16

1M1N19087 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2019

MPH1C01 - Classical Mechanics

(2019 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A

(Answer all questions, Each carry weightage 1)

1. State D'Alembert's principle.
2. Define Poisson bracket.
3. What do you mean by normal modes and normal frequencies?
4. Obtain Hamiltonian for a charged particle in electromagnetic field.
5. What is the physical significance of Hamiltonian.
6. What do you meant by logistic map.
7. Write down Euler equation of motion.
8. What are singular points. Explain different types.

(8 x 1 =8 Weightage)

Section B

(Answer any two questions, Each carry weightage 5)

9. Use H-J theory to solve Kepler problem for a particle in an inverse square centre force field.
10. What do you mean by stable and unstable equilibrium? Establish the Lagrangian and deduce the Lagrange's equations of motion for the small oscillations of a system in the neighbourhood of stable equilibrium.
11. Discuss about infinitesimal rotations and rate of change of vector in rigid body dynamics.
12. Define canonical transformations and obtain the transformation equations corresponding to all possible generating functions.

(2 x 5 =10 Weightage)

Section C

(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. Consider a bead of mass **m** is sliding freely on a hoop of radius **R** rotating with angular velocity ω in a constant gravitational field with acceleration . Obtain the equation of motion using Hamilton's method.
15. The Lagrangian of a dynamical system is given by, $L = \frac{1}{2}m(\dot{x}^2 - \omega^2 x^2)e^{\gamma t}$. Obtain the canonical momentum and the Hamiltonian of the system.
16. Show that the transformation $P = \frac{1}{2}(p^2 + q^2)$and $Q = \tan^{-1}\left(\frac{q}{p}\right)$ is canonical.
17. Define Euler angles and obtain an expression for first matrix.
18. Obtain an expression for coriolis force.
19. Discuss harmonic oscillator as an example of canonical transformation.

(4 x 3 =12 Weightage)

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1M1N19088 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2019

MPH1C02 - Mathematical Physics - I

(2019 Admission onwards)

Time: 3 hours Max. Weightage : 30

SECTION – A

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

1. Express the volume element dV in cylindrical and spherical coordinates.
2. If λ is an eigen value of a matrix $\boldsymbol{A}$ show that λ^2 is an eigen value of $\boldsymbol{A^2}$.
3. Define outer product of tensors with an example.
4. Define Dirac delta function. Write one of its applications.
5. Define Laplace transform and inverse Laplace transform.
6. State Fuch's theorem in differential equations.
7. Prove that $P_n(1) = 1$ and $P_n(-1) = (-1)^n$.
8. State the convolution theorem for Fourier transforms.

(8 x 1 = 8 weightage)

SECTION - B

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

9. Describe the cylindrical and spherical polar coordinates and show that these co-ordinate systems are orthogonal.
10. Establish the orthogonality of Legendre polynomials.
11. (a) Explain the method of diagonalization and its importance

    (b) Diagonalise the matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$
12. Obtain the series solution of Bessel differential equation using Frobenius method.

(2 x 5 = 10 weigh

SECTION – C

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

13. Prove that single contraction of a tensor A_{lm}^{ijk} is a tensor of rank 3.

14. Derive the relation between beta and gamma functions. Show that

$\int_0^{\pi} \sqrt{\tan\theta}\, d\theta = \frac{1}{2}\Gamma\left(\frac{3}{4}\right).\Gamma\left(\frac{1}{4}\right)$.

15. Show that $\bar{r} = \rho\hat{\rho} + z\hat{z}$ in circular cylindrical coordinates.

16. Explain Gram-Schmitz orthogonalisation process with an example.

17. Expand $f(x) = x^2$ for $-\pi \leq x \leq \pi$ in a Fourier series and hence show that $\frac{\pi^2}{6} = \sum_{n=1}^{\infty}\left(\frac{1}{n^2}\right)$.

18. State Stokes' theorem and verify it for the vector $\mathbf{A} = (2x - y)\hat{\imath} - yz^2\hat{\jmath} - y^2z\hat{k}$ over the upper half surface of a sphere $x^2 + y^2 + z^2 = 1$.

19. From the generating function of Hermite polynomials, obtain the following recurrence relations

(a) $2nH_{n-1}(x) = H_n'(x)$

(b) $H_n'(x) = 2xH_n(x) - H_{n+1}(x)$

(4 x 3 = 12 weightage)

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1M1N19089 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2019

MPH1C03 - Electrodynamics & Plasma Physics

(2019 Admission onwards)

Time: 3 hours Max. Weightage : 30

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

1. Are all four Maxwell's equations independent? Explain
2. What you mean by retarded potential?
3. Express electric and magnetic fields in terms of potential functions
4. What are cavity resonators? Give their most desirable properties
5. What is Lorentz condition for potentials. What is its physical significance ?
6. Write the Lorentz transformation matrix and explain
7. Discuss the motion of a charged particle in an electromagnetic field
8. What is cyclotron frequency? Write the expression for it.

(8 x 1 = 8 weightage)

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

9. State and prove Poynting theorem
10. Obtain expressions for reflection and transmission coefficients for electromagnetic waves incident normally on a plane dielectric boundary.
11. What are wave guides? Discuss the behavior of TM waves in rectangular waveguides.
12. Obtain 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. Obtain the electromagnetic boundary conditions
14. Obtain Gauss law in magneto statics from Faraday's law, Gauss law in electrostatics from Amperes law and equation of continuity
15. Show that Lorentz transformation is orthogonal
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. Obtain the covariant form of continuity equation
18. Compute the Larmor radius for a solar wind proton with velocity 300 km/s in the magnetic field of 5×10^{-9} Tesla.
19. Compute λ_D *and* N_D for a glow discharge with $n = 10^{16}/m^3$ and $kTe = 2eV$

(4 x 3 = 12 weightage)

19

1M1N19090 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2019

MPH1C04 - Electronics

(2019 Admission onwards)

Time: 3 hours Max. Weightage : 30

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

1. Briefly explain the working principle of a Tunnel Diode.
2. Write a note on the short circuit current, fill factor and conversion efficiency of solar cells.
3. Explain any two methods for biasing JFET.
4. Explain how a MOSFET acts as a switch.
5. Explain an OPAMP integrator circuit and draw the output wave form for a square wave input.
6. Draw the voltage follower circuit using an OPAMP and list its advantages.
7. Explain don't care condition in Karnaugh map and its representation.
8. Construct a JK Flip-flop and draw its truth table.

(8x1=8 weightage)

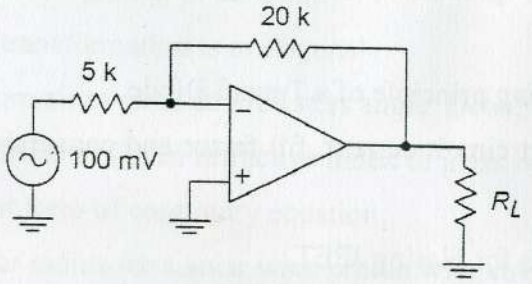
Section B
(Answer ANY TWO questions, each carry weightage 5)

9. Compare the basic operation and transfer characteristics of depletion type MOSFET and enhancement type MOSFET.
10. (i) Explain the quantum efficiency and response speed of a photodiode.
    (ii) Discuss briefly the construction and working of a solar cell.
11. How an OPAMP can be configured as (i) voltage to current converter and
    (ii) summing amplifier.
12. Draw the block diagram of 8085 microprocessor and explain the functions of various registers.

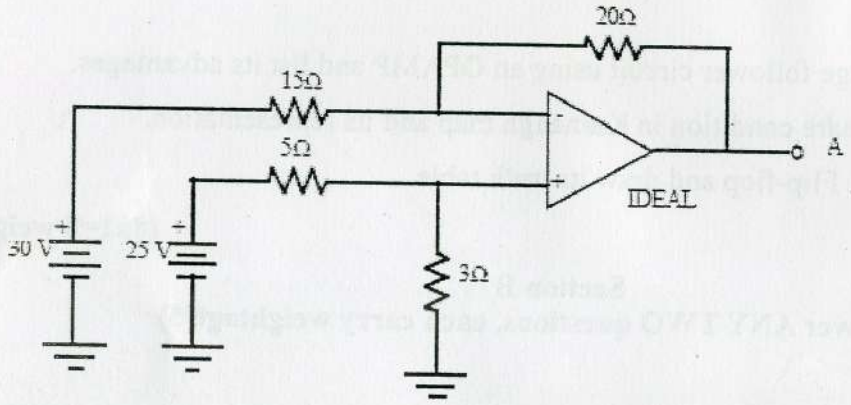
(2x5=10 weightage)

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

13. Calculate the source resistance and transconductance of an n-channel JFET to self-bias it with I_{DSS} = 25mA, $V_{GS(off)}$ = -10V, V_{GS} = -5V.
14. Design a Schmidt trigger circuit using OPAMP having upper triggering voltage +0.3 V and lower triggering voltage -0.2 V. Saturation voltage of the OPAMP is 15V.
15. Determine the input impedance and output voltage for the circuit in Figure.



16. For the given differential amplifier circuit, determine the value of output voltage.



17. For a 4 - bit R-2R Ladder Digital to Analog converter (DAC), find the minimum resolution, full scale output voltage and output voltage corresponding to the digital input of 1000 if V_F = 5 V, R_F = 2 kΩ and R = 1 kΩ.
18. How an SR flip-flop can be converted into T flip-flop.
19. Write down the output of a four bit Johnson ring counter starting from 0000.

(4x3=12weightage)