28-11-18

Exam Code: 209001 **Paper Code: 8357 (50)**

Programme: M.Sc. (Physics) Sem: I

Course Title: Analog & Digital Electronics

Course Code: MPHL-1391

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

Instructions to the candidates:

1. **There are four Sections A, B, C and D. Candidates are required to attempt five questions in all, selecting at-least one question from each Section and fifth question may be attempted from any of the Section. Each Section is of 20 marks.**

Section-A

Q-1. (a) Explain the construction and working of SCR and discuss some important applications of SCR.

(b) What is EPROM? Differentiate between PROM and EPROM.

Q.-2. (a) What is MOSFET and their types. Discuss construction and working of n-channel D-MOSFET.

(b) A FET has a drain current of 5mA. If I_{DSS} = 10 mA and $V_{GS\,(off)}$ is -6V, find the value of VGS.

Section-B

Q-3. (a) What is operational amplifier? Explain the working of differential amplifier and discuss its transfer characteristics and explain transconductance.

(b) Explain how an Op-Amp works as an differentiator.

Q-4. (a) What do you mean by non-inverting and inverting input of a differential amplifier.

(b) Discuss the operation of summing amplifier.

Section-C

Q-5. (a) What is an exclusive –OR gate. Give its all definitions. Why it is called odd-parity tester.

(b) What is full adder? Explain working of full adder in serial and parallel mode.

Q-6. (a) Prove that $(B + BC)(B + \bar{B}C)(B + D) = B$

(b) Show that $(A\bar{B}C + B + B\bar{D} + AB\bar{D} + \bar{A}C = B + C$

(c) Prove that $\overline{(A + \overline{BC})}(A\bar{B} + ABC) = 0$

(d) Distinguish between multiplexer and a de-multiplexer. Discuss few applications of multiplexer.

Section –D

Q-7. (a) What is a counter and discuss their type. Explain the functioning of asynchronous counter as up and down counter.

(b) What is a flip flop? Draw and explain the working of S-R flip flop. What was wrong with it and how does J-K flip flop solved the ambiguity condition of SR flip flop.

Q-8. (a) Define a register. Explain the working of serial in serial out register.

(b) Describe in detail the working of digital to anlog converter.

Exam Code: 209001 **Paper Code: 8358 (50)**

Programme : M.Sc. (Physics) Semester-I

Course Title: Mathematical Physics

Course Code: MPHL-1392

Time Allowed: 3 Hours **Max Marks: 100**

Note : Attempt Five Questions. One Question from each section is compulsory. Fifth question can be attempted from any section.

Secton A

I. Using Rodrigue's formula, prove that

i) $\int_{-1}^{+1} Po\,(x)dx = 2$

ii) $\int_{-1}^{+1} Pn\,(x)dx = 0$

iii) $\int_{-1}^{+1} x^2\, P_5\,(x)dx = 0$

4+6+6
~~6+7+7~~

2. (i) Generate a group from two elements A and B only to relation $A^2 = B^3 = (AB)^2 = E$. What will be the order of this group.

(ii) Prove that the groups of order two and three are always cyclic.

~~8+6+6~~
6+5+5

(iii) Starting from the generating function for Bessel's function $J_n(x)$, find the Jacobi series.

Section B

3. (i) Define Gamma Function. Show that

(a) $\Gamma(n) = (n-1)!$

(b) $\Gamma\left(\frac{1}{2}\right) = \sqrt{\Pi}$

(ii) Show that $j_{-n}(x) = (-1)^n j_n(x)$ ~~14+6~~ 12+4

4. Show that Bessel function $J_n(x)$ is the coefficient of z^n in the expansion of $e^{x(z-1/z)/2}$ in the ascending or descending power of z. 16

Section C

5. State and prove Taylor's series. ~~20~~ 16

6. (i) Using method of contour Integration, show that

$$\int_0^{2\pi} \frac{d\theta}{1-2p\cos\theta+p^2} = \frac{2\pi}{1-p^2}$$

For $0 < p < 1$

(ii) Prove that

$$\int_0^{\pi} \frac{a\,d\theta}{a^2+\sin^2\theta} = \frac{\pi}{\sqrt{1+a^2}} \quad a > 0$$

~~10+10~~ 8+8

Section D

7. (i) Show that

$$A = \begin{bmatrix} -xy & -y^2 \\ x^2 & xy \end{bmatrix}$$

is a tensor

and

$$B = \begin{bmatrix} -xy & y^2 \\ x^2 & -xy \end{bmatrix}$$

is not a tensor

(ii) Show that any tensor of rank 2 can be expressed as sum of symmetric and anti-symmetric tensor, each of rank 2. ~~15+5~~ 12+4

8. (i) Use the Fourier's theorem to analyses the periodic curve such that the displacement is linear with time from $y=a$ at $t=0$ to $y=0$ at $t=T$

(ii) State and prove convolution Theorem. ~~10+10~~ 8+8

Exam Code: 209001 **Paper Code: 8359 (50)**

Programme: M. Sc. (Physics) Sem-I

Course Title: Classical Mechanics

Course Code: MPHL-1393

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

Instructions:

Attempt five question in all selecting at least one question from each section(unit).

Unit –I

1. a) Derive the Neilson form of Lagrange's equation

$$\frac{\partial T'}{\partial q'} - 2\frac{\partial T}{\partial q} = Q_j$$

From Lagrange's equation of motion.

b) Set up lagrangian for spherical pendulum and obtain equation of motion for it.

c) What are holonomic and non-holonomic constraints? Explain with example. 6,6,4

2. a) Discuss symmetry properties and conservation theorems in lagraingian and Hamiltonian formulation.

b) Using navigational principle, derive an expression for growth of current in LR circuit. 8,8

Unit-II

3. a) Derive the equation for the orbit of a particle moving under the influence of an inverse square central force field.

b) A particle moves in a circular orbit in a central force field given by the potential V=$-\frac{k}{r}$ (k>0). Suddenly k becomes $\frac{k}{2}$. Show that the orbit becomes parabolic.

c) What are the values of eccentricity for a orbit to be hyperbola, parabola, ellipse or circle. 8,6,2

4. a) For central force problems, show that the angular momentum being invariant implies that $\frac{dA}{dt}$ =constant, where dA is the area swept by the radius vector in time dt. Draw a sketch to indicate a area dA. What is the physical implication of $\frac{dA}{dt}$ =Constant.

b) Examine the scattering produced by a repulsive central force $f = kr^{-3}$. Show that the differential cross section is given by

$$(\theta)d\theta = \frac{k}{2E}\frac{(1-x)dx}{x^2(2-x)^2\ \sin \pi x}$$ 8,8

Where x is the ratio $\frac{\theta}{\pi}$ and E is the energy.

Unit-III

5. a) Set up equations of motion in poisson bracket formulation and thus deduce Hamilton equation.

b) Show that the transformation $P = q\cot p,\ \ Q = log\left(\frac{\sin p}{q}\right)$ is conical. Also show that the generality function is

$F = e^{-Q}(1 - q^2e^{2Q})^{1/2} + q\sin^{-1}(qe^{-Q})$ 8,8

6. a) Derive Hamilton's equations from variational principle.

b) The lagrangian of an harmonic oscillator of unit mass is $L = \frac{1}{2}x^2 - \frac{1}{2}\omega^2x^2 - \alpha x^3 + \beta x x^2$; α and β being constants. What is Hamiltonian.

c) What are cyclic coordinates? Explain. 8,6,2

Unit-IV

7. a) What are Euler angles. Represent a general rotation matrix as a product of three simple rotation matrices.

b) What is an orthogonal transformation? For infinitesimal Rotations, the transformation matrix is written as $A = 1 + \epsilon$. Show that the orthogonality of A implies that ϵ is anti symmetric. 8,8

8. a) Find the frequency and normal coordinates of vibration of a linear triatomic molecule, considering small displacement from the mean position.

b) Explain briefly small oscillations and their application.

c) What do you mean by principle axis transformation? 10, 4, 2

Exam Code : 209001 **Paper Code : 8360 (50)**

Programme : M.Sc. (Physics) Semester-I

Course Title : Computational Techniques

Course Code : MPHL-1394

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

Note: Attempt FIVE questions in all, selecting at least ONE question from each section.

Section A

1. a) Solve a 4x4 matrix equation with parameter r and also calculates determinant of the matrix.
   b) Calculate the Perfect numbers.
   (20)

2. a)Explain the followings
   i. Arithmetic operators
   ii. Relational operators
   iii. Logical operators

   b) Plot y=sinx where $0 \leq x \leq \pi$ taking 10 linearly spaced points on the given interval. Label the axis and put a suitable title to the created plot.
   (20)

Section B

3. Develop the method of Newton formula for Backward interpolation.
   (20)

4. Given the table of values as

x	5	6	9	11
y	12	13	14	16

Find Y(10). (20)

Section C

5. Derive Simpson's 1/3rd rule for numerical integration and use it to prove that $\log_e 7$ is approximately 1.9587 using

$$\int_1^7 \frac{dx}{x}$$

(20)

6. Using Runge- Kutta fourth order method to approximate y, when x=0.1, x=0.2 and x=0.3. Given that y=0 when x=0 and

$$\frac{dy}{dx} = x + y$$ (20)

Section D

7. Derive the Regula Falsi method. Use this formula to find the roots of the non-linear equation

$$x^3 - 2x - 5 = 0$$

lies between 1.75 and 2.5. Find the root correct to four significant digits. (20)

8. Solve the following system of equations using Matrix Inversion method.

$$2x_1 - 2x_2 + 5x_3 = 13$$
$$2x_1 + 3x_2 + 4x_3 = 20$$
$$3x_1 - x_2 + 3x_3 = 10$$

(20)