K21P 4199

Reg. No. : ....

Name : ....

I Semester M.Sc. Degree (CBSS – Reg./Supple./Imp.) Examination, October 2021 (2018 Admission Onwards) PHYSICS PHY 1C04 : Electronics

Time : 3 Hours | Max. Marks : 60

SECTION – A

Answer **both** questions (either **a** or **b**).

1. a) Explain with circuit diagram the closed loop op-amp configuration with voltage shunt feedback. Derive the expression for its voltage gain. Also discuss how an inverting amplifier can be modified as current to voltage converter.

OR

b) Explain a basic differentiator with circuit diagram. Obtain input and output waveforms and frequency response of a practical differentiator. Also obtain the expression for its output voltage.

2. a) With the help of neat diagrams, explain the working of R2R ladder type DAC.

OR

b) Describe with circuit diagram and waveform the working of astable multivibrators using

a) Schmitt Trigger

b) 555 Timer

c) Inverter. **(2×12=24)**

P.T.O.

SECTION – B

Answer **any four**. **1** mark for part **a**, **3** marks for part **b**, **5** marks for part **c**.

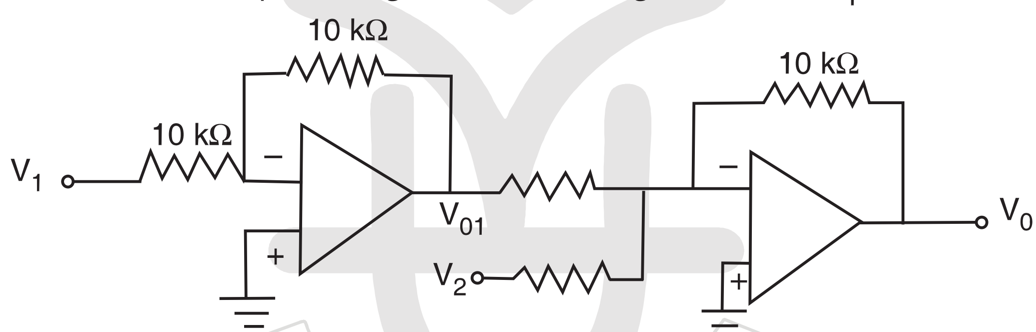
3. a) What is input offset voltage ?

   b) Determine the output voltage of a differential amplifier for the input voltages of 300 μV and 250 μV. The differential gain of the amplifier is 5000 and the value of CMRR is 100.

   c) Explain with circuit diagram, the working of an open loop op-amp in differential amplifier configuration.

4. a) What is slew rate ?

   b) Calculate the output voltage of the following circuit with V_1 = 5 V and V_2 = 5 V.



   c) Describe with circuit diagram the working of a voltage to current converter.

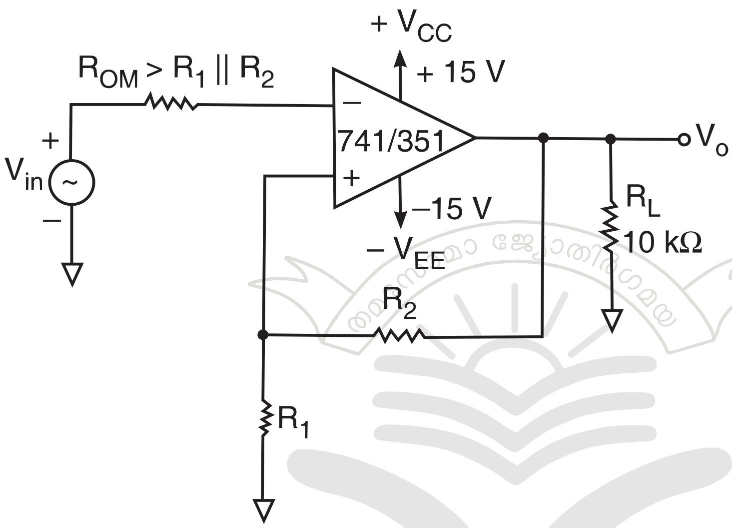
5. a) Distinguish between triangular wave generator and sawtooth wave generator.

   b) Find the resistance to be used to convert a first order low pass Butterworth filter with resistance 30 kΩ and f_H 2 KHz into a filter with f_H 3 KHz.

   c) Explain briefly with circuit diagram, the voltage limiting action of a basic op-amp comparator.

6. a) What is Schmitt Trigger ?

   b) In a Schmitt trigger circuit using op-amp having maximum output voltage swing ±14 V, R_1 = 100 Ω and R_2 = 56 kΩ, calculate the upper and lower threshold voltages.



   c) Explain 8085 microprocessor and name the registers used in it.

7. a) What is PROM ?

   b) What is meant by race around condition in flip flops ?

   c) Explain with logic diagram the working of

      i) Serial in parallel out shift register.

      ii) Parallel in parallel out shift register.

8. a) What do you mean by maximum clock frequency associated with flip flops ?

   b) Use a 4 × 1 MUX to implement the logic function F(A, B, C) = $\sum m$ (1, 2, 6, 7).

   c) Explain the design of synchronous counter. **(4×9=36)**

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I Semester M.Sc. Degree (C.B.S.S. – Reg./Supple./Imp.) Examination, October 2021
(2018 Admission Onwards)
PHYSICS
PHY1C03 : Electrodynamics

Time : 3 Hours	Max. Marks : 60

SECTION – A

Answer **both** questions either **a** or **b**. **Each** question carries **12** marks.

I. a) Explain reflection and refraction of vertically polarized wave. Derive expressions for the reflection and refraction coefficient.

OR

b) Discuss the motion of charged particles in uniform $\vec{E}$ and $\vec{B}$ fields.

II. a) Explain Guage transformations. Obtain the Lorentz Guage condition.

OR

b) Derive the electromagnetic field tensor which is consistent with the equation of charge continuity. **(2×12=24)**

SECTION – B

Answer **any four** questions. Question **(a)** carries **1** mark, **(b)** carries **3** marks, **(c)** carries **5** marks.

III. a) Define the electric scalar potential.

b) Show that the electric field generated by a stationary charge is a conservative field.

c) Explain Gauss's law in electrostatics.

IV. a) State Poynting's theorem.

b) What is the significance of the Poynting's vector ?

c) Derive the Poynting theorem.

V. a) What is a wave guide ?

b) For a rectangular wave guide with a wall separation of 0.03m and desired frequency of operation of 6 Ghz. Calculate the cut off frequency and cut off wavelength.

c) Explain the TE and TM mode of propagation.

VI. a) What is a Hertizan dipole ?

b) Explain radiation resistance of a Hertizan dipole antenna.

c) Discuss Magnetic dipole radiation and arrive at the equation for magnetic dipole radiation.

VII. a) What is radiation reaction ?

b) Explain the significance of radiation reaction.

c) Derive the Abraham Lorentz formula.

VIII. a) What are the types of polarization ?

b) Explain Brewsters angle.

c) Prove the Snell's law of refraction for oblique incidence. **(4×9=36)**

Reg. No. : ....

Name : ....

I Semester M.Sc. Degree (CBSS – Reg./Sup./Imp.) Examination, October 2022
(2019 Admission Onwards)
PHYSICS
PHY 1C02 : Classical Mechanics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** questions (either **a** or **b**). **Each** question carries **12** marks. **(2×12=24)**

1. a) Write down the Lagrangian for a symmetric trilinear CO_2 and obtain the normal mode frequencies of oscillations. Explain the physical oscillations each of these frequencies represent. Choose mass of carbon atom to be M and that of oxygen atom to be m.

OR

b) Demonstrate that the Schrödinger equation for a quantum mechanical particle reduces in the classical limit to the corresponding Hamilton-Jacobi equation.

2. a) Explain the classical scattering in a central force potential V(r) and derive the Rutherford formula for scattering cross-section.

OR

b) State Hamilton's principle and derive Euler-Lagrange equations of motions using calculus of variations.

SECTION – B

Answer **any four** questions. (**1** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**) **(4×9=36)**

3. a) Define equilibrium points of a potential and explain how they are classified.

b) Explain normal modes of oscillations.

c) Can a particle of mass m experiencing a potential $V(r) = \frac{l^2}{2mr^2} - \frac{GMm}{r}$ have stable equilibrium points ? If yes, find the points and the frequency of small oscillations about the stable points. Here the constants l, G, M are positive numbers and the coordinate $r \geq 0$.

P.T.O.

4. a) Explain what is a cyclic coordinate. Provide one example.

b) Explain the type of constraints and the number of degrees of freedom for the following systems in three dimensional space.

i) N particles moving on a cylinder whose radius R change in time.

ii) A particle moving inside a cubical box with fixed edges.

c) Write down the Lagrangian for a pendulum and obtain its Euler-Lagrange equations of motion. What form does the Lagrangian take when this is a simple pendulum ?

5. a) Explain any situation where a Hamiltonian method have an advantage over a Lagrangian method.

b) Write down the Hamiltonian for a simple harmonic oscillator in one dimension and plot its phase space trajectory. What is the phase space trajectory if it is a damped oscillator ?

c) i) Write down the Hamiltonian and obtain the Hamilton's equations of motion for a charged particle moving in an electromagnetic field.

ii) Obtain the Lagrangian for the above from the Hamiltonian.

6. a) Write the generating function of an identity canonical transformation and demonstrate it.

b) Hamiltonian for a particle is $H = \frac{p_x^2 + p_y^2 + p_z^2}{2m} + \frac{1}{2}mw^2\,(x^2 + 3y^2 + z^2)$. Find out which of the components of angular momentum vector L are conserved.

c) For what value of the constant α does the transformation $Q = \frac{p}{2q}$ and $P = -\frac{\alpha q^2}{2}$ becomes a canonical transformation $(q, p) \rightarrow (Q, P)$? Apply this canonical transformation to a simple harmonic oscillator and find the Hamiltonian (Kamiltonian) in coordinates (Q, P).

7. a) Explain the relevance of Hamilton's characteristic function in Hamilton-Jacobi formalism.

b) Explain how Hamilton-Jacobi method helps to solve a problem in mechanics.

c) Solve simple harmonic oscillator using the method of action-angle variables.

8. a) A particle is moving on the surface of rigid body that is rotating with constant angular velocity ω. If the force acting on the particle measured from a space coordinate system $F_s = 0$. What is the acceleration of the particle at position r_b, as measured in the body system ?

b) Write down the Euler equations for an object that is symmetric about one axis and describe its motion qualitatively.

c) The moment of inertia tensor for a rigid body in a certain coordinate system is given by the matrix.

$$\begin{pmatrix} 8 & -3 & -3 \\ -3 & 8 & -3 \\ -3 & -3 & 8 \end{pmatrix}$$

Find the moment of inertia tensor in the principal axes coordinate system.

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I Semester M.Sc. Degree (C.B.S.S. – Reg./Supple./Imp.) Examination, October 2021
(2018 Admission Onwards)
PHYSICS
PHY1C02 – Classical Mechanics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer both questions (either **a** or **b**) :

1. a) Derive Lagrange's equation of motion from Hamiltonian principle.

OR

b) Obtain Lagrange's equation of motion for small oscillations.

2. a) Derive Hamilton Jacobi differential equation. Work out Harmonic oscillator problem as an example of Hamilton Jacobi method.

OR

b) Account for the vibrations of a linear triatomic molecule. **(2×12=24)**

SECTION – B

Answer **any four** questions :

3. a) What are cyclic coordinates ?

b) Show that generalized momentum conjugate to a cyclic coordinate is conserved.

c) Discuss Liouville's theorem.

4. a) Define degrees of freedom.

b) Derive Hamilton's canonical equations of motion.

c) Find the Lagrangean of a spherical pendulum and obtain the equations of motion.

P.T.O.

5. a) Define Poisson's bracket.
   b) Give the fundamental Poisson bracket.
   c) Show that the transformation defined by $q = \sqrt{2P}\,\text{Sin}Q$ and $p = \sqrt{2P}\,\text{Cos}Q$ is canonical.

6. a) Define Lagrangean.
   b) Discuss the superiority of Lagrangean approach over Newtonian approach.
   c) Show that Poisson bracket of two constants of motion is itself a constant of motion.

7. a) What are normal coordinates ?
   b) Explain conditions for stable and unstable equilibrium during small oscillations.
   c) Account for the free vibrations of a linear triatomic molecule.

8. a) State Hamiltons principle for a conservative system.
   b) Explain principle of least action.
   c) Express equations of motion in Poisson bracket form. **(4×9=36)**

K22P 1588

Reg. No. : ....

Name : ....

I Semester M.Sc. Degree (CBSS-Reg./Sup./Imp.) Examination, October 2022
(2019 Admission Onwards)
PHYSICS
PHY1C01 : Mathematical Physics – I

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** questions. (either **a** or **b**), **each** question carries **12** marks. **(2×12=24)**

1. a) Express the unit vectors in spherical polar coordinate system in terms of the unit vectors in Cartesian coordinates.

OR

b) Diagonalize the matrix $A = \begin{pmatrix} 2 & 1 & 1 \\ 1 & 0 & -1 \\ 1 & -1 & 2 \end{pmatrix}$.

2. a) Discuss the Laurent series. Find the Laurent series of the function $f(z) = \frac{1}{1-z^2}$ with centre at z = 1.

OR

b) Deduce the relation $\beta(m, n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$ and hence show that $\Gamma(m)\Gamma(1-m) = \frac{\pi}{\sin m\pi}$. Given that $\int_0^\infty \frac{y^{m-1}}{(1+y)} dy = \frac{\pi}{\sin m\pi}$.

SECTION – B

Answer **any four** questions, Part **a** carries **1** mark, Part **b** carries **3** marks and Part **c** carries **5** marks. **(4×9=36)**

3. a) If R is an orthogonal matrix, show that detR = ±1.

b) Show that the product of two orthogonal matrices is orthogonal.

c) Find the most general 2×2 orthogonal matrix.

4. a) Show that $\nabla \times \vec{r} = 0$.
   b) Resolve the cylindrical unit vectors into their Cartesian components.
   c) Obtain the Laplacian operator in cylindrical coordinates.

5. a) Comment on the eigenvalues of an anti Hermitian matrix.
   b) Show that the eigenvectors of a unitary matrix is unimodular.
   c) Consider the matrices $A = \begin{pmatrix} 2 & 1 & 1 \\ 1 & 0 & -1 \\ 1 & -1 & 2 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 1 \end{pmatrix}$. Verify whether they can be simultaneously diagonalized, and find the common eigenvectors of the two matrices.

6. a) Evaluate $\delta_{ik}\delta_{kl}$.
   b) Evaluate all the components of Levi civita tensor $\in_{ijk}$ in three dimensions, if $\in_{123} = 1$.
   c) Show that for Levi civita tensor, $\in_{ijk} \in_{pqk} = \delta_{ip}\delta_{jq} - \delta_{iq}\delta_{jp}$.

7. a) Write down the generating function for the Legendre polynomials.
   b) Obtain $P_1(x)$ and $P_2(x)$ from the generating function.
   c) Show that $P'_{n+1}(x) - P'_{n-1}(x) = (2n + 1)P_n(x)$.

8. a) Develop the Taylor expansion for ln (1 + z).
   b) Find the analytic function $w(z) = u(x, y) + iv(x, y)$ if $u(x, y) = x^3 - 3xy^2$.
   c) Find the residue of $f(z) = \frac{e^z}{z^2 + a^2}$ at its singularities.