1M1N21094 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2021

MPH1C02 - Mathematical Physics – I

(2019 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. Write down the expression for gradient and divergence in spherical polar coordinates.
2. State and explain Fuch's theorem in differential equations.
3. State the convolution theorem for Fourier transforms.
4. Explain the physical significance of the unitary transformation.
5. Show that the contraction operation reduces the rank of a tensor by 2.
6. What is meant by Wronskian?
7. Define Dirac delta function.
8. Define a vector in terms of its transformation under a rotation of coordinates.

(8x1=8weightage)

Section B

(4 Essay questions, each answerable within 30 minutes)

Answer ANY TWO questions, each carry weightage 5)

9. Diagonalize the matrix A by a similarity transformation $\begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$
10. Establish the orthogonality of Legendre polynomials.
11. Derive the expression for curl in general curvilinear coordinates. Deduce the curl in spherical polar coordinates.
12. Obtain the series solution of Bessel differential equation using Frobenius method.

(2x5=10 weightage)

Section C

(7 Problem questions, each answerable within 15 minutes)
Answer ANY FOUR questions, each carry weightage 3)

13. Prove that single contraction of a tensor A_{lm}^{ijk} is a tensor of rank 3.
14. Expand $f_1(x) = x^2 for - \pi \leq x \leq \pi$ in a Fourier series.
15. Prove that $\vec{\nabla} \times (\varphi \vec{\nabla} \varphi) = 0$.
16. Transform the unit vectors i,j, and k into their components in a spherical polar coordinate system.
17. Find the Laplace transform of the function $e^{at} \sin t$.
18. Show that $H_{2n}(0) = (-1)^n \frac{(2n)!}{n!}$, where $H_n(x)$ are the Hermite polynomials.
19. Derive the recurrence relation $\Gamma(z+1) = z\Gamma(z)$.

(4x3=12 weightage)

1M1N21093 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2021

MPH1C01 - Classical Mechanics

(2019 Admission onwards)

Time: 3 hours Max. Weightage : 30

PART A (Short answer questions)

Answer all questions. Each question carries a weight of 1 and answerable within 7.5 minutes

1. Explain the significance of Hamilton's principle of least action.
2. How is generalized potential defined? How is it different from conventional potential?
3. Comment on the statement, 'Hamilton Jacobi equation is the shortest wavelength limit of Schrodinger equation'.
4. Write a short note on the spinning of symmetrical top under the influence of gravity.
5. Justify the statement,'Centrifugal and coriolis forces are fictitious forces'
6. What is meant by chaotic attractors and limit cycles?
7. What are universal constants with reference to bifurcation diagram in logistic mapping?
8. Show that rigid body has six degrees of freedom.

(8x1=8 weightage)

PART B (Essay Question)

Answer any two. Each question carries weight of 5 and is answerable within 30 minutes

9. Derive the Euler's equation of motion for rigid bodies.
10. Discuss the free vibrations of a linear triatomic molecule and obtain the normal modes and normal frequencies.
11. Solve the problem of one dimensional harmonic oscillator using Hamilton – Jacobi equation. Cite the circumstances where Hamilton Jacobi theory is more useful.
12. What is differential scattering cross-section? Discuss the problem of scattering of charged particles by a Coulomb field and obtain Rutherford formulae for the differential scattering cross-section

(2x5=10 weightage)

PART C (Problem questions)

Answer any four. Each question carries weight of 3 and is answerable within 15 minutes.

13. Show that Poisson bracket is invariant under canonical transformation
14. Find the Lagrangian of an electric charge q, of mass m moving at a velocity v, in an electromagnetic field.
15. Discuss the iteration of logistic equation $x_{n+1} = ax_n(1 - x_n)$, where $0 <= x_n \leq 1$, for control parameter a=2, 3.2 and 4.
16. The Lagrangian of a system is given below. Find the eigen frequencies and eigen vectors of the system using the theory of small oscillation

$$L = \frac{1}{2}(\dot{x}_1^2 + \dot{x}_2^2 + \dot{x}_3^2) - \frac{1}{2}[\, x_1^2 + (x_2 - x_1)^2 + (x_3 - x_2)^2 + x_3^2 \,]$$

17. Show that moment of inertia is a symmetric second rank tensor
18. Show that the transformation

    $Q = \ln(\frac{1}{q}\sin p)$ *and* $P = q\cot p$is canonical. Also obtain the generating function for the transformation.
19. In a spherical pendulum, a small bob is constrained to move on a smooth spherical surface of radius R, R being the length of the pendulum. Set up the Lagrangian for the spherical pendulum and obtain the equation of motion.

(4x3=12 weightage)

1M1N21095 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2021

MPH1C03 - Electrodynamics & Plasma Physics

(2019 Admission onwards)

Time: 3 hours Max. Weightage : 30

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

1. Write down the integral form of Maxwell's equations and write significance of each equation.
2. State Poynting theorem.
3. What do you meant by Debye shielding?
4. What are cavity resonators. Mention any of its uses?
5. Why TEM waves cannot be transmitted through a hollow waveguide?
6. Why is magnetism a relativistic phenomenon?
7. Give the conditions for plasma to exist.
8. What is intrinsic impedance of the free space?

(8 x 1 = 8weightage)

Section B
(Answer any two. Each carry 5 weightage)

9. Obtain the solution of wave equations for potentials
10. Discuss the behavior of electromagnetic waves incident obliquely on a plane conducting boundary.
11. What are transmission lines? Derive the transmission line equations and explain the characteristics of the transmission lines.
12. Reformulate Maxwell's equations and Lorentz force in relativistic form.

(2 x 5 = 10 weightage)

Section C
(Answer any four questions. Each carry 3 weightage)

13. Find the exact magnetic field at a distance z above the center of a square loop of side p, carrying a current I. Verify that it reduces to the field of a dipole, with the appropriate dipole moment, when $z >> p$.

14. A lossless transmission line operating at 5 GHz has L = 2.4 μH/m and characteristic impedance85 Ω. Calculate the phase constant and the phase velocity.

15. Calculate the skin depth for copper at 2 MHz
(Given $\sigma = 5.8 \times 10^7\ S/m,\ \mu = 4\pi \times 10^{-7}\ H/m.$)

16. Light is incident from air to water at Brewster's angle. Calculate the angle of incidence and angle of transmission (Given refractive index of glass is 1.33 and that of air is 1.)

17. Calculate Larmor radius for a 10keV electron in the earth's magnetic field of $B = 5 \times 10^{-5}\ T$, when the speed in the plane perpendicular to B is negligible.

18. A rectangular air-filled waveguide has a cross section of $2\ cm \times 8\ cm$. Find the frequency of propagation in the waveguide for TE_{10} mode?

19. Calculate the Debye length (λ_D) and the number of particles (N_D) in a Debye Sphere for the earth's atmosphere, when $n = 10^{12}\text{m}^{-3}$ and $kTe = 0.1\ eV$

(4 x 3 = 12 weightage)

1M1N21096 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2021

MPH1C04 - Electronics

(2019 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A

(Answer all questions, each carry weightage 1)

1. Draw and discuss the drain characteristics for a D-MOSFET.
2. Explain how FET can be used as a VVR.
3. Write the characteristics of an ideal OPAMP.
4. Explain the working of charge coupled devices.
5. Differentiate between static and dynamic RAM.
6. What is a redundant group in Karnaugh map.
7. Define the terms slew rate and common mode rejection ratio of an OPAMP.
8. List the characteristics of an ideal OPAMP.

(8x1=8weightage)

Section B

(Answer ANY TWO questions, each carry weightage 5)

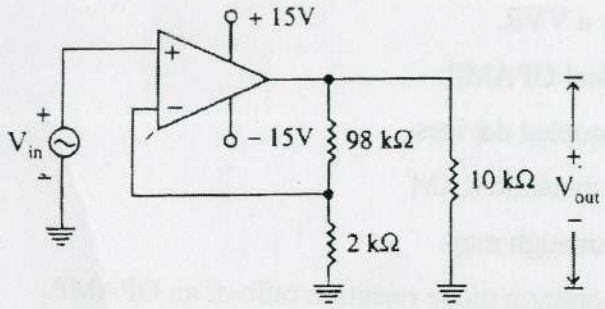
9. Design a mode- 10 counter. Explain how it can be converted into a mode-5 counter.
10. Explain the working of first order low pass and high pass Butterworth filter using OPAMP.
11. Discuss the working of Common Source and Common Drain amplifiers at low frequencies. Derive the expression for voltage gain and draw the equivalent Thevenin circuits.
12. Discuss the working of p-n junction solar cells. Discuss short circuit current, fill factor and efficiency.

(2x5=10 weightage)

Section C
(Answer ANY FOUR questions, each carry weightage 3)

13. Design a practical differentiator that will differentiate signals with frequencies upto 200 Hz. The gain at 10 Hz should be 0.1.
14. The device parameters for n-channel JFET are: $I_{DSS} = 10\,mA$ and $V_p = -4\,V$. Calculate the drain current for

    a) $V_{GS} = 0V$ (b) $V_{GS} = -4V$
15. For the given circuit, open loop voltage gain is 100,000. What is the closed loop gain?. If Vin = 1 mV, What is the output voltage and error voltage.



16. A JFET produces gate current of 2 nA when gate is reverse biased with 8V. Determine the resistance between gate and source.
17. Draw the internal architecture of Intel 8085.
18. Differentiate between a synchronous and Asynchronous counter with diagrams.
19. Determine the output voltage of an OPAMP for input voltages of $V_{i1} = 50\ \mu V$ and $V_{i2} = 50\ \mu V$. The amplifier has a differential gain of $A_d = 4000$ and CMRR is 100.

(4x3 = 12 weightage)