Exam Code: 229001 **Paper Code: 1217**
(20)

Programme: Master of Science (Physics)
Semester-I

Course Title: Analog and Digital Electronics

Course Code: MPHL-1391

Time Allowed: 3 Hours **Max Marks: 80**

Note: Attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries equal marks.

Section- A

1. (a) Explain the working of Unijunction Transistor. (8)

   (b) Explain the working of S.C.R and discuss its application. (8)

2. (a) Explain the following (8)
   a. R.A.M
   b. R.O.M
   c. EPROM

d. EEPROM

(b) Discuss the Construction and working of MOSFET. (8)

Section B

3. (a) What are Inverting and Non Inverting operational Amplifiers? Discuss its input/output impedance? (8)

   (b) Write a note on Schmitt trigger and Logarithmic amplifiers (8)

4. Explain the following

   (a) Electronic Analog computational circuit

   (b) Integrator

   (c) Differentiator

   (d) Summer in context of Operational Amplifiers (16)

Section C

5. (i) Convert the following

   (a) $(25.15625)_{10}$ to binary

   (b) $(60)_{10}$ to binary

   (c) $(11011101100)_2$ to hexadecimal

(d) Apply De. Morgan's theorem for

(i) $\overline{\bar{X} + \bar{Y} + \bar{Z}}$

(ii) $\overline{(A + \bar{B}).(\bar{C} + D)}$ (8)

(ii) Explain the working of

(a)Encoders/ Decoders

(b) Parity generators and Adder Subtractor circuits

(8)

6. (a) Explain the concept of

(i) Karnaugh maps with rules and three variable example

(ii) Multiplexer and De Multiplexer (8)

(b) Prove that

(i) $A+\overline{A}B = A+B$

(ii) (A+B) (A+C)=A+BC. Also state De. Morgan's theorem. (8)

Section D

7. Explain the concept of

(i) J-K Flip Flop

(ii) Binary Ladder and, Analog to Digital Converter

(16)

8. Write a note on the following

(a) Registers

(b) Up-Down Counters

(c) Digital to Analog Converter (16)

Exam Code: 209001 **Paper Code: 1218**

Programme: Master of Science (Physics) Semester-I

Course Title- Mathematical Physics

Course Code: MPHL-1392

Time Allowed: 3 Hours **Max Marks: 80**

Note: Attempt five questions in all, selecting atleast one question from each section. Fifth question may be attempted from any section. Each question carries 16 marks.

Section-A

1. a. Show that for cylindrical and spherical coordinate system $\nabla.\vec{R}=3$ and $\nabla\times\vec{R}=0$ 8

   b. A covariant tensor has $xy, 2y-x^2, xz$ as Cartesian components. Find its spherical components. 8

2. a. Find the Laplace transform of the function $g(t) = e^{3t} + \cos 6t - t^4 e^{3t} \cos 5t$ 5

   b. Find the inverse Laplace transform of $\frac{s+7}{s^2-3s-10}$ 4

   c. State and prove Convolution theorem for Fourier Transforms. 7

Section-B

3. a. State and prove Cauchy's integral theorem. 4

   b. Compute the integral of the function $f(z) = \frac{\sin z}{z^2-1}$ around the contour C|z| = 1. 5

c. Determine the Laurent series expansion of $f(z) = \frac{1}{z^2+z-2}$ in the region $0<|z+1|<1$. 7

4. a. Expand the function $f(z) = e^z$ using Taylor's series expansion. 4

b. State and prove Taylor series expansion of an analytic function. 12

Section-C

5. Derive the Expression of Rodrigue's formula for the representation of Legendre's Functions. 16

6. Solve the second order linear differential equation $y'' + xy' + y = 0$ using power series method. 16

Section-D

7. a. If (G, *) is a group, then prove that for each g∈G has exactly one inverse. 4

b. Prove that in a group multiplication table, each element occurs only once in a row or column. 5

c. Check if natural numbers form a group under multiplication. 4

d. Prove that $(i, -1, -i, 1)$ forms an abelian cyclic group. 3

8. a. Check if integers form a group under multiplication. 4

b. Define O (n) and SO(3) group. Derive the matrix representation of SO (3) Group. 8

c. Prove that complex numbers form a group under addition. 4

Exam Code: 229001 **Paper Code: 1219**
(20)

Programme: Master of Science (Physics)
Semester-I

Course Title: Classical Mechanics

Course Code: MPHL-1393

Time Allowed: 3 Hours **Max Marks: 80**

Note: Attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 16 marks.

Section A

1. (a) What are generalized coordinates and degrees of freedom? (6)
   (b) Deduce Hamilton's principle from variational principle. (10)
2. (a) Find the equation for the curve joining two points along which a particle falling from rest under the influence of gravity reaches the lowest point in the least time. (10)
   (b) Explain virtual displacement and principle of virtual work? (6)

Section B

3. Define impact parameter, particle intensity and solid angle in Rutherford scattering experiment. Also derive formula for scattering cross-section. (16)
4. Discuss the different possible shapes of the orbits for a particle moving under central force. Also obtain the condition of the stability of the orbit. (16)

Section C

5. (a) Define Poisson brackets. Using Poisson brackets, prove that the transformation $q = (2P)^{1/2} \sin Q$, $p = (2P)^{1/2} \cos Q$ is canonical. (10)
   (b) Obtain equation of motion for a simple pendulum using Hamilton's equations. (6)
6. Discuss the principle of least action. Using this principle show that light takes a path to travel in minimum. (16)

Section D

7. Explain the terms: inertia tensor, principal axis, and principal moment of inertia for a rigid body. (16)
8. State and prove Euler's theorem for the motion of a rigid body with point fixed. (16)

Exam Code: 229001 **Paper Code: 1220**

Master of Science (Physics) Semester-I

Course Title: Computational Techniques

Course Code: MPHL-1394

Time Allowed: 3 Hours **Max Marks: 80**

Note: Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 16 marks. Students can use Non-programmable scientific calculators or trigonometric/logarithmic tables.

Section A

1. (a) Write a MATLAB program to plot a y=sin(x) function with 100 linearly spaced points. (4)
   (b) Explain the order of precedence in mathematical calculations in MATLAB and calculate the out of following mathematical expressions. (2)
   (i) `27^(1/3)+32^0.2`
   (ii) `27^1/3+32^0.2`
   (c) What is vectorization? State various arithmetic operations and corresponding operators used in MATLAB for scalars and arrays? Explain the difference between Array operations and Scalar operations with the help of examples? (10)
2. (a) Explain the importance of inline functions and function handlers? How they are defined and used? Give examples? (4)
   (b) What is p-code in MATLAB? Explain its importance? (4)
   (c) Explain for and while loop in MATLAB with proper examples? (8)

Section B

3. (a) Prove that the divided diffrences are symmetrical? (6)
   (b) Estimate from the following table the no. of students who got the marks between 40 and 45? (10)

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

4. Derive Newton's divided difference formula and find y (3.5) from the following data (16)

x	2.5	3.0	4.5	4.75	6.0
Y(x)	8.85	11.45	20.66	22.85	38.60

Section C

5. (a) Compute the integral $\int_{0.2}^{0.4}(\sin x - \log(x) + e^x)dx$ by Simpson's 1/3 rule? (8)

   (b) Drive Simpson's 1/3 rule to solve numerical integration? Why this method is preferred over trapezoidal rule. Explain graphically? (8)

6. Using Runge-Kutta fourth order method find approximate value of y correct upto three decimal places in interval [1,1.5] using step size h=0.1 if (16)

$$\frac{dy}{dx} = xy$$
$$given\ that\ y = 5\ when\ x = 1$$

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.

   $5x + y + z + w = 4$
   $x + 7y + z + w = 12$
   $x + y + 6z + w = -5$
   $x + y + z + 4w = -6$ (16)

8. (a) Explain the least square method for curve fitting and find the expression for regression coefficients for straight line fit of x on y and y on x. (8)

   (b) Discuss the Newton Raphson method graphically to find the roots of a polynomial equation and evaluate $\sqrt{12}$ correct to three decimal places using Newton Raphson method. (8)