Exam Code: 225501 **Paper Code: 1209**

Programme: Master of Science (Physics) Semester - I

Course Title: Analog and Digital Electronics

Course Code: MPHL-1391

Time Allowed: 3 Hours **Max. Marks: 70**

Note: - Attempt five questions in all, selecting at least one question from each section. Fifth question may be attempted from any section. Each question carries 14 marks.

Section A

1. (a) Explain the working of MOSFET and its characteristics. (7)

   (b) How SCR is modified using four layer device and discuss its application. (7)

2. (a) How storage devices work and discuss different types of memories. (7)

   (b) Discuss the Construction and working of U.J.T and its use. (7)

Section B

3. (a) What are operational Amplifiers and its characteristics? Discuss its input/output impedance? (7)

   (b) Write a note on Schmitt trigger and Logarithmic amplifiers. (7)

4. Explain the following:
   (a) Electronic Analog computational circuit
   (b) Integrator
   (c) Differentiator
   (d) Summer in context of Operational Amplifiers

(4 X 3.5 = 14)

Section C

5. (i) Convert the following:
   (a) $(829)_{10}$ to Hexadecimal
   (b) $(778.7625)_{10}$ to hexadecimal
   (c) $(11011101100)_2$ to hexadecimal (7)

   (ii) Explain the working of
   (a) Encoders/ Decoders
   (b) Parity generators and Adder Subtractor circuits
   (3.5 + 3.5)

6. (a) Explain the concept of:
   (i) Karnaugh maps with rules and three variable example
   (ii) Multiplexer and De Multiplexer
   (7)

   (b) Prove that
   (i) $A+\bar{A}B = A+B$
   (ii) $(A+B)(A+C) = A+BC$.
   Also state De. Morgan's theorem (7)

Section D

7. Explain the concept of
   (i) J-K Flip Flop
   (ii) Binary Ladder and , Analog to Digital Converter
   (14)

8. Write a note on the following:
   (a) Registers
   (b) Up-Down Counters
   (c) Digital to Analog Converter
   (14)

Exam Code: 225501 **Paper Code: 1210**

Programme: Master of Science (Physics) Semester - I

Course Title: Mathematical Physics

Course Code: MPHL-1392

Time Allowed: 3 Hours **Maximum Marks: 70**

Note: - Attempt five questions in all, selecting at least one question from each section. Fifth question may be attempted from any section. Each question carries 14 marks.

Section-A

1. (a) Obtain the Fourier Series expansion for

$$F(x)=\begin{cases} -\pi & -\pi<x<0 \\ x & 0<x<\pi \end{cases}$$

Also Show that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\ldots\ldots=\frac{\Pi^2}{8}$ (7)

(b) Find Fourier series of function $F(x) = x \sin x$; $-\pi<x<\pi$. (7)

2. Define Tensors. Discuss the Algebraic operations on tensors. (14)

Section-B

3. (a) Evaluate $\int_0^{2\pi} \frac{\cos 2\theta}{5+4\cos\theta} d\theta$ by using contour integration. (7)

(b) State and Prove Cauchy Integral Formula. (7)

4. (a) State & Prove Laurent's Theorem. (7)

(b) Find the Laurent Series expansion of (7)

$f(z) = \frac{z}{(z-1)(z-2)}$ valid for $|z-1|>1$

Section-C

5. **(a)** Prove that $P_n(x)$ is the coefficient of Z^n in the expansion of $(1-2xz+z^2)^{-1/2}$ in ascending powers of x. (7)

(b) Show that

$$\int_{-1}^{+1} [P_n(x)]^2 dx = \frac{2}{2n+1} \quad (7)$$

6. **(a)** Find the power series solution (frobenious method) of differential equation about x=0

$$3x\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0 \quad (7)$$

(b) Prove that

$$J_{1/2} = \sqrt{\left(\frac{2}{\Pi x}\right)} Sinx \quad (7)$$

Section-D

7. **(a)** Prove that set of integers is a group under addition. (7)

(b) Define Abelian group. Show that (1, -1, i, -i) is an abelian group under multiplication. (7)

8. **(a)** Define Isomorphic and Homomorphic groups. Differentiate between them and give at least two properties of each. (7)

(b) Write a note on (i) special unitary group SU(2) (ii) Permutation group. (7)

Exam Code: 225501 **Paper Code: 1211**

Programme: Master of Science (Physics) Semester - I

Course Title: Classical Mechanics

Course Code: MPHL-1393

Time Allowed: 3 Hours **Maximum Marks: 70**

Note: - Attempt five questions in all, selecting at least one question from each section. Fifth question may be attempted from any section. Each question carries 14 marks. Students can use non-scientific calculator if necessary.

Section A

1. (a) Explain why the rigid body possesses six degrees of freedom. (3)

   (b) What is D'Alembert's principle? Derive Lagrange's equations of motion from it for conservative system. (11)

2. (a) Prove the laws of conservation of linear momentum, angular momentum and energy for a system of interacting particles. (9)

   (b) The Lagrangian of a particle moving in a plane is given by Cartesian coordinates as $L = \dot{x}\dot{y} - x^2 - y^2$
   Find the expression for its canonical momentum p_r (in radial coordinates r). (5)

Section B

3. State and prove Kepler's three laws of planetary motion. (14)

4. (a) A mass m, moves in a circular orbit of radius r_0 under the influence of a central force whose potential is $-\frac{k}{r^n}$. Show that the circular orbit is stable under small oscillations, if $n < 2$. (5)

(b) What is differential scattering cross-section? Prove its dependence on the scattering angle ϕ. (9)

Section C

5. (a) Derive transformation equations for the generating functions of types $F_1(q, Q, t)$, $F_2(q, P, t)$. (9)

(b) What are fundamental Poisson brackets? Deduce them. (5)

6. (a) What are canonical transformations? Give conditions for a transformation to be canonical. Write a short note on infinitesimal contact transformation. (9)

(b) A canonical transformation (q,p)→(Q,P) is made through the generating function $F(q, P) = q^2P$ on the Hamiltonian $H(q, P) = \frac{p^2}{2\alpha q^2} + \frac{\beta}{4}q^4$ where α and β are constants. Find the equations of motion for (Q,P). (5)

Section D

7. (a) Define inertia tensor. Give its physical significance. (5)

(b) What is a rigid body? Obtain Euler's equation of motion for a rigid b (9)

8. What is the theory of small oscillations? By using theory of small oscillations find expression for frequency of free vibrations. (14)

Exam Code: 225501 **Paper Code: 1212**

Programme: Master of Science (Physics) Semester - I

Course Title: Computational Techniques

Course Code: MPHL-1394

Time Allowed: 3 Hours **Maximum Marks: 70**

Note: - Attempt five questions in all, selecting at least one question from each section. Fifth question may be attempted from any section. Each question carries 14 marks. Students can use Non-programmable scientific calculator or trigonometric/logarithmic table.

Section A

1. (a) Explain the importance of inline functions and function handlers? How they are defined and used? Give examples? (3.5)
   (b) What is p-code in MATLAB? Explain its importance? (3.5)
   (c) Explain Switch Case Otherwise and Break statements in MATLAB with proper examples? (7)
2. Discuss about cells and structures in MATLAB with examples in detail? (14)

Section B

3. (a) What is interpolation? How it is different from curve fitting? Derive Newton's Backward interpolation formula? When it is preffered? (9)
   (b) Estimate from the following table the no. of students who got the marks between 40 and 45? (5)

Marks :	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
No. of Students :	31	42	51	35	31

4. (a) Prove that the divided diffrences are symmetrical in their arguments? (7)
   (b) Compute $f(8)$ for the following data. (7)

x:	4	5	7	10	11	13
$f(x)$:	48	100	294	900	1210	2028

Section C

5. (a) A solid of revolution is formed about the x-axis, the area between the x-axis, the lines x=0 and x=1 and a curve through the points with the following co-ordinates: (7)

x	0.00	0.25	0.50	0.75	1.00
Y	1.0000	0.9896	0.9589	0.9089	0.8415

Estimate the volume of the solid formed by Simpson 1/3 rule.

(b) Drive Trapezoidal rule to solve numerical integration? Explain it graphically? (7)

6. Using Runge-Kutta fourth order method, find approximate value of y correct up to three decimal places at x=0.2, 0.4 and 0.6 for

$$\frac{dy}{dx} = 1 + y^2$$

given that $y = 0$ when $x = 0$ (14)

Section D

7. Discuss the Gauss elimination method? Why it is preferred over Gauss Jordan Method? Solve the following system of linear equations by Gauss elimination method.

$$5x + y + z + w = 4$$
$$x + 7y + z + w = 12$$
$$x + y + 6z + w = -5$$
$$x + y + z + 4w = -6$$

(14)

8. Discuss False -position method with the help of graph? Find the root of $x^3 - 2x - 5 = 0$ in the interval (1.75, 2.5) using False position method correct up to 3 decimal places. (14)

Exam Code: 225501 Paper Code: 1213

Programme: Master of Science (Physics) Semester I

Course Title: Introduction to Glass Science and Glass Ceramics

Course Code: MPHM-1395

Time Allowed: 3 Hours Max. Marks: 40

Note: Attempt five questions in all, selecting at least one question from each section. Fifth question may be attempted from any Section. Each question carries 8 marks.

Section A

1. Explain the classification of materials on basis of structure with suitable examples. 8
2. Write a note on Obsidian, Fulgurites and Lunar Glasses. 8

Section B

3. Explain the concept of glass formers, modifiers, and intermediates with examples. 8
4. Define and differentiate between homogeneous and heterogeneous nucleation. 8

Section C

5. A) How do glass ceramics differ from traditional glasses? 2
   B) Discuss the effect of temperature on thermal expansion of glasses. 6
6. Describe the methods for determination of density of glasses. 8

Section D

7. Explain the role of the Indian glass industry in the global market. Mention major players and their contributions. 8
8. What are the prospects of recyclable or green glasses? 8