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2M1N20087 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2020

MPH1C01 - Classical Mechanics

(2020 Admission onwards)

Time: 3 hours Max. Weightage : 30

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

1. Discuss Legendre transformations.
2. Show that $[L_x, L_y] = L_z$
3. What is period doubling bifurcation in chaotic system.
4. What do you mean by limit cycle.
5. What are action angle variables.
6. What is moment of inertia tensor? Why do we need it.
7. State Hamilton's principle.
8. Explain principle of least action. **(8 x 1 = 8 Weightage)**

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

9. Solve harmonic oscillator problem using Hamilton Jacobi equation.
10. Obtain Euler equation of motion for a rigid body and apply it for force free motion of a symmetric top.
11. Explain free vibration of linear triatomic molecule.
12. State and explain D' Alemberts principle and derive Lagranges equation from it.

(2 x 5 =10 Weightage)

Section C

(Answer any four questions, Each carry weightage 3)

13. Prove that the transformation $Q = q \tan p$ and $P = \ln \sin p$ is canonical.
14. Consider a simple pendulum of length l and bob mass m. Write down the Hamiltonian and Hamilton's equations of motion.
15. Show that Poisson bracket is invariant under canonical transformation.
16. Find the value of α and β so that the equations $Q = q^{\alpha} \cos \beta p$,$P = q^{\alpha} \sin \beta p$ represents a canonical transformation.
17. Derive equations of motion in terms of Poisson brackets.
18. Prove that the shortest distance between two points in space is straight line.
19. The generating function of a canonical transformation is given $F_1 = \frac{1}{2} q^2 \cot Q$.Show that $p^2 + q^2 = 2P$.

(4 x 3 =12 Weightage)

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2M1N20088 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2020

MPH1C02 - Mathematical Physics - I

(2020 Admission onwards)

Time: 3 hours Max. Weightage : 30

SECTION – A

Answer all questions. Each question carries a weightage of 1.

1. Which are the coordinate surfaces in spherical polar coordinates.
2. Distinguish between covariant and contra variant tensors with examples.
3. Prove that eigen functions of an hermitian operator are orthogonal.
4. Prove that$\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$.
5. Show that is $J_n(-x) = J_n(x)$ for even n and $J_n(-x) = -J_n(x)$ for odd n.
6. What is meant by Wronskian? Explain.
7. Write a note on Pauli spin matrices.
8. Write the Rodrigue's formula for Legendre polynomial and deduce the value of $P_0(x)$.

(8 x 1= 8 weightage)

SECTION - B

Answer any two questions. Each question carries a weightage of 5.

9. (a) Derive an expression for the divergence of a vector point function in orthogonal curvilinear co-ordinate system.

   (b) Express the divergence in cylindrical co-ordinate system

10. Show that $(1 - 2xt + t^2)^{-\frac{1}{2}}$ is a generating function of $P_n(x)$. Hence prove the following recurrence relations.

    (a) $nP_n(x) = (2n-1)x.P_n(x) - (n-1)P_{n-2}(x)$.

    (b) $nP_n(x) = x.P_n'(x) - P_{n-1}'(x)$

11. Discuss hermitian, unitary and orthogonal matrix with example. Show that eigen values of hermitianmatrix are real and eigen vectors are orthogonal.

12. (a) What are even and odd functions.

(b) Explain Dirichlet's conditions.

(c) Expand $f(x) = x^2$ for $-\pi \leq x \leq \pi$ in a Fourier series.

(2 x 5 = 10 weightage)

SECTION – C

Answer any four questions. Each question carries a weightage of 3.

13. Resolve the spherical polar unit vectors into their cartesian components and hence show that spherical co-ordinate system is orthogonal.

14. Define beta and gamma functions. Evaluate the integral $\int_{-1}^{+1} \left(\frac{1+x}{1-x}\right)^{\frac{1}{2}} dx$ using the properties of beta and gamma functions.

15. Prove that $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \sin x$

16. Write Rodrigues formula for Lauguerre polynomials and deduce the value of $L_0(x), L_1(x)$ and $L_2(x)$

17. Define Kronecker delta.

Prove that (a) $\delta_{ii} = 3$ (b) $\delta_{ik}\varepsilon_{ikm} = 0$.

18. Diagonalise the matrix $\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$

19. Find the Laplace transform of a square wave

$$F(t) = \begin{cases} a & \text{for } 0 \leq t \leq \frac{T}{2} \\ 0 & \text{for } \frac{T}{2} \leq t \leq T \end{cases}$$

(4 x 3 = 12 weightage)

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2M1N20089 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2020

MPH1C03 - Electrodynamics & Plasma Physics

(2020 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A

(Answer all questions, each question carries 1 weightage)

1. Write down the Maxwell's equations in the differential forms and give their significance
2. Write down the inhomogeneous wave equation for scalar and vector potential and explain the terms
3. Discuss the electromagnetic boundary conditions
4. What is Poynting vector?
5. What is meant by cutoff frequency of a waveguide?
6. What are cavity resonators? Give their most desirable properties
7. Write the Lorentz transformation matrix and explain
8. What is Debye shielding?

(8 x 1 = 8weightage)

Section B

(Answer any two. Each carries 5 weightage)

9. Obtain the solution of wave equations for potentials
10. Make a study of the behavior of electromagnetic waves incident obliquely on a plane conducting boundary.
11. What are wave guides? Discuss the behavior of TM waves in rectangular waveguides
12. Obtain the tensor form of electromagnetic field. Discuss the properties of this tensor

(2 x 5 = 10 weightage)

Section C

(Answer any four questions. Each carries 3 weightage)

13. 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.

14. A lossless transmission line is 80 cm long and operates at a frequency of 600 MHz. The line parameters are $L = 0{:}25H/m$ and C = $100pF/m$. Find the characteristic impedance, the phase constant, and the phase velocity.

15. Consider a 50-MHz uniform plane wave having electric field amplitude 10 V/m. The medium is lossless, $\in_r = 9.0$ *and* $\mu_r = 1.0$. The wave propagates in the x, y plane at a 30^0 angle to the x axis and is linearly polarized along z. Write down the phasor expression for the electric field.

16. Light is incident from air to glass at Brewsters angle. Determine the angle of incidence and angle of transmission. Given refractive index of glass is 1.45 and air is 1.

17. Compute λ_D *and* N_D for a glow discharge with $n = 10^{16}$= m^3 and $kTe = 2eV$

18. A point charge q is at rest at the origin in system So. What is the electric field of this same charge in system S, which moves to the right at speed Vo relative to So?

19. A 200 keV deuteron in a large mirror fusion device has pitch angle of θ of 45^0 at the midplane, where B = 0:7 Tesla. Compute the Larmor radius

(4 x 3 = 12 weightage)

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2M1N20090 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2020

MPH1C04 - Electronics

(2020 Admission onwards)

Time: 3 hours Max. Weightage : 30

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

1. Explain the biasing of enhancement MOSFET with a suitable diagram.
2. Explain how FET can be used as VVR.
3. Describe the lasing action mechanism of a semiconducting laser.
4. Tabulate the characteristics of an ideal OPAMP.
5. Define the terms slew rate and CMRR of OPAMP.
6. Explain negative and positive feedback in an OPAMP with the help of suitable diagram.
7. Distinguish between static and dynamic RAM.
8. List the advantages of synchronous counter over ripple counters.

(8x1=8weightage)

Section B
(Answer ANY TWO questions, each carry weightage 5)

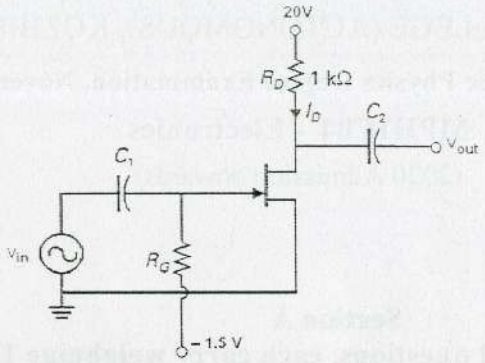
9. Discuss briefly the construction and operation of semiconductor lasers. How the population inversion can be achieved?
10. Explain the working of first order low pass and high pass Butterworth filter using OPAMP.
11. Design a stable and mono stable multi vibrators using OPAMP. Determine the frequency and duty cycle of the output waveforms.
12. Design a mode- 10 counter. Explain how it can be converted into a mode-7 counter.

(2x5=10 weightage)

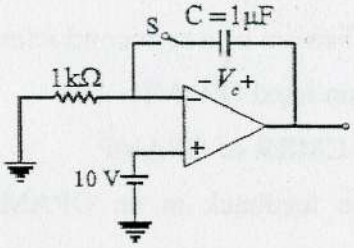
Section C
(Answer ANY FOUR questions, each carry weightage 3)

13. Calculate the source resistance and trans conductance of an n-channel JFET to self-bias it with I_{DSS} = 20 mA, $V_{GS(off)}$ = -10V, V_{GS} = -5V.

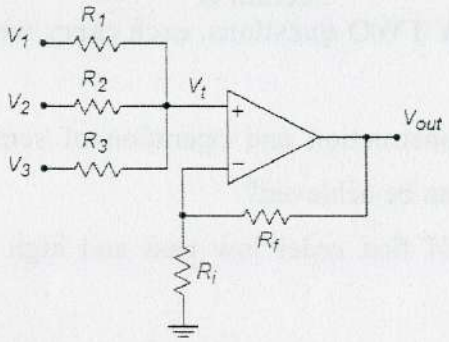
14. Determine the dc Q-point of the amplifier shown in figure and draw its dc load line. Given the I_{DSS} and $V_{GS(off)}$ of JFET are 20 mA and - 4.0 V respectively.



15. For the circuit shown in the following figure, the capacitor C is initially uncharged. At $t = 0$ the switch S is closed. The voltage Vc across the capacitor at t = 1 ms is (the OPAMP is supplied with ±15V)



16. A non inverting OPAMP summer shown in the Figure is used to combine three signals. V_1 = 1 V DC, V_2 = -0.2 V DC, and V_3 is a 2 V peak 100 Hz sine wave. Determine the output voltage if $R_1 = R_2 = R_3 = R_f = 20$ kΩ and $R_i = 5$ kΩ.



17. Determine the output voltage of an OPAMP for input voltages of V_{i1} = 10 μV and V_{i2} = 20 μV. The amplifier has a differential gain of A_d = 6000 and of CMRR is 200.
18. Draw the simplest logic circuit using Karnaugh map for the following Boolean equation, where d represents don't care condition locations.

$$f(a,b,c,d) = \sum m(3,4,5,7) + d(10,11,12,13,14,15)$$

19. Draw the internal architecture of Intel 8085.

(4x3=12 weightage)