

**PG-712**

**MPHY-11**

**M.Sc. DEGREE EXAMINATION –  
DECEMBER 2019.**

**First Year**

**Physics**

**CLASSICAL AND STATISTICAL MECHANICS**

**Time : 3 hours**

**Maximum marks : 75**

**PART A — (5 × 3 = 15 marks)**

**Answer any FIVE questions.**

1. What are canonical transformations?
2. What are Generalised coordinates?
3. Define degrees of freedom.
4. Write down two connections between thermodynamics and statistical mechanics.
5. What are the conditions for a system of particles to obey Bose-Einstein statistics?
6. What are Euler angles?

7. Write Hamilton-Jacobi equation.
8. Distinguish between Bosons and Fermions.

PART B — ( $5 \times 12 = 60$  marks)

Answer FIVE questions.

9. (a) Solve Kepler problem applying action angle variables.

Or

- (b) (i) Deduce equation of motion in terms of poisson's bracket. (6)
- (ii) Write a note on Lagrange and Poisson'S brackets. (6)

10. (a) Derive the Euler's equation of motion in terms of Euler's angles.

Or

- (b) Obtain the expression for angular velocity and angular momentum of a rigid body.

11. (a) Explain formulation of the problem.

Or

- (b) Apply the theory of small oscillations of a system about an equilibrium position to the oscillations of a symmetric linear triatomic molecule.

12. (a) Explain how Gibb's paradox can be resolved and obtain the corrected entropy equation of an ideal gas.

Or

- (b) Write short notes on  
(i) Canonical partition function and  
(ii) Grand canonical partition function

13. (a) Obtain the Bose-Einstein distribution function.

Or

- (b) Show how a system of Bosons condenses when cooled below the critical temperature.

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**PG-713**

**MPHY-12**

M.Sc. DEGREE EXAMINATION –  
DECEMBER, 2019.

First Year

Physics

MATHEMATICAL PHYSICS

Time : 3 hours

Maximum marks : 75

PART A — (5 × 3 = 15 marks)

Answer any FIVE questions.

1. Define unitary matrix. Mention its properties.
2. P.T  $J_{n-1}(X) - J_{n+1}(x) = 2J_n 1(x)$ .
3. Find  $a_0$  and  $a_n$ , if  $f(x) = x^2$  in the interval  $(0, 2\pi)$ .
4. Find the bilinear map which maps the points  $Z = 1, -1, \infty$  onto the points  $W = -1, i, i$ .
5. Find  $a^{-1}ba$  given  $a = \begin{pmatrix} 1 & 3 & 5 \end{pmatrix}$ ,  $b = \begin{pmatrix} 1 & 5 & 7 \end{pmatrix}$ .

6. Define eigen values and eigen vectors of a matrix.
7. Define legendre polynomial and Rodrique's formula.
8. Define group and subgroup.

PART B — (5 × 12 = 60 marks)

Answer any FIVE questions.

9. (a) Diagonalise the given matrix

$$A = \begin{pmatrix} 11 & -4 & -7 \\ 7 & -2 & -5 \\ 10 & -4 & -6 \end{pmatrix}.$$

Or

- (b) Apply Gram-Schmid orthonormalization, construct an orthonormal basis with  $V_3$ .

$$X_1 = (1 \ -1 \ 0)^T$$

$$X_2 = (2 \ -1 \ 2)^T$$

$$X_3 = (1 \ -1 \ -2)^T$$

10. (a) (i) P.T.  $(x^{-n} J_n)' = -x^{-n} J_{n+1}(x)$  (6)
- (ii) P.T.  $(x^n J_n)'(x) = x^n J_{n-1}(x)$ . (6)

Or

(b) (i) P.T.  $\int_{-1}^1 P_m(x)P_n(x)dx=0$  (if  $m \neq n$ ). (6)

(ii) P.T.  $\int_{-1}^1 P_n^2(x)dx=\frac{2}{2^{n+1}}$ . (6)

11. (a) Expand  $f(x)=x$  as Fourier series in the interval  $(0,2\pi)$ .

Or

- (b) Solve  $d^2y/dt^2+4dy/dt+4y=\sin t$ ;  $dy/dt=0$  and  $y=2$ , when  $t=0$ .

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

Or

- (b) Expand  $f(z)=\frac{z^2-1}{(z+2)(z+3)}$  in a Laurent's series if

(i)  $|z|<2$             (ii)  $|z|>3$  and

(iii)  $2<|z|<3$ .

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. (8)

Or

- (b) (i) Find the group of symmetries of a square. (4)
- (ii) Any group  $G$  of order  $3^0$  is cyclic. (8)

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**PG-714**

**MPHY-13**

**M.Sc DEGREE EXAMINATION —  
DECEMBER, 2019.**

**First Year**

**Physics**

**ELECTROMAGNETIC THEORY**

**Time : 3 hours**

**Maximum marks : 75**

**PART A — (5 × 3 = 15 marks)**

**Answer any FIVE questions.**

1. Give the meaning of electric flux. Give its unit.
2. State Biot-Savart law. Give its mathematical form too.
3. Mention the properties of dielectrics.
4. List Maxwell's equation in differential form for free space.
5. Define: normal and oblique incidence.
6. What is meant by polarisation?
7. Specify the application of Gauss law.
8. State ampere's circuital law. Give its mathematical form also.

PART B — ( $5 \times 12 = 60$  marks)

Answer ALL questions.

9. (a) Calculate the energy associated to an electrostatic field. (12)

Or

- (b) Deduce electrostatic Uniqueness theorem. (12)

10. (a) Derive an expression for magnetic vector potential and Discuss its cases too. (12)

Or

- (b) Derive an expression for Ampere's circuital law and Find an expression for magnetic field due to a long current carrying conductor. (12)

11. (a) (i) Derive an expression for Gauss law in dielectric medium. (6)

- (ii) Deduce an expression for electric susceptibility and dielectric constant. (6)

Or

- (b) Calculate the force on a point charge embedded in a dielectric. (12)

12. (a) Explain the relation between E and H vectors in a uniform plane wave. (12)

Or

- (b) Deduce the wave equation for a conduction medium and write about skin depth too. (12)

13. (a) Explain the reflection and refraction of electromagnetic waves in a matter at oblique incidence. (12)

Or

- (b) Obtain basic transmission line equations. (12)

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**PG-715**

**MPHY-14**

**M.Sc. DEGREE EXAMINATION —  
DECEMBER, 2019.**

**First Year**

**Physics**

**NUCLEAR PHYSICS**

**Time : Three hours**

**Maximum marks : 75**

**PART A — (5 × 3 = 15 marks)**

**Answer any FIVE questions.**

**ALL questions carry equal marks**

1. Write short notes on isotope shift.
2. State and explain Pauli's exclusion principle.
3. List the similarities between molecules in the drop of liquid correspond to the nucleons in the nucleus.
4. Write short notes on electric quadrupole moment.
5. What is inelastic scattering? Give one example.

6. Give any three assumptions for Fermi theory of beta decay.
7. The study of p-p scattering is capable of much higher accuracy than n-p scattering give reasons.
8. What are Leptons, Hadrons and Baryons?

PART B — ( $5 \times 12 = 60$  marks)

Answer ALL questions, choosing either (a) or (b).

9. (a) Discuss the proton-electron theory of nuclear composition.

Or

- (b) In a mass spectrometer, a single charged positive ion is accelerated through a potential difference of 1000 volt. It then travels through magnetic field for which  $B = 1000$  gauss and is deflected into a circular path of 18.2 cm in radius. Calculate (i) the speed of the ion? (ii) the mass of the ion?

10. (a) Explain the evidences for the existence of Magic numbers.

Or

- (b) From the predictions of the shell model, explain magnetic moments of nuclei.

11. (a) Derive an expression for Q-value.

Or

(b) Explain the Gamow's theory of alpha decay.

12. (a) Derive an expression for the depth of the well of deuteron at excited states.

Or

(b) Derive Breit-Wigner one level formula.

13. (a) Explain the artificial production of pions.

Or

(b) Obtain the Gell-Mann-Okubo mass relation for baryons.

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**PG-716**

**MPHY-15**

**M.Sc.DEGREE EXAMINATION —  
DECEMBER, 2019.**

**First Year**

**Physics**

**ELECTRONICS**

**Time : Three hours**

**Maximum marks : 75**

**SECTION A — (5 × 3 = 15 marks)**

**Answer any FIVE questions.**

**ALL questions carry equal marks**

1. What are ASCII codes? Give examples;
2. Write short notes on Karnaugh maps Give one example.
3. What is a four bit adder?
4. Explain the working of latch circuit.
5. What are decade counters? Explain.
6. Write short notes on multivibrators.

7. List the characteristics of analog to digital converter.
8. Write short notes on Flash memory.

SECTION B — (5 × 12 = 60 marks)

Answer ALL questions, choosing either (a) or (b).

9. (a) Explain the procedure to convert decimal number into its excess-3 code.

Or

- (b) Draw the logic circuit whose Boolean equation is  $Y = \overline{A}BC + A\overline{B}C$ .

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

Or

- (b) What is BCD to decimal converter? Explain the working of a seven segment decoder.

11. (a) Explain the functioning of JK flip flop.

Or

- (b) What are the different types of counters? Explain the general theory of Mod-n counter.

12. (a) Explain the working of binary weighted resistor D/A converter with operational amplifier.

Or

- (b) Explain the working of ADC.

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

Or

- (b) What is the basic difference between SRAM and DRAM? Explain the organization of SRAM.

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