.2 Write notes on the followings:
(a) Magnetic dipole interaction
(b) Lamb Shift (qualitative description)
(c) Hyperfine structure

Unit –II

- Q.3 (a) Calculate exact solution for the hydrogen like atom, if optimum trial function is given $\psi = e^{-kr}$ and the upper bound to the ground state energy of the hydrogen like atom. Also calculate the minimum ground state energy.
(b) Explain and write basic idea of Heitler London method for hydrogen molecule.
- Q.4 Write short notes on the followings:
(a) The WKB method.
(b) The barrier penetration.

Unit –III

- Q.5 (a) Explain general features of the spectra of alkali atoms. Draw energy levels of sodium and explain principal features of its spectrum.
(b) Explain D_1 and D_2 lines of Sodium Spectrum.
- Q.6 (a) What is Raman Scattering? Explain Raman effect on the basis of Quantum Theory.
(b) Why all molecules do not show vibrational Spectrum?

Unit –IV

- Q.7 (a) Write basic principle and working of optical molasses technique. How it is differ from magneto optical trap?
(b) Write short notes on ‘Atomic fountain’.
- Q.8 (a) Discuss in detail the Sisyphus cooling mechanism.
(b) Explain the Doppler Cooling limit.

S.S Jain Subodh PG (Autonomous) College, Jaipur
Academic Year 2023-24
M.Sc. II Sem
Subject-Physics
Paper III- Classical Electrodynamics-II
Assignment

Note: Attempt any two questions

Unit I

- Q.1 Explain Frequency dispersion characteristics of dielectrics and plasma. What is dissipative medium?
- Q.2 Explain casualty connection between D and E. Derive Kramers-Kronig relation.

Unit II

- Q.3 Explain Magnetic diffusion, viscosity and pressure. Derive MHD equations for plasma.
- Q.4 What is short wave length limit of plasma oscillations? Explain instabilities in pinched plasma column.

Unit III

- Q.5 Explain invariance of electric charge and covariance of electrodynamics. Discuss the Transformation of electromagnetic field.
- Q.6 Derive Larmor's formula and its relativistic generalization. Explain Angular distribution of radiation emitted by an accelerated charge.

Unit IV

- Q.7 What is radiative reaction force? Explain difficulties with Abraham Lorentz model.
- Q.8 Explain Line Breadth and level shift of an oscillator. Discuss about Scattering of radiation by an oscillator and energy transfer to a harmonically bound charge.

S.S Jain Subodh PG (Autonomous) College, Jaipur
Academic Year 2023-24
M.Sc. II Sem
Subject-Physics
Paper IV- Numerical Methods
Assignment

Note: Attempt any two questions

Unit –I

1. (a) Explain the sources of errors and error analysis with example.
(b) An approximate value of π is given by $X_1 = \frac{22}{7} = 3.1428571$ and its true value is $X = 3.1415926$. Find the absolute and relative errors.

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) Obtain the formula for the evaluation of double integral defined as -

$$I = \int_{y_j}^{y_{j+1}} \int_{x_i}^{x_{i+1}} f(x, y) dx dy$$

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) Explain Least-Squares Approximation with example.
6. a) Using predictor – corrector method find the solution of following equation

$$\frac{dy}{dx} = -xy \quad , \quad y(0) = 1$$

- 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
i) To get a sum of ten
ii) To get a sum greater than ten
8. a) Describe the Binomial Distribution.
b) Write short note on –
i) Discrete random variable distribution
ii) Continuous random variable distribution

S.S Jain Subodh PG (Autonomous) College, Jaipur
Academic Year 2023-24
M.Sc. IV Sem
Subject-Physics
Paper I- Introductory Quantum Field Theory
Assignment

Note: Attempt any two questions

Unit I

- Q.1 Explain Lagrangian density for electromagnetic field and Classical Lagrangian field theory. Derive Euler Lagrange's equation.
- Q.2 Explain Occupation number representation for simple harmonic oscillator, the meson propagator and second quantization of the K.G field.

Unit II

- Q.3 Explain The occupation number representation for fermions and second quantization of the Dirac field.
- Q.4 Describe the em interaction and gauge invariance. Explain covariant quantization of the free electro- magnetic field.

Unit III

- Q.5 Discuss the S-matrix expansion and explain Wick's theorem.
- Q.6 Discuss Feynman diagrams of basic processes and explain Feynman rules of QED.

Unit IV

- Q.7 Explain Coulomb scattering and Bhabha scattering.
- Q.8 Explain Moller scattering and Compton scattering.

S.S Jain Subodh PG (Autonomous) College, Jaipur
Academic Year 2023-24
M.Sc. IV Sem
Subject-Physics
Paper II- Solid State Physics
Assignment

Note: Attempt any two questions

UNIT I

- Q.1 Describe Vibration of a one dimensional diatomic lattice.
Q.2 Explain Interaction of phonons with photon.

UNIT II

- Q.3 Explain the optical transitions in semiconductors and deduce the Shockley – Read theory for generation and recombination of charge carriers.
Q.4 (a) What do you mean by color centers? How they are produced? What are the experimental facts on F-centers and how are they explained?
(b) What are Line Defects? Explain different types of such defects and define the terms burger vector and slip plane.

UNIT III

- Q.5 (a) What is Paramagnetism? Discuss Langevin Theory of Paramagnetism and expression for susceptibility. Also discuss its drawbacks.
(b) Discuss Heisenberg's Exchange Interaction as the Quantum Theory of Ferromagnetism.
Q.6 Obtain the dispersion relation for magnons in a ferromagnet in one dimension with nearest neighbour interactions and discuss the Bloch $T^{3/2}$ law.

UNIT IV

- Q.7 (a) What is Meissner Effect? Prove that in a superconductor, Meissner effect and resistivity properties are independent phenomenon.
(b) What are DC and AC Josephson Effect? Explain Quantum Mechanical Theories on these effects.
Q.8 (a) What is Flux Quantization? Obtain an expression for fluxoid.
(b) How are Cooper Pairs formed? Explain qualitatively the BCS theory of super conductivity and discuss the energy gap based on this theory.

S.S Jain Subodh PG (Autonomous) College, Jaipur
Academic Year 2023-24

M.Sc. IV Sem
Subject-Physics
Paper III- Nuclear Physics -II
Assignment

Note: Attempt any two questions

UNIT – I

- Q 1. Define single particle model in detail. Define shell model predictions for ground state parity, angular momentum, magnetic dipole and electric quadrupole moments.
- Q2. What is configuration mixing? Define single particle transition probability as per the shell model. Define selection rules. What is nuclear isomerism?

UNIT – II

- Q 3. Define collective nuclear model in terms of rotational spectra. Give a brief description of collective model Hamiltonian.
- Q 4. Define vibrational collective model, collective modes of a deformed even-even nucleus and moments of inertia.

UNIT – III

- Q 5. Explain electric and magnetic multipole moments, gamma decay probabilities in nuclear system and selection rules.
- Q 6. Explain Fermi theory of beta decay with special reference to parity conserved selection rules Fermi and Gamow-Teller for allowed transitions.

UNIT- IV

- Q 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.
- Q 8. What is Optical model? Explain PWBA and its shortcomings.

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Academic Year 2023-24
M.Sc. IV Sem
Subject-Physics
Paper IV- Microwave Electronics II
Assignment

Note: Attempt any two questions

UNIT – I

- Q.1 Explain Avalanche Transit Time. Using small signal approximation, obtain impedance of avalanche region of a read diode.
- Q.2 Explain the working and structure of Directional Coupler.

UNIT – II

- Q.3 Explain the term Abrupt PN Junction. Obtain expression for junction capacitance unit area in an abrupt junction diode.
- Q.4 Using Manley Rowe relations show that maximum gain of an up convertor is
$$1 + w_p/w_s$$
Where w_p and w_s are pumping frequency and signal frequency respectively.

UNIT – III

- Q.5 What is meant by Huygen's Source? Derive expression for E – field, H – field and directivity for a Huygen's Source.
- Q.6 Write the radiation pattern for antenna. What do you understand by Magnetic current? Explain. Discuss the radiation mechanism of a micro strip antenna.

UNIT – IV

- Q.7 Explain the term Synchronous Satellites, Satellite orbits and Link design.
- Q.8 Define LOS Microwave System and explain in detail: (a) Ionospheric propagation (b) Eclipse effect.