

M.Sc. DEGREE EXAMINATION – DECEMBER 2020.  
PHYSICS

CLASSICAL AND STATISTICAL MECHANICS

Time : 3 hours

Maximum Marks : 75

**PART A (5 x 3 = 15)**

Answer any **FIVE** questions.

1. What are action angle variables?
2. Define Euler angles.
3. What are degrees of freedom?
4. What is a partition function?
5. What are the limitations of classical statistics?
6. What is meant by Bose –Einstein condensation?
7. Write Hamilton's principle function with explanation.
8. What are generalized coordinates?

**PART B (5 x 12 = 60)**

9. Explain in detail Hamilton Jacobi theory.

Or

Derive the canonical transformation equations.

10. Deduce the expression for angular momentum of a rigid body.

Or

Prove that the rotational kinetic energy is conserved in the rigid body.

11. Apply the theory of small oscillations of a system to the oscillations of a linear triatomic molecule.

Or

Explain normal coordinates.

12. Derive the Sackur-tetrode equation for a mono atomic ideal gas.

Or

Explain the ideal gas in micro canonical ensemble.

13. Obtain the Bose-Einstein distribution function.

Or

Write short notes on i) density matrix ii) Equation of motion for density matrix

**PG-C-796**

**MPHY-12**

M.Sc. DEGREE EXAMINATION –  
DECEMBER - 2020

PHYSICS

First Year

MATHEMATICAL PHYSICS

Time: 3 Hours

Maximum Marks: 75

PART A ( $5 \times 5 = 25$  Marks)

Answer any FIVE questions.

1. If  $A = \begin{pmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{pmatrix}$ , then show that  $A$  is orthogonal.
2. Show that  $P_2(x) = 3/2 x^2 - \frac{1}{2}$ .
3. Find  $L(e^{-3t} \cos 4t \cos t)$ .
4. Derive Cauchy-Riemann equation by using calculus.

5. Show that  $\sigma^0$  is called a permutation of degree  $n$ .
6. What do you mean by diagonalization of a matrix?
7. Find the orthogonal trajectories for the family of curves (a)  $y = cx$  (b)  $y = cx^2$ .
8. Define group and subgroup.

PART B — (5 × 10 = 50 marks)

Answer the following questions (a) or (b).

9. (a) P.T the following matrix is unitary

$$\begin{pmatrix} \frac{1+i}{2} & \frac{-1+i}{2} \\ \frac{1+i}{2} & \frac{1-i}{2} \end{pmatrix}.$$

Or

- (b) Using Cayley-Hamilton theorem find  $A^4$ .

$$\text{Given } A = \begin{pmatrix} 2 & -2 & 1 \\ 0 & 1 & 2 \\ 1 & 0 & 1 \end{pmatrix}.$$

10. (a) Describe the powers series solution of the Bessel.

Or

(b) Show that and prove the Rodrique's formula.

11. (a) Develop half range cosine series  $f(x) = x^2$  in the interval  $(0, \pi)$ . Hence deduce the sum
- $$1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots$$

Or

(b) Using Laplace transform, solve  $d^2y/dt^2 + 5 dy/dt + 4y = t^2$  ;  $y^1(0) = y(0) = 1$ .

12. (a) (i) State and prove Cauchy's Residue theorem. (8)

(ii) Evaluate  $\int_C \frac{2 dz}{(z-1)^2(z+1)}$  where  $c$  is  $|z|=2$ . (4)

Or

(b) Prove that  $\int_{-\infty}^{\infty} \frac{x^4}{x^6-1} dx = \frac{\pi}{\sqrt{3}}$ .

13. (a) (i) Find the group of symmetries of an equilateral triangle. (4)

- (ii) For  $n > 1$ , the set  $A_n$ , of all even permutation in  $S_n$  is a subgroup of  $S_n$ .

Also the order of  $A_n$  is  $\frac{|n|}{2}$ . (8)

Or

- (b) (i) Find the group of symmetries of square. (6)
- (ii) Any permutation  $\sigma \in S_n$  can be expressed as a product of a finite number of disjoint cycles. (6)
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**M.Sc. DEGREE EXAMINATION – DECEMBER 2020****PHYSICS****First Year****ELECTRO MAGNETIC THEORY**

Time : 3 Hours

Maximum Marks : 75

**PART - A (5 x 3 = 15 Marks)****Answer any FIVE Questions**

- 1 State Uniqueness theorem.
- 2 State and explain Biot-Savart law.
- 3 Define Polarization. Give its unit.
- 4 What is Poynting vector? What does it denote?
- 5 What do you mean by an oscillating dipole?
- 6 Use Gauss law to find electric field intensity due to a uniformly charged cylinder.
- 7 Distinguish between scalar and vector potentials.
- 8 What are the major differences between field theory and circuit theory.

**PART - B (5 x 12 = 60 Marks)****Answer all the Questions**

9. State and prove Gauss law. Explain any one application of Gauss law.

OR

Derive electrostatic Uniqueness theorem.

10. Derive an expression for magnetic scalar potential and highlight its importance.

OR

Derive an expression for Ampere's circuital law and Find an expression for magnetic field due to a long current carrying conductor.

11. Explain Gauss theorem in a dielectric and obtain an expression for electric displacement vector. (12)

Or

- i) Deduce an expression for electric susceptibility and dielectric constant. (8)
- ii) Write a note on relation between electric susceptibility and dielectric constant. (4)
12. State and prove Poynting theorem.

OR

Deduce the wave equation for a conducting medium and write about skin depth also.

13. Discuss the reflection and refraction of plane electromagnetic waves at an interface between two conducting media in normal incidence.

OR

Obtain basic transmission line equations.

**M.Sc., DEGREE EXAMINATION – DECEMBER – 2020**

**PHYSICS**

**FIRST YEAR**

**Nuclear Physics**

**Time : 3 Hours**

**Maximum Marks : 75**

**PART – A**

**(5 x 3 = 15 Marks)**

**Answer any FIVE questions:**

1. What is meant by exchange force?
2. What are magic numbers?
3. Write any three assumptions of Fermi theory of beta decay?
4. Write short note on deuterons.
5. What are mesons and baryons?
6. What is meant by Q-value of a nuclear reaction?
7. What do you mean by elastic scattering? Give one example.
8. What is mass spectrograph? What are the basic components used in mass spectrograph?

**PART – B**

**(5 X 12 = 60 Marks)**

**Answer All the questions:**

9. a) Discuss the proton – neutron theory of nuclear composition.

OR

- b) Explain the Bain-Bridge and Jordan mass spectrometer with a neat diagram.

10. a) Explain in detail about Collective nuclear model.

OR

- b) i) Write assumptions of nuclear shell model.  
ii) Write short notes on comparison of liquid drop and shell model of nuclei .

11. a) i) Write a note on nuclear isomerism.

ii) Write a note on nuclear internal conversion.

OR

- b) Discuss any three conservation laws namely energy, change and angular momentum.

12. a) Discuss the meson theory of nuclear force.

OR

- b) State and explain Reciprocity theorem.

13. a) Obtain the Gell-Mann-Okuba mass formula for Baryons.

OR

- b) Discuss in details in quark model of the elementary particles.

**PG-C-799**

**MPHY-15**

**PG DEGREE EXAMINATION - DECEMBER 2020**

**FIRST YEAR**

**ELECTRONICS**

**Time: 3 Hours**

**Maximum Marks: 75**

**Section A (5 x 3 = 15 Marks)**

Answer any **FIVE** questions:

1. State Demorgan's laws and Boolean laws for OR operation.
2. Draw the logic diagram of a half-adder and write its truth table.
3. How many flip flops are required to construct for (a) Mod 9 counter and (b) Mod 12 counter.
4. Define resolution of a D/A converter.
5. Write a note on types of semiconductor memories.
6. What are ASCII codes? Give examples.
7. What are asynchronous sequential circuits? Give diagram of it.
8. Write a short note on multivibrators.

**Section B (5 x 12 = 60 Marks)**

Answer any **FIVE** questions:

9. a) (i) What is a Karnaugh map? How it can be constructed? (8)  
(ii) How grouping / circling can be done in K-maps? (4)

(OR)

b) Simplify the Boolean expression and draw the logic circuit whose Boolean equation is  
 $Y = (A + B + C) \cdot (A + B + \bar{C}) \cdot (\bar{A} + B + C) \cdot (\bar{A} + B + \bar{C})$

10. a) With the help of a block diagram, explain the working of four input multiplexer.

(OR)

b) Explain the working of a Full adder and Full subtractor with the help of a circuit diagram.

11. a) Explain the working of JK master slave flip flop.

(OR)

b) Describe the operation of a shift register. What are the applications of Shift registers?

12. a) Explain the neat circuit diagram, the operation of a bistable multivibrator using op-amp.

(OR)

b) Explain the working of Analog to Digital converters.

13. a) Write short notes on (i) PROM (ii) EEPROM (iii) EPROM

(OR)

b) Write short notes on (i) Flash memory (ii) Charge coupled device

**M.Sc. DEGREE EXAMINATION – DECEMBER 2020**  
**PHYSICS**

**Second Year**

**QUANTUM MECHANICS**

Time: 3 Hours

Maximum Marks: 75

**PART A**

**(5 x 3 = 15 Marks)**

Answer any **FIVE** questions.

1. What is Heisenberg picture?
2. What is called WKB approximation?
3. What is the relevance of Klein-Gordon equation?
4. When is born approximation valid?
5. Give the expression for the Einstein coefficient of induced emission.
6. State the principle of Hartree method.
7. Give an example of harmonic perturbation.
8. Explain briefly about negative energy states.

**PART B**

**(5 x 12 = 60 Marks)**

9. Derive the equation of motion in Schrodinger picture.

Or

Explain the matrix representation in quantum mechanics.

10. a) Evaluate the energy of Helium atom by the application of time independent Perturbation theory.

Or

- b) i) Write a short note o harmonic perturbation.

ii) State and Prove Fermi golden rule for the rate of transition.

11. Discuss the matrix representation of angular momentum.

Or

Explain the method of adding angular momenta.

12. Explain the method of partial waves.

Or

Describe the use of Fermi Thomas model in the study of molecular structure.

13. Explain spontaneous and induced emission of radiation using semi classical theory.

Or

Write briefly about Creation and Destruction operators.

**M.Sc. DEGREE EXAMINATION – DECEMBER 2020****Second Year****Physics****CONDENSED MATTER PHYSICS**

Time: 3 Hours

Maximum Marks: 75

**PART A — (3 × 5 = 15 Marks)**

Answer any THREE questions.

1. Define F-centre.
2. Give the distinguishing property of reciprocal lattice.
3. Classify materials into metals, semiconductory and insulators
4. Define Fermi Energy.
5. What do you understand by Meissner effect?
6. Write about energy gap of super conductor.
7. What is called dielective susceptibility?
8. State curie-weiss law.

**PART B (5 × 12 = 60 Marks)**

Answer ALL questions.

9. (a) Find the primitive translation vectors of the reciprocal lattice to SC, BCC and FCC lattice.

Or

- (b) Describe an Essay about defects in Crystals.

10. (a) Describe the number of orbitals in a band and hence the classification of solids.

Or

- (b) Explain and distinguish between extended zone, reduced zone and periodic zone scheme of plotting energy bands.

11. (a) Discuss in detail about BCS theory of superconductivity.

Or

(b) Explain super conducting tunneling get the formulation of dc Josephson effect. Explain current of dc Josephson effect.

12. (a) Derive an expression for local electric field at an atom.

Or

(b) Derive an expression for Clausius – Mossotti relation.

13. (a) Describe the Weiss theory of ferromagnetism

Or

(b) Derive the Dispersion Relation for magnon in ferro magnetic material.

**M.Sc. DEGREE EXAMINATION — DECEMBER, 2020.****SECOND YEAR****PHYSICS****SPECTROSCOPY****Time : 3 hours****Maximum marks : 75****PART-A****(5 × 3 = 15 marks)****Answer any FIVE questions.**

1. Distinguish between normal and anomalous zeeman effect.
2. What You understand in Hyperfine structure of spectral lines
3. Outline briefly the advantages of FTIR spectroscopy over the conventional procedure.
4. Why anti-stokes lines are less intense than stokes lines?
5. List the basic requirements of a typical NMR spectrometer.
6. Explain the principle of NQR.
7. Why microwave source and techniques have to be applied for the observation of ESR?
8. What is isomer shift? Give examples.

**PART-B****(5 × 12 = 60 Marks)****Answer ALL the questions.**

9. (a) Describe the magnetic moment of an atom and derive an expression for Lande 'g' factor.  
Or  
(b) Why does the normal Zeeman effect occur only in atoms with even number of electrons, explain in detail.
10. (a) Explain the practical aspects of infrared spectroscopy.  
Or  
(b) Describe, with theory, rotation vibration spectra of diatomic molecules.
11. (a) Describe the quantum theory of Raman effect.

Or

- (b) Explain in detail about Laser Raman spectroscopy.
12. (a) (i) Define chemical shift. Distinguish between  $\delta$  and  $\tau$  chemical shifts.  
(i) Derive Bloch equation.

Or

- (b) What do you understand by NQR group frequencies? Explain its use in molecular structure determination.
13. (a) Explain the factors responsible for the hyperfine structure in ESR spectra.

Or

- (b) Explain recoilless emission and absorption of gamma rays.
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**M.Sc. DEGREE EXAMINATION —  
DECEMBER 2020**

**Second Year**

**Physics**

**LASER AND FIBER OPTICS**

**Time : Three hours**

**Maximum marks : 75**

**PART A — (5 × 3 = 15 marks)**

**Answer any FIVE questions.**

1. Mention the characteristics of laser light?
2. Define electro optic effect.
3. Define Numerical Aperture.
4. What are double heterostructure LEDs?
5. What is photoluminescence?
6. What are liquid crystals?
7. What is a semiconductor laser?
8. What is plasma?

PART B — ( $5 \times 12 = 60$  marks)

Answer FIVE questions.

9. (a) Derive the Einstein's relations and the conditions required for laser action.

Or

- (b) Describe the construction and working of He-Ne laser. Explain the medical applications

10. (a) Explain electro optic and magneto optic effects.

Or

- (b) Explain reflection and refraction at the boundary of an absorbing medium of a solid.

11. (a) Explain Fiber Fabrication Technique.

Or

- (b) Explain the various types of losses in an optical fiber.

12. (a) Explain briefly about distributed feedback laser.

Or

- (b) Write short notes on (i) Quantum well laser  
(ii) index guided laser

13. (a) (i) What is an LED display? Mention its types with its applications. (8)
- (ii) Give the concept of Drive circuits. (4)

Or

- (b) (i) Mention the advantages and disadvantages of plasma display. (6)
- (ii) Write a note on LCD display. (6)

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M.Sc DEGREE EXAMINATION - DECEMBER – 2020

PHYSICS

SECOND YEAR

NUMERICAL METHODS

Time : 3 Hrs

Maximum Marks : 75

**Part - A** (5 x 3 = 15 Marks)

Answer any FIVE questions. ALL questions carry equal marks.

- Briefly explain iterative method for polynomial equations:-
- Find the real root of the equation  $x^3 - 2x - 5 = 0$ , using bisection method:-
- Write short notes on Eigen vectors:-
- Explain the Jacobi method for solving symmetry matrices:-
- The function  $y = \sin x$  is tabulated below. Using Newton's interpolation formula, find the value of  $\sin(\pi/6)$ .

x	y = sin x
0	0
$\pi/4$	0.70711
$\pi/2$	1.0

- Explain the procedure of Newton-Cotes integration method:-
- Compute  $I_p = \int_0^1 \frac{x^p dx}{x^3+10}$  for p=0 using trapezoidal rule with the number of points 3.
- Explain Euler's method for solving differential equations.

**PART - B** (5 x 12 = 60 Marks)

Answer ALL questions by choosing either (a) or (b). ALL questions carry equal marks.

- (a) Find a real root of the equation  $x = e^{-x}$ , using the Newton-Raphson method.

**Or**

- (b) Explain Bairstow method for solving polynomial equations.

- (a) Solve the following system by using Gauss-Jordan elimination method.

$$x + y + z = 5; \quad 2x + 3y + 5z = 8; \quad 4x + 5z = 2$$

**Or**

- (b) Use the Gauss-Seidel method to solve the simultaneous linear equations.

$$5x + y - z = 4; \quad x + 4y + 2z = 15; \quad x - 2y + 5z = 12$$

11. (a) Derive the Lagrange's interpolation formula for unequally spaced data:-

**Or**

(b) Certain experimental values of x and y are given below:

(0, -1), (2, 5), (5, 12), (7, 20).

Obtain the equation for line of best fit using least square approximation.

12. (a) Evaluate  $I = \int_0^1 \frac{1}{1+x} dx$ , correct to three decimal places by Simpson's 1/3 rule, with h=0.5 and 0.25

**Or**

(b) Derive an expression for Gauss quadrature formula to find integration.

13. (a) Obtain the expression for Runge-Kutta fourth order formulae.

**Or**

(b) The differential equation  $y' = x^2 + y^2 - 2$ , satisfies the following data: Use Milne's method to obtain the value of y(0.3)

x	y
-0.1	1.0900
0.0	1.0000
0.1	0.8900
0.2	0.7605

