

*M.Sc. 1st Semester Examination 2020-21*  
**PHYSICS**

**M. Sc. 1st Semester Examination**

**Paper I : Mathematical Physics**

[Max. Marks : Regular 85 / Private 100

[Min. Marks : Regular 28 / Private 33

Note : Answer all five questions. All questions carry equal marks.

1 .Prove the following recursion relation involving Bessel function

(i)  $J_{n-1}(x) + J_{n+1}(x) = \frac{2n}{x} J_n(x)$

(ii)  $J_{n-1}(x) - J_{n+1}(x) = \frac{2n}{x} J_n'(x)$

(iii) Prove the following orthogonality relation involving Legendre functions  $P_n(x)$  and  $P_m(x)$  for  $n \neq m$  :

$$\int_{-1}^{+1} P_n(x) P_m(x) dx = 0$$

OR

(i) Obtain Hermite Polynomial by the generating function and show that

$$H_n(x) = (-1)^n H_n(-x)$$

(ii) From the Generating function derive the recurrence relation :

$$H_{n+1}(x) = 2x H_n(x) - 2n H_{n-1}(x)$$

2 .State and convolution theorem for Fourier transformation.

Define the property of Laplace transformation. State and Prove Laplace transform of derivatives.

OR

Making use of laplace transform method , obtain the solution of

(a) Simple harmonic oscillator

(b) Damped Oscillator

3 . What do you mean by eigen function ? expand it for green's function.

OR

Explain fourier transform method of construction of Green's function

4. prove Cauchy theorem. solve Cauchy integral formula

OR

Obtain Cauchy – Riemann conditions in polar form.

5. Attempt any two of the following:

(a) obtain Greens function for Quantum Mechanical Scattering .

(b) Laurent Series.

(c) Jordans Leema Integrals.

(d) Curvilinear coordinate system with specific cases of Cartesian.

**February 2021**  
**MSc Ist Sem Examination**  
**Physics**  
**Paper II**  
**[ Classical Mechanics ]**

Max. Marks : Regular 85/Private 100

Min. Marks : Regular 28 / Private 33

Note : **Answer all 5 questions. All questions carry equal marks**

Q.1 a) Deduce Hamilton's principle from D' Alembert's Principle.

b) Explain constraints and their classification.

Or

a) What do you mean by generalised co-ordinates? Express generalized momentum and Lagrangian formulation of conservation theorem.

b) Explain configuration space?

Q.2 Discuss Hamilton- Jacobi equation and show that Hamilton's Principle function is a generator of canonical transformation of constant co-ordinate and moments?

Or

a) Discuss Poisson's bracket with its properties.

b) Show that the Lagrange's bracket is invariant under canonical transformation.

Q.3 Explain theory of small oscillations and discuss its normal modes.

Or

Obtain Euler's equation of motion for a rotating rigid body.

Q.4 Discuss the concept of 4- force and 4- vectors.

Or

What is the need of covariant formulation? Deduce expression for Covariant Hamiltonian.

Q.5 Write short notes on any 2 of the following –

a) Principle of Least action.

b) Coriolis force and its uses.

c) Invariance of space and time.

d) Principle of virtual work

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**Paper III : Quantum Mechanics**

[Max. Marks : Regular 85 / Private 100

[Min. Marks : Regular 28 / Private 33

Note : Answer all five questions. All questions carry equal marks.

1. State and prove Ehrenfest's Theorems.

OR

Explain the basic postulates of quantum Mechanics and Deduce equation of continuity for probability density .

2. (a) Explain the significance of Hilbert Space in Quantum Mechanics.

(b) Write a short note on Annihilation and Creation Operators.

OR

Describe Heisenberg Uncertainty Relation through operators. Explain Schwartz Inequality.

3. Establish Schrodinger equation for a linear harmonic oscillator and solve it to obtain its eigen values and eigen functions for its energy.

OR

Solve the radial part of Schrodinger equation for the hydrogen atom.

4. Assuming commutation relations for various angular momentum components, get the eigen values of  $L^2$  and  $L_z$ .

OR

What are C. G. Coefficients ? Mention their properties and selection rules.

5. Write short notes on any two of the following :

(a) Normalisation and Orthogonal properties of eigen functions.

(b) Bra and Ket notations / vectors.

(c) Zero point energy of harmonic oscillator.

(d) Pauli Spin Matrices.

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**Paper IV**  
**[ Electronic Devices ]**

Max. Marks : Regular 85/Private 100

Min. Marks : Regular 28 / Private 33

Note : Answer all 5 questions. All questions carry equal marks

Q.1 a) Explain I-V characteristics of MOSFET.

b) Explain circuit of Enhancement type of MOSFET. How it can be use as switch.

Or

a) Explain construction and characteristics of JFET. What is pinch off voltage in JFET?

b) Explain application of JFET?

Q.2 Describe working principle and construction of semiconductor laser.

Or

Explain working of Solar cell. Define solar cell efficiency, describe experimental method to calculate it.

Q.3 a) Explain CMOS and NMOS memories. Discuss their advantages and disadvantages.

b) Write short note on Optical storage devices

Or

a) Differentiate between SRAM & DRAM.

b) Explain CD-ROM.

Q.4 a) Explain magnetostrictive constant and magnetostrictive energy.

b) Explain with two examples the piezo electric activator

Or

a) Write short note on magnetostrictive Oscillator.

b) Explain electrostrictive effect.

Q.5 Write short notes on any 2 of the following –

a) Gunn diode.

b) Radiative and Non radiative transition.

c) Operation and characteristics of impact diodes.

d) Sensors and Actuators.

e) Ferroelectric memories.