

1M1N22306

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Reg. No:.....

Name:

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2022

MPH1C01 – Classical Mechanics

(2022 Admission onwards)

Time : 3 hours

Max. Weightage : 30

Section A-Short Answer Questions
(Answer all questions, Each carry weightage 1)

1. What do you understand by generalized momentum?
2. Write equation of motion in Poisson bracket form.
3. What do you mean by normal modes and normal frequencies?
4. Obtain Lagrangian for a charged particle in electromagnetic field.
5. What is the physical significance of Hamilton characteristic function.
6. What is period doubling bifurcation in chaotic system?
7. What are Euler angles?
8. Give an example for velocity dependant potential.

(8 x 1 =8Weightage)

Section B-Essay Questions
(Answer any two questions, Each carry weightage 5)

9. Discuss the motion of a particle moving in a plane under the action of central force using Hamilton – Jacobi equation.
10. Discuss small oscillations of CO₂ like molecule.
11. State Hamilton's principle and deduce Lagrange's equation from Hamilton's principle and hence find the equation of motion of one-dimensional Harmonic Oscillator.
12. Obtain an expression (a) moment of inertia tensor (b) rotational kinetic energy of a rigid body.

(2 x 5 =10Weightage)

Section C-Problem Questions
(Answer any four questions, Each carry weightage 3)

13. Obtain the equation of motion of a projectile in space by using Hamilton's method.
14. Two rigid bodies of masses 'm' and '2m' are connected by a light spring of spring constant K. Write down the Lagrangian of the system and obtain Lagrange's equation of motion.
15. Obtain the Hamiltonian for particle of mass 'm' moving in a force field with its potential given by $V = \frac{-K \cos \theta}{r^2}$
16. For what values of α and β , $Q = q^\alpha \cos \beta p$, $P = q^\alpha \sin \beta p$ equations represent a canonical transformation? Find generating function in this case.
17. Derive Euler's equation of motion.
18. Derive the expression for Coriolis force. Discuss its importance in earth related phenomenon.
19. Explain Legendre transformations.

(4 x 3 = 12 Weightage)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2022

MPH1C02 – Mathematical Physics – I

(2022 Admission onwards)

Time : 3 hours

Max. Weightage : 30

Section A**(8 Short questions, each answerable within 7.5 minutes)****(Answer all questions, each carry weightage 1)**

1. Explain contraction of a tensor using an example.
2. Distinguish between elliptic and parabolic partial differential equations.
3. Describe the Dirac delta function.
4. What are self-adjoint differential equations?
5. Explain spherical harmonics with special emphasis on its significance.
6. State and prove convolution theorem for Fourier transforms.
7. Define orthogonal matrix. Explain orthogonal transformation.
8. What is binomial distribution? Give its properties.

(8 × 1 = 8 weightage)**Section B****(4 Essay questions, each answerable within 30 minutes)****(Answer ANY TWO questions, each carry weightage 5)**

9. Explain Frobenius method and find the power series solution of the differential equation

$$\frac{d^2y}{dx^2} + x \frac{dy}{dx} + (x^2 + 2)y = 0, \text{ about } x_0 = 0.$$

10. Explain the diagonalization of the matrix $\begin{bmatrix} 3 & 2 & -1 \\ 2 & 2 & 3 \\ -1 & 3 & 1 \end{bmatrix}$.

11. Using orthogonal curvilinear coordinates, find the expression for the divergence of a vector field. Hence express the divergence in terms of spherical polar coordinates.
12. Briefly explain Bessel functions of first and second kind. Find the generating function and recurrence formula for the Bessel functions.

(2 × 5 = 10 weightage)

Section C

(7 Problem questions, each answerable within 15 minutes)

(Answer ANY FOUR questions, each carry weightage 3)

13. Define Hermitian matrix. Show that the eigenvalues are real and the eigenvectors are orthogonal to each other for a Hermitian matrix.
14. Show that $P_n(-x) = (-1)^n P_n(x)$ for the Legendre's polynomial.
15. Show that $2J_n'(x) = J_{(n-1)}(x) - J_{(n+1)}(x)$ for Bessel functions.
16. Find the components of unit vectors of spherical polar coordinates in Cartesian coordinates.
17. Evaluate the surface integral of the function $\vec{V} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$.
18. Find the Fourier series for the periodic function

$$f(x) = -\pi \text{ if } -\pi < x < 0, \\ = x \text{ if } 0 < x < \pi.$$

Hence prove that $\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + \dots$

19. Show that $\beta(m, n) = \frac{\Gamma m \Gamma n}{\Gamma(m+n)}$.

(4 × 3 = 12weightage)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2022

MPH1C03 – Electrodynamics & Plasma Physics

(2022 Admission onwards)

Time : 3 hours

Max. Weightage : 30

Section A (Answer all questions, each question carries 1 weightage)

1. What are electric and magnetic potentials?.
2. What do you mean by a plane wave. Write the equation for it.
3. What is meant by a Poynting vector. Explain.
4. What are cavity resonators?
5. What is a wave guide. Give an use of it.
6. What is covariant formalism in electrodynamics?
7. Define plasma and give examples.
8. Explain plasma oscillations.

(8 × 1 = 8 weightage)**Section B (Answer any two. Each carries 5 weightage)**

9. Obtain the Maxwell's equations in integral and differential forms.
10. Explain the behavior of plane waves in a lossy media and hence derive an expression for the depth of penetration.
11. Discuss the motion of TEM wave along a parallel plate transmission line. Obtain expressions for inductance and capacitance per length.
12. Explain electromagnetic field tensor. Show that the four Maxwell's equations can be reduced to two using electromagnetic field tensor.

(2 × 5 = 10 weightage)**Section C****(Answer any four questions. Each carries 3 weightage)**

13. Obtain electromagnetic boundary conditions.
14. Find the Poynting vector on the surface of a long straight conducting wire of radius b and conductivity σ that carries a direct current I . Verify Poynting theorem.
15. A narrow band signal propagates in a lossy dielectric medium which has a loss tangent 0.2 at 550 kHz the carrier frequency of the signal. The dielectric constant is 2.5. Find α and β .

16. Determine the wave impedance and guide wavelength at a frequency equal to twice the cutoff frequency in a wave guide for TM and TE modes.
17. The attenuation on a 50Ω distortionless transmission line is 0.01 dB/m . If the line has a capacitance of 0.02 nF/m , find resistance, inductance and conductance per meter of the line and velocity of propagation.
18. Obtain the four vector form of continuity equation and wave equations for potentials
19. If $B = 0.32 \text{ T}$ and $n = 10^{18} \text{ /cubic meter}$ show that plasma frequency is approximately equal to cyclotron frequency for electrons

(4 × 3 = 12 weightage)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2022

MPH1C04 – Electronics

(2022 Admission onwards)

Time : 3 hours

Max. Weightage : 30

Section A

(Answer All questions, each carry Weightage 1)

1. Write any two properties of an ideal opamp.
2. Define slew rate of an opamp.
3. Draw a neat circuit diagram of a Schmitt trigger using an opamp.
4. What are notch filters?
5. Draw the logic diagram and truth table of a D flip flop.
6. What is a charge coupled device?
7. Define transconductance of an FET.
8. Define fill factor of a solar cell.

(8x1 =8 Weightage)

Section B

(Answer any two questions, each carry weightage 5)

9. Compare Dominant-Pole and Pole-Zero compensation.
10. What are registers? Mention different types of shift registers. With a neat diagram and waveform representation explain the construction and working of a 4 bit serial in- serial out shift register.
11. Explain the construction, working and characteristics of a depletion type MOSFET.
12. Explain the principle of a tunnel diode. Discuss its construction and characteristics.

(2x5 =10 Weightage)

Section C

(Answer any four questions, each carry weightage 3)

13. Sketch the transfer curve of a JFET defined by $I_{DSS} = 12\text{mA}$ and $V_P = -6\text{V}$.
14. If (i) $V_1 = 50\mu\text{V}$ and $V_2 = -50\mu\text{V}$ and (ii) $V_1 = 1,050\mu\text{V}$, $V_2 = 950\mu\text{V}$ and common mode rejection ratio 100, calculate the percentage difference in output voltage obtained for the two sets of input signals.
15. Show that the output of the inverting integrator is the time integral of the input signal
16. The JK flip-flop removes the intermediate or not allowed state of the RS flip-flop. Discuss the operation of the JK flip-flop and construct its truth table.
17. Write a short note on Light emitting diodes.
18. Given $g_{fs} = 3.8\text{mS}$ and $g_{os} = 20\mu\text{S}$, sketch the FET ac equivalent model.
19. Draw the logic symbol, truth table and waveform of Mod-8 binary counter with parallel clock input.

(4x3 =12 Weightage)