PH 571.1

Reg. No. | | | | | | |

St Aloysius College (Autonomous)
Mangaluru

Semester I – P.G. Examination – M. Sc. Physics
November - 2019

MATHEMATICAL PHYSICS - I

Time: 3 Hours Max. Marks: 70

PART - A

Answer all questions choosing one from each unit. (15x4=60)

UNIT - I

1.a) Derive the expression for the volume element in polar coordinates starting from the idea of general curvilinear coordinates. (9)

b) Evaluate $\int_s x^2dydz + y^2dzdx + 2z(xy-x-y)dxdy$ where S is the surface of the cube, $0 \le x \le 1,\ 0 \le y \le 1, 0 \le z \le 1$. (6)

OR

2.a) Obtain the expression for curl in general curvilinear coordinates. (9)

b) If $\phi = 2xy^2z + x^2y$ evaluate $\int \phi . d\vec{r}$ along the path

$(0, 0, 0) \rightarrow (1, 1, 0) \rightarrow (1, 1, 0) \rightarrow (1, 1, 1)$. (6)

UNIT - II

3.a) Show that the following matrix is a tensor

$$\begin{bmatrix} y^2 & -xy \\ -xy & x^2 \end{bmatrix}$$ (9)

b) Show how a real symmetric matrix can be diagonalised. (6)

OR

4.a) Show that the Eigen values of a Hermitian matrix are real and eigen vectors corresponding to distinct eigen values are orthogonal to each other. (8)

b) What are inner products of tensors? Explain with example. (7)

UNIT - III

5.a) Solve two dimensional wave equation. (8)

b) Solve 3-dimensional Laplace's equation. (7)

OR

6.a) Solve one dimensional wave equation. (8)

b) Final solution of $\frac{\partial u}{\partial t} = u\frac{\partial u}{\partial x}$. (7)

UNIT - IV

7.a) Starting from the generating function define series form of Bessel's functions of first kind and obtain the relation between J_{n-1}, J_n an J_{n+1} (15)

OR

8.a) Solve the Legendre equation, $(1-x^2)y''-2xy'+n(n-1)y=0$ by power series method and arrive at the Legendre polynomials (8)

Contd...2

b) Solve the following differential equation by the power series method

$x(x+1)\,y''+(3x+1)y'+y=0$ (7)

PART – B

Answer any TWO questions (5x2=10)

9.a) Show that $\beta(x,y)=\dfrac{\Gamma(x)\Gamma(y)}{\Gamma(x+y)}$

b) Prove that $\oint_c \phi\, d\vec{r} = \int_s d\vec{s}\times\vec{\nabla}\phi$

c) Prove that $2xH_n(x)=2nH_{n-1}(x)+H_{n+1}(x)$.

d) If A_{ij} and B_{ij} are two tensors. Prove that $A^{ij}\,B_{ij}=A_{ij}\,B^{ij}$.

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St Aloysius College (Autonomous)

Mangaluru

Semester I – P.G. Examination – M.Sc. Physics

November - 2019

CLASSICAL MECHANICS

Time: 3 hrs. **Max Marks: 70**

PART – A

Answer all questions choosing one from each unit. **(15x4=60)**

UNIT- I

1.a) Derive Lagrange's equations of motion from D'Alembert's principle. **(10)**

b) Explain the connection between symmetries and conserved quantities. **(5)**

OR

2.a) Discuss the conservation of energy for a system of particles. **(10)**

b) Find Lagrange's equation of motion for an electrical circuit comprising an inductance L and capacitance C. **(5)**

UNIT- II

3.a) What is variational principle? Obtain Hamilton's equations from variational principle. **(10)**

b) Obtain the Hamiltonian and Hamilton's equations for a Projectile. **(5)**

OR

4.a) Define Canonical transformations and obtain the transformation equations corresponding to all possible generating functions. **(10)**

b) Define Poisson brackets and discuss their properties. **(5)**

UNIT- III

5.a) Discuss a two body problem reduced to one body problem. **(10)**

b) Show that the motion of a particle under central force takes place in a plane. **(5)**

OR

6.a) Discuss the scattering of α-particles under a central force field and hence obtain the expression for Rutherford scattering cross section. **(10)**

b) Calculate reduced mass of hydrogen atom and positronium. **(5)**

UNIT- IV

7.a) Obtain Euler's equation of motion for a rotating rigid body with a fixed point. **(10)**

b) Define inertia tensor. Give its physical significance. **(5)**

Contd...2

OR

8.a) Discuss the torque free motion of a rigid body. **(10)**

b) Obtain the angular momentum of a rigid body. **(5)**

PART – B

Answer any TWO questions: **(5x2=10)**

9.a) Find the Lagrangian for a coplanar double pendulum.

b) Find the Hamiltonian for a single particle in Cartesian, cylindrical and spherical coordinate.

c) Determine the Poisson brackets formed from the Cartesian components of the momentum $\vec{p}$ and the angular momentum $\vec{L} = \vec{r} \times \vec{p}$ of a particle.

d) Three particles of equal mass m move without friction in one dimension. Two of the particles one each connected to the third by a massless spring of spring constant k. Find the normal frequencies.

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St Aloysius College (Autonomous)

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Semester I – P.G. Examination – M.Sc. Physics

November - 2019

CLASSICAL ELECTRODYNAMICS

Time: 3 Hours

Max. Marks: 70

PART - A

Answer all questions choosing one from each unit. (15x4=60)

UNIT -I

1. a) State and prove the first uniqueness theorem. (7)

   b) What is "method of images" technique? Use this to illustrate the solution to any problem in electrostatics. (8)

OR

2. a) Derive an expression for the vector potential of a localized current distribution using multipole expansion. (8)

   b) Define Ampere's law. Find the magnetic field at a distance 's' from a long straight wire, carrying a steady current I. (7)

UNIT -II

3. a) State and prove Poynting's theorem. (8)

   b) Discuss the gauge transformation and the role of Coulomb and Lorentz gauge. (7)

OR

4. a) Obtain Maxwell's equations in terms of scalar and Vector potentials of the electromagnetic field. (9)

   b) What are Lièнard-Wiechert potentials? Explain. (6)

UNIT -III

5. a) Discuss the propagation of electromagnetic waves in a linear medium. (8)

   b) Obtain the Maxwell's equation within a medium. (7)

OR

6. a) Derive expressions for cut off wavelength and cut off frequency for TM_{mn} waves propagating through rectangular waveguides. (8)

   b) Work out the plane wave solutions for an electromagnetic wave. Comment on its polarization. (7)

UNIT -IV

7. a) Express the electromagnetic fields in tensor notation. (7)

   b) Derive Maxwell's equations in Four Vector notations. (8)

OR

8. a) Derive the relativistic length contraction and time dilation using the Lorentz transformation. (8)

Contd...2

b) Write a note on Einstein's postulates for special theory of relativity. (7)

PART - B

Answer any TWO questions: (5x2=10)

9. a) Prove that the value of V at a point 'r' is the average value of V over a spherical surface of Radius centered at r.

b) What are retarded potentials? Explain.

c) Discuss the various properties and characteristics of waveguides.

d) What are Relativistic potentials? Explain.

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PH 574.1

Reg. No. :

St Aloysius College (Autonomous)
Mangaluru
Semester I – P.G. Examination – M.Sc. Physics
November- 2019
ELECTRONICS

Time: 3 Hours Max. Marks: 70

PART - A

Answer all questions choosing one from each unit. (15x4=60)

UNIT - I

1.a) With the help of a circuit, explain the working of inverting Schmitt trigger. Write down the input and output wave form and hysteresis of Schmitt trigger. (9)

b) What is an operational amplifier? Explain. What are its ideal and practical characteristics? (6)

OR

2.a) What is a comparator? Explain with a neat circuit diagram. (8)

b) What are active and passive filters? Discuss the action of first order high pass butter worth filter. (7)

UNIT - II

3.a) Explain the working principle of IC555 timer based monostable multivibrator. Discuss how monstable multivibrator is used as frequency divider and pulse stretcher. (10)

b) With the help of a block diagram, explain the operating principle of phase-locked loop. (5)

OR

4.a) Explain with circuit diagrams, the working of opamp based sawtooth wave generator and square wave generator. (8)

b) Explain the working of voltage controlled oscillator using IC566 with a block diagram. (7)

UNIT - III

5.a) What are transducers? Explain how thermistor can be used in temperature controlling circuits? (8)

b) Discuss lock in detector with the help of block diagram. (7)

OR

6.a) Explain (i) Construction and working of solar cell.
(ii) IR emitters. (8)

b) What are power amplifiers? Draw the circuit diagram of class-B amplifier and explain its working. Also discuss the efficiency of class – A amplifier. (7)

UNIT - IV

7.a) Draw the circuit diagram of digital to analog converter using R and 2R resistors and explain its working. (8)

Contd...2

b) What are flip-flops? Explain the construction and operation of JK flip-flop circuit with its truth table. (7)

OR

8.a) What is Karnaugh map? Explain. Describe the K-map for the variables (A,B,C) and obtain simplified SOP. (8)

b) Explain with circuit diagram, the working of analog to digital conversion using flash technique. (7)

PART – B

Answer any TWO questions. (5x2=10)

9.a) Design a practical differentiator that will differentiate an input signal with f_{max}=100Hz.

b) With a circuit diagram, explain the working of relaxation oscillator using UJT.

c) Explain (i) Heat sink (ii) Power derating curve for a power transistor.

d) Explain the working of master-slave flipflop.

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St Aloysius College (Autonomous)

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Semester I – P.G. Examination – M.Sc. Physics

November - 2018

MATHEMATICAL PHYSICS - I

Time: 3 hrs. Max Marks: 70

PART – A

Answer all questions choosing ONE from each unit. (15x4=60)

UNIT- I

1.a) Explain concept of Volume integral. If $\vec{F} = (5xy - x^2)i + (2y - 4x)j$, find the integral of $\vec{F}.\vec{dr}$ along the curve by $y = x^3$ in x-y plane from point (1,1) to (2,8). (8)

b) State Stokes theorem, verify Stokes theorem for $\vec{A} = (2x - y)i - yz^2j$, for the square surface of unit side. (7)

OR

2.a) Express $\vec{\nabla}\emptyset$ and $\vec{\nabla}.\vec{E}$ in cylindrical coordinate system. (8)

b) Obtain and expression for the curl of vector function in curvilinear coordinates. Hence identify it explicitly in spherical coordinate system. (7)

UNIT- II

3.a) Find the eigen value and eigen vector of the matrix $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$. (5)

b) Explain with example the transformation properties of contravarient and covariant tensors. (5)

c) Explain quotient law as a test to check whether a given Physical quantity is a tensor or not. (5)

OR

4.a) Define eigen values and show that the eigen values of Hermitian matrix are real and vectors corresponding to distinct eigen values are perpendicular to each other. (8)

b) Write a note on algebra of tensors. (7)

UNIT- III

5.a) Discuss the classification of second order partial differential equations. (6)

b) Solve the boundary value equation $\frac{\partial u(x,t)}{\partial t} = h^2 \frac{\partial^2 u(x,t)}{\partial t}$, where h is constant and $u(x,0) = F(x), -\infty < x < \infty$. (9)

Contd...2

OR

6.a) Solve the 3-dimensional Laplace equation using cylindrical polar coordinates. **(11)**

b) Solve the equation $\frac{\partial^2 u(x)}{\partial x^2} = 1$ under the condition $\frac{\partial u(x)}{\partial x} = 3$ when $x = 0$ and $u(1) = 1$. **(4)**

UNIT- IV

7.a) Show that the Gamma function satisfies $\Gamma\left(\frac{1}{2}\right) = \sqrt{\Pi}$. **(4)**

b) Solve Bessel differential equation and obtain a general series solution. **(11)**

OR

8.a) Solve Hermite differential equation to get a series solution at any regular point. **(11)**

b) Prove the recurrence relation $nP_n(x) = (2n-1)xP_{n-1}(x) - (n-1)P_{n-2}(x)$ for Legendre polynomials. **(4)**

PART – B

Answer any TWO questions: **(5x2=10)**

9.a) Find the gradient of a scalar function $\Phi(r, \theta, \emptyset) = r^3 \sin^2\theta \cos\theta \cos\emptyset \sin\emptyset$ in terms of spherical polar coordinates.

b) Show that $\sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$ is both Hermitian and Unitary.

c) Show that the gradient of a scalar field is covariant vector.

d) Show that the Hermite polynomials satisfy the relation

$$\int_{-\infty}^{\infty} e^{-x^2} H_m(x) H_n(x) dx = 0 \text{ if } m \neq n.$$

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St Aloysius College (Autonomous)
Mangaluru
Semester I - P.G. Examination - M.Sc. Physics
November 2018

CLASSICAL MECHANICS

Time: 3 Hours Max.Marks:70

PART A

Answer all questions choosing one from each unit (15×4=60)

UNIT - I

1. a) How many types of constraints a dynamical system can have? Discuss them. (8)

b) A bead slides on a wire in the shape of a cycloid described by equations (7)

$$x = a(\theta - sin\theta)$$

$$y = a(1 + cos\theta)$$

Where $0 \leq \theta \leq 2\pi$. Find the Lagrangian function and the equations of motion (neglect friction between the bead and the wire)

OR

2. a) Derive the Euler-Lagrange equations. (10)

b) Discuss the phase space of a simple harmonic oscillator. (5)

UNIT - II

3 a) Set the Hamiltonian and Hamilton's equations of motion for a charged particle moving in an electromagnetic field. (8)

b) Establish Hamilton's equations from the variational principle. (7)

OR

4.a) Write and prove the Jacobi identity. (5)

b) Solve the one dimensional Harmonic oscillator problem by Hamilton Jacobi method. (10)

UNIT - III

5.a) How does a two-body problem reduce to a one body problem? Compare the corresponding factors such as mass and distance in the two cases. (7)

b) Discuss the motion of a particle in an arbitrary central potential field. (5)

c) What is a central force field? What is the meaning of bounded and unbounded motion? (3)

OR

6.a) Derive the differential equation for the orbit of a particle moving under a central force. (8)

b) Discuss the stability of the orbit under central force and conditions for the closed orbit. (7)

Contd...2

UNIT - IV

7.a) Discuss the force free motion of a symmetric top. (8)

b) Consider a dumb-bell formed by two point masses m at the ends of a massless rod of length 2a. It is constrained to rotate with constant angular velocity ω about an axis that makes and angle α with the rod. Calculate the angular momentum and the tarque that is applied to the system. (7)

OR

8.a) Explain (i) normal modes of vibration (ii) normal coordinates and (iii) normal frequencies of a system. (5)

b) Establish the Lagrangian and deduce the Lagrange's equations of motion for small oscillations of a system in the neighbourhood of stable equilibrium. (10)

PART - B

Answer any two questions (5x2=10)

9. a) A body of mass m splits into two masses m_1 and m_2 by an explosion. After the split, the bodies move with a total kinetic energy T. Show that their relative speed is (5)

$$\sqrt{\frac{2Tm}{m_1 m_2}}.$$

b) Using Poisson bracket, show that the following transformation is canonical. (5)

$$Q = (e^{-2q} - p^2)^{1/2}$$

$$P = \cos^{-1}(pe^q)$$

c) A particle moves in a circular orbit and the center of attraction is on the circumstance of the circle. Find the law of force. (5)

d) Two equal masses move without friction on a plane. They are connected to each other and to the wall by two springs. The two springs have equal spring constants and the motion is restricted to a straight line (one-dimensional motion). Find (5)

(i) The equation of motion

(ii) The normal frequencies

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St Aloysius College (Autonomous)

Mangaluru

Semester I – P.G. Examination – M.Sc. Physics

November - 2018

CLASSICAL ELECTRODYNAMICS

Time: 3 Hours

Max. Marks: 70

PART - A

Answer all questions choosing one from each unit. (15x4=60)

UNIT -I

1. a) State and obtain Gauss Law in differential form. (5)

   b) Give the multipole expansion of the electrostatic potential due to a charge distribution and hence obtain the dipole moment of this distribution. (10)

OR

2. a) State and prove first uniqueness theorem. (7)

   b) Define Vector potential. Find the vector potential of an infinite solenoid with 'n' turns per unit length, of radius R and current I. (8)

UNIT -II

3. a) Express Maxwell's equations in forms of scalar and vector potentials. (8)

   b) What are gauge transformations? Explain Lorentz and Coulomb gauges. (7)

OR

4. a) Derive an expression for the motion of charged particle in uniform magnetic field. (6)

   b) State and prove Poyntings theorem and arrive at the continuity equation for conservation of energy. (9)

UNIT -III

5. a) Derive an expression for reflection and transmission coefficient at normal incidence. (7)

   b) Discuss the propagation of plane electromagnetic waves in conducting media. (8)

OR

6. a) Describe TE and TM modes of electromagnetic wave propagation in a Rectangular waveguide. (10)

   b) Write a note on cavity resonator. (5)

UNIT -IV

7. a) Express the electromagnetic field in tensor notation. (9)

   b) Explain 'Length Contraction' and 'time dilation'. (6)

OR

8. a) Express Maxwell's equations in four vector notations. (10)

Contd...2

b) What are the general transformation rules for electromagnetic fields? (5)

PART - B

Answer any TWO questions: (5x2=10)

9. a) An infinite plane carries a uniform surface charge σ. Find its electric field.

b) What are retarded potentials?

c) A rectangular waveguide has the dimensions of 6 cmx4 cm. Calculate the cut off frequency for a TE_{01} wave propagating through it.

d) Write a note on Four-vector notation.

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St Aloysius College (Autonomous)

Mangaluru

Semester I – P.G. Examination – M.Sc. Physics

November - 2018

ELECTRONICS

me: 3 Hours

Max. Marks: 70

PART - A

Answer all questions choosing one from each unit. (15x4=60)

UNIT -I

1. a) Explain the concept of feedback. What are the different types of feedback? Describe the voltage-series feedback with its circuit and obtain its closed loop gain. (9)

b) What is an operational amplifier? What are its ideal and practical characteristics? (6)

OR

2. a) Explain with circuit diagrams how opamp can be used as a comparator and Schmitt trigger. Write down the input and output waveforms. (8)

b) Explain the inverting and non inverting amplifier with the circuit diagrams. Obtain the expression for output of summing amplifier in inverting configuration. (7)

UNIT -II

3. a) Write the internal circuit diagram of IC555 timer and explain with a circuit diagram, the working of a monostable multivibrator. (9)

b) With a circuit diagram, explain the working of opamp based sine wave generator. (6)

OR

4. a) Explain the working of voltage controlled oscillator using IC566 with a block diagram. (8)

b) With a circuit diagrams, explain the working of relaxation oscillator using UJT. Also obtain an expression for frequency of oscillation. (7)

UNIT -III

5. a) What are power amplifiers? Explain the operation of class-B amplifier and calculate its maximum efficiency. (8)

b) What are transducers? Explain briefly various types of transducers. (7)

OR

6. a) Explain the construction and working of a solar cell. Also discuss the efficiency of a solar cell. (8)

b) Describe the operation of the SCR using the two transistor equivalent circuit. Also discuss the variable resistance phase control using SCR. (7)

Contd...2

UNIT -IV

7. a) Explain the working of a four bit digital to analog converter with R-2R network. (8)

   b) With necessary functional diagram, explain the working of a 4 bit synchronous decade counter with timing diagram. (7)

OR

8. a) Explain how Karnaugh maps are employed in the simplification of a logic function. Simplify the function $Y = A\bar{B}C + ABC\bar{D} + \bar{A}BC$ using Karnaugh map. (9)

   b) Explain the working of master slave flip-flop. (6)

PART - B

Answer any TWO questions: (5x2=10)

9. a) Design a practical integrator circuit to properly process input sinusoidal waveforms up to 1 kHz. The input amplitude is 10 mV.

   b) Explain the principle of frequency multiplier using block diagram.

   c) With a circuit diagram explain the working of a clocked RS FlipFlop.

   d) Explain boxcar integrator with suitable block diagram.

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St Aloysius College (Autonomous)

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Semester I – P.G. Examination – M.Sc. Physics

November - 2017

MATHEMATICAL PHYSICS - I

Time: 3 Hours Max. Marks: 70

PART - A

Answer all questions choosing one from each unit. (15x4=60)

UNIT -I

1. a) Evaluate $\int_c \vec{F} \cdot \vec{dr}$ where $\vec{F} = x^2\hat{\imath} + xy\hat{\jmath}$ and c is the boundary of the square in the plane $z = 0$ and bounded by lines $x = 0$, $y = 0$, $x = a$ & $y = a$. (5)

b) Find gradient of ϕ and divergence of $\vec{A}$ in orthogonal curvilinear coordinates. (10)

OR

2. a) State Gauss's divergence theorem and verify the same for $\vec{A} = x^2\hat{\imath} + y^2\hat{\jmath} + z^2\hat{k}$ over the unit cube $0 \le x, y, z \le 1$ (10)

b) Find the square of the element of arc length in spherical polar coordinates. (5)

UNIT -II

3. a) State Cayley-Hamilton theorem. Verify the theorem for the following matrix. (7)

$$A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$$

b) Write a note on algebra of tensors. (8)

OR

4. a) Explain orthogonal matrices, hermitian and unitary matrices with examples. (6)

b) Explain with examples the transformation properties of contravarient and covariant tensors. (5)

c) Explain symmetric and antisymmetric tensors. (4)

UNIT -III

5. a) Mention the classification of linear second order partial differential equations into various types, giving an example for each. (6)

b) By the use of separation of variables method solve the one dimensional heat equation $k\frac{\partial^2 T}{\partial x^2} = \frac{\partial T}{\partial t}$ satisfying the boundary condition $T(0,t) = T(L,t) = 0$, L being the length of the rod. (9)

OR

6. a) Obtain the solution of Laplace's equation in general cylindrical coordinates. (8)

Contd...2

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b) Find the solution of the differential equation $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 3y = x$ satisfying the initial condition $y(0) = {}^4/_9$ and $y'(0) = {}^7/_3$ (7)

UNIT -IV

7. a) Solve Laguerre's differential equation: $x\frac{d^2y}{dx^2} + (1-x)\frac{dy}{dx} + ny = 0.$ (8)

b) Show that Legendre polynomials satisfy recurrence relation

$(2n+1)x\,P_n(x) = (n+1)\,P_{n+1}(x) + nP_{n-1}(x)$ (7)

OR

8. a) Obtain a series solution for Legendre differential equation. (10)

b) Obtain the recurrence relation for Bessel's function

$x[J_{n-1}(x) + J_{n+1}(x)] = 2n\,J_n(x)$ from the generating function.

$G(x,t) = \exp\left[\frac{x}{2}\left(t - \frac{1}{t}\right)\right] = \sum_{n=-\infty}^{+\infty} t^n\,J_n(x)$ (5)

PART - B

Answer any TWO questions: (5x2=10)

9. a) Find the constants a, b, c so that

$\vec{F} = (x + 2y + az)\hat{\imath} + (bx - 3y - z)\hat{\jmath} + (4x + cy + 2z)\hat{k}$ is irrotational.

b) Prove the relation $\frac{\Gamma(m)\,\Gamma(n)}{\Gamma(m+n)} = \beta(m,n)$ where Γ, β are respectively the gamma and beta functions.

c) Obtain matric tensor for a two dimensional plane in terms of Cartesian co ordinates.

d) Explain the process of diagonalisation of a matrix.

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St Aloysius College (Autonomous)

Mangaluru

Semester I – P.G. Examination – M.Sc. Physics

November - 2017

CLASSICAL MECHANICS

Time: 3 hrs. Max Marks: 70

PART – A

Answer all questions choosing one from each unit. (15x4=60)

UNIT- I

1.a) Discuss the principle of least action. (10)

b) Prove that the shortest distance between two points in space is a straight line. (5)

OR

2.a) Derive the Lagrangian for a charged particle in an electromagnetic field. (10)

b) Write down the generalized coordinates for a simple pendulum and explain why Cartesian coordinates are not suitable here. (5)

UNIT- II

3.a) Define canonical transformation and obtain the transformation equation corresponding to four generating functions. (10)

b) Outline Hamilton Jacobi theory. (5)

OR

4.a) Derive equation of motion in terms of Poisson brackets. Prove Jacobi identity. (10)

b) What are Legendre transformation and canonical variables? (5)

UNIT- III

5.a) Derive the differential equation for the orbit of a particle moving under central force. (10)

b) State and prove Virial theorem. (5)

OR

6.a) Give the details of classification of orbits in central force problem. (10)

b) Show that Hooke's law and inverse square law are the only central forces that result in closed orbits for bound particles. (5)

UNIT- IV

7.a) Find the relation between angular momentum, the inertia tensor and the angular velocity. (10)

b) Derive an expression for rotational kinetic energy of a rigid body. (5)

Contd...2

OR

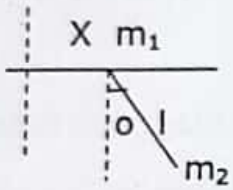
8.a) What do you mean by stable and unstable equilibrium? Establish the Lagrangian and deduce the Lagrange's equation of motion for small oscillations of a system about stable equilibrium. **(10)**

b) Write a short note on normal modes and eigen frequencies for small oscillations. **(5)**

PART – B

Answer any TWO questions: **(5x2=10)**

9.a) A simple pendulum of mass m_2, with a mass m_1 at the point of support which can move on a horizontal line lying in the plane in which m_2 moves.



Find the Langrangian.

b) Determine the Poisson Brackets formed from the components of angular momentum $\vec{L}$.

c) The Hamiltonian for a system has the form

$H = \frac{1}{2}\left(\frac{1}{q^2} + p^2q^4\right)$ Find the equation of motion for q.

d) Two identical harmonic oscillators are coupled together. Setup the equations of motion and obtain the general solutions. Describe the two normal modes.

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St Aloysius College (Autonomous)

Mangaluru

Semester I – P.G. Examination – M.Sc. Physics

November - 2017

CLASSICAL ELECTRODYNAMICS

Time: 3 Hours Max. Marks: 70

PART - A

Answer all questions choosing one from each unit. (15x4=60)

UNIT -I

1. a) State and prove the first uniqueness theorem. (7)

   b) Show that the potential due to a localized charge distribution can be written as a series of multipole. (8)

OR

2. a) Define Gauss's Law in Electrostatics. Using this find the field outside a uniformly charged solid sphere of radius R and total charge q. (6)

   b) Deduce the potential and field of an electrostatic dipole. Draw the field lines of a 'pure" and "physical" dipole. (9)

UNIT -II

3. a) State and prove Poynting's theorem. (8)

   b) What are Gauge transformations? Explain Lorentz and Coulomb gauges. (7)

OR

4. a) Derive the Larmor's formula for the total power radiated by an accelerated charged particle. (9)

   b) Mention basic differences between electric dipole radiation and magnetic dipole radiation. (6)

UNIT -III

5. a) Obtain the plane wave solutions to the Maxwell's equations. (9)

   b) Obtain the expression for Reflection and Transmission Coefficients at normal incidence. (6)

OR

6. a) What do you understand by dominant mode? Show that TM_{11} mode is the dominant TM mode in rectangular waveguides. (8)

   b) Obtain the Fresnel's equation for electromagnetic waves incident obliquely at the boundary of a medium. (7)

UNIT -IV

7. a) Express the electromagnetic fields in tensor notation. (8)

Contd...2

b) What are Relativistic potentials? Explain. (7)

OR

8. a) Explain transforming measurements from one intertial system to another using Lorentz transformation. (7)

b) Define Lorentz transformation matrix. Explain Einstein Summation Convention. (8)

PART - B

Answer any TWO questions: **(5x2=10)**

9. a) Starting with Coulomb's law, derive Poisson's and Laplace's equations for electrostatic potential.

b) Write a note on Lienard-Wiechert potentials.

c) Discuss the various properties and characteristics of waveguides.

d) What are the general transformation rules for electromagnetic fields?

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PH 574.1

Reg. No. :

St Aloysius College (Autonomous)
Mangaluru
Semester I – P.G. Examination – M.Sc. Physics
November- 2017
ELECTRONICS

Time: 3 Hours

Max. Marks: 70

PART - A

Answer all questions choosing one from each unit. (15x4=60)

UNIT - I

1.a) With the help of schematic diagram, explain the operational amplifier voltage and current feedback concepts. (6)

b) Discuss the opamp based differentiator circuit. Sketch the output waveform for this circuit with square wave input. (6)

c) Explain the effect of feedback on frequency response in an opamp circuit. (3)

OR

2.a) What are active filters? Discuss the action of first order low pass butter worth filter. (6)

b) Explain summing amplifier using opamp in inverting configuration. (4)

c) Design a differentiator to differentiate an input signal that varies in frequency from 10 Hz to about 1 kHz. If a sin wave of 1 volt peak at 1 kHz is applied to the differentiator, draw its output waveform. (5)

UNIT – II

3.a) Explain with diagram, the working of an astable multivibrator using the IC555 timer. Obtain an expression for the frequency of the output waveform. (8)

b) With a circuit diagram, explain the working of relaxation oscillator using UJT. Also obtain an expression for frequency of oscillation. (7)

OR

4.a) Explain with circuit diagrams, the working of opamp based triangular wave generator and square wave generator. (8)

b) Explain the working of voltage controlled oscillator using IC566 with a block diagram. (7)

UNIT - III

5.a) What are power amplifiers? Draw the circuit diagram of class – A amplifier and explain its working. Also discuss the efficiency of class-A amplifier. (8)

b) Describe the operation of the SCR using the two transistor equivalent circuit. Also discuss the variable resistance phase control using SCR. (7)

OR

Contd...2

6.a) What are transducers? Explain how thermistor can be used in temperature controlling circuits? (8)

b) Explain the construction and working of solar cell. Also discuss the efficiency of a solar cell. (7)

UNIT - IV

7.a) What are multiplexers and demultiplexers? Describe the operation of 1-8 line demultiplexer using AND gates and verify its truth table. (8)

b) With the help of neat circuit diagram and timing diagram explain the working of a 4 bit decade synchronous counter. (7)

OR

8.a) Write a short note on i) RAM
ii) Analog to digital converters
iii) Flash memory (9)

b) Using karnaugh map technique, minimize the following Boolean function:
$F(A,B,C,D)=\Sigma m(0,1,2,5,8,9,10)$. Implement the equation using basic gates. (6)

PART – B

Answer any <u>TWO</u> questions. **(5x2=10)**

9.a) Design a practical integrator circuit to properly process input sinusoidal wave form up to 1kHz.

b) Explain the basic operation of Pulse locked loop (PLL) with the help of block diagram.

c) Write a short note on IR emitters.

d) Briefly explain i) EPROM ii) CCD memory

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