35

M1N18087 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2018

MPHY1B01 – Classical Mechanics

(2017Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Section A

(Answer all questions, each has weightage 1)

1. What is differential scattering cross-section?
2. What is the Hamiltonian function? Explain its physical significance.
3. Explain the principle of least action.
4. What is meant by infinitesimal rotation?
5. Define Poisson's brackets and discuss their properties.
6. Distinguish between the space-fixed and the body-fixed coordinate systems.
7. Explain stable and unstable equilibrium?
8. What are normal modes and normal frequencies?
9. Period doubling bifurcation leads to chaos - Explain.
10. What is Lyapunov exponent? Explain its significance.
11. Show that the phase trajectory for a linear harmonic oscillator is an ellipse.
12. What is fictitious force?

(12 x 1 = 12 weightage)

Section B

(Answer any two questions, each has weightage 6)

13. Deduce the eigenvalue equation for the small oscillations. Obtain eigenvalues and eigenvectors from this equation.
14. Discuss the torque free motion of a rigid body using the Poinsot's construction.
15. Derive the Lagrange's equations from Hamilton's principle. Discuss the superiority of Lagrangian approach over the Newtonian approach.
16. Show that the oscillations of a pendulum is nonlinear with time period, $T = \frac{4}{\omega_0} K(\sin\frac{\theta_0}{2})$, where $K(\sin\frac{\theta_0}{2})$ is the elliptical integral and θ_0 the angular amplitude.

    Show that for relatively small amplitudes $T = T_0\left[1 + \frac{\theta_0^2}{16}\right]$ where $T_0 = \frac{2\pi}{\omega_0}$.

(2 x 6 = 12 weightage)

Section C

(Answer any four, each has weightage 3)

17. a) Find the Lagrangian for the case when the Hamiltonian is,

$$H(p,r) = \frac{p^2}{2m} - (\boldsymbol{a}.\boldsymbol{p}), a = constant.$$

b) Find the Hamiltonian for the Lagrangian,

$$L = \frac{\dot{q}_1^2}{2} + \frac{\dot{q}_1\dot{q}_2}{2} + \frac{\dot{q}_2^2}{2}.$$

18. Prove that the transformation

$q = \sqrt{2P}\ \sin Q$ *and* $\sqrt{2P}\ \cos Q$ is canonical.

Find the generating function of the transformation.

19. Determine whether the transformations

a) $Q = p + i\,a\,q\,, P = \frac{p - i\,a\,q}{2i\,a}$,

b) $Q = p\,, P = -q$,

are canonical.

20. Three equal mass points are located at (a,0,0), (0,a,2a) and (0,2a,a). Find the principal moments of inertia about the origin and a set of principal axis.

21. Find out the normal modes of a linear triatomic molecule.

22. Prove that the shortest distance between two points in space is a straight line.

(4 x3 = 12 weightage)

36

M1N18088 (Pages : 2) Reg. No:.....

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2018

MPHY1B02 – Mathematical Physics – I

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Section A

Answer all the questions, each has a weightage 1

1. What are the coordinate surfaces in cylindrical coordinate system?
2. A set of coordinates (u,v,ϕ) is related to the spherical polar coordinates (r,θ,ϕ) by the relation $u = r(1-\cos\theta)$ and $v = r(1+\cos\theta)$. Find the metric coefficients with respect to the coordinates (u,v,ϕ).
3. What are pseudo tensors?
4. What do you mean by contraction of a tensor? Illustrate with an example.
5. What is meant by singular point of a differential equation? Explain the different types of singularities with examples.
6. Show that a second order homogeneous ordinary equation cannot have three linearly independent solutions.
7. What is meant by a self adjoint ordinary differential equations? Explain with two examples.
8. Prove the symmetry property of beta function.
9. Show that $P_n(1) = 1$ and $P_n(-1) = (-1)^n$.
10. Define Laplace transform of a function. State and prove the first shifting property of Laplace transform.
11. Explain the essential conditions to be satisfied for a function to be expanded in a Fourier series.
12. Show that $\int_0^\infty e^{-x^2} dx = \sqrt{\pi}/2$.

(12 x 1= 12 weightage)

Section B

Answer any two questions, each has a weightage 6

13. a) Separate Helmholtz equation in spherical polar coordinates.

    b) If A and B are Hermitian matrices, show that (AB + BA) and i(AB – BA) are also Hermitian.

14. Obtain Rodrigue's formula for Legendre polynomial. Deduce the first three Legendre polynomials.

15. Explain Gram Schmidt orthogonalization procedure, with suitable example.

16. Derive the two recurrence relations for Bessel function. Evaluate $J_{3/2}(x)$ and $J_{-3/2}(x)$.

(2 x 6 = 12 weightage)

Section C

Answer any four questions, each has a weightage 3

17. Show that $\Gamma(m)\,\Gamma(1-m) = \frac{\pi}{sin m\pi}$.

18. Prove that $\cos x = J_0(x) - 2J_2(x) + 2J_4(x) - \ldots$

19. Show that $\int_{-1}^{+1} xP_n(x)\,P_{n-1}(x)dx = 2n/(4n^2-1)$.

20. Find the Fourier transform of $e^{-|t|}$.

21. Find the series solution to the equation $y'' = k^2 y$. Identify the function.

22. Find the Fourier series of the function $f(x) = x^2$, $-\pi \leq x \leq \pi$.

(4 x 3= 12 weightage)

37

M1N18089 (Pages : 2) Reg. No:.....

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2018

MPHY1B03 – Electrodynamics & Plasma Physics

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

SECTION A

(Answer all questions, each has weightage 1)

1. Explain the use of phasors in time varying fields.
2. Define Poynting vector. What is its significance?
3. What is loss tangent? How can materials be classified based on it?
4. How is group velocity related to phase velocity for normal and anomalous dispersion?
5. Single-conductor, hollow or dielectric filled waveguide cannot support TEM waves. Why?
6. What is meant by cut off frequency of a waveguide? Can a waveguide have more than one cut off frequency?
7. What do you mean by a distortionless transmission line?
8. Show that space-time interval is invariant under four-vector transformation.
9. Show that current-density four-vector is divergenceless.
10. Determine the relativistic product of velocity four-vector $\eta^{\mu}\eta_{\mu}$.
11. What is plasma? What are the parameters for an ionised gas to be called plasma?
12. What are plasma oscillations? Give an expression for plasma frequency.

(12 x 1 = 12 weightage)

SECTION B

(Answer any TWO questions, each has weightage 6)

13. Obtain the non-homogeneous wave equation for vector potential **A** and scalar potential V. Discuss about the solutions to these non-homogenous wave equations for potentials.
14. Discuss the reflection and transmission of electromagnetic waves for oblique incidence at a plane conducting boundary.
15. Obtain matching condition for the propagation of electromagnetic waves on transmission lines from general transmission line equations. What is the necessity of transmission line impedance matching?
16. Obtain the transformation equations for the components of electric and magnetic fields when we move from one inertial frame to another moving with a uniform relative velocity.

(2 x 6 = 12 weightage)

SECTION C

(Answer any FOUR questions, each has weightage 3)

17. Show that if (**E**, **H**) are solutions of source-free Maxwell's equations in a simple medium characterized by ε and μ, then so also are (**E′**,**H′**), where $\mathbf{E}' = \eta\mathbf{H}$ and $\mathbf{H}' = -\mathbf{E}/\eta$. Given $\eta = \sqrt{\mu/\varepsilon}$ is called the intrinsic impedance of the medium.
18. Prove that, in a dispersive medium, the relation between group velocity u_g and phase velocity u_p , $u_g = u_p - \lambda \frac{du_p}{d\lambda}$.
19. An air-filled rectangular wave guide has cross-section a = 5 cm and b = 4 cm. Calculate the lowest cut off frequency and corresponding cut-off wavelength for TM modes propagating in this waveguide.
20. The attenuation of an air-dielectric coaxial transmission line at 400 MHz is 0.01 dB/m. Find Q and half-power bandwidth of a quarter wavelength section of a line with short-circuit termination.
21. Prove that symmetry of a tensor is preserved under Lorentz transformation. Also, check it for antisymmetric tensors.
22. Compute Debye length and number of particles in a Debye sphere for $n = 10^{18}$ per m^3 and $k_B T_e = 0.1$ eV.

(4 x 3 = 12 weightage)

38

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2018

MPHY1B04 – Electronics

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Section A

(Answer all questions, each has weightage 1)

1. Draw the low and high frequency small signal FET models
2. Describe the optical absorption process in a semiconductor
3. Explain the working of a CMOS based memory cell
4. With a schematic diagram explain the working of an LDR
5. What is the significance of dominant pole compensation in op-amps
6. With a schematic diagram explain the working of a pn junction photo diode
7. Explain the working of an op-amp as a summing amplifier
8. What is race around condition of a JK flip-flop
9. Discuss the function of the signals i) HOLD ii) HLDA
10. With a schematic diagram of an ideal non inverting operation amplifier with voltage shunt feedback, obtain the expression for voltage gain
11. Describe the working of Mod-5 counter
12. Explain the instructions of 8085 microprocessor i) LDA addr ii) STA addr

(12 x 1= 12 weightage)

Section B
(Answer any two questions, each has weightage 6)

13. Explain the internal architecture of a 8085 microprocessor with a block diagram
14. Draw the circuit of common source amplifier. Derive the expression for the voltage gain at low frequencies. Compare the source stage with the common drain configuration.
15. With the help of Schematic diagrams, explain the working i) tunnel diode, ii) semiconductor PN junction laser
16. Explain the operation of a regenerative comparator with the help of a diagram. Sketch the transfer characteristics and hysteresis. What parameter determine the hysteresis

(2 x 6 = 12 weightage)

Section C
(Answer any four, each has weightage 3)

17. Explain the operation of the master slave JK Flip-flop
18. The saturation drain current in a JFET is 8.6mA when the gate voltage is zero. If the pinch off voltage is -3V, calculate the drain current when the gate voltage is – 1V.Also find the transconductance when the gate voltage changes from -1V to -1.4V
19. Design a wide-band pass filter with f_L=200Hz, f_H=1kHz and a pass band gain =4.Calculate the value of Q-factor
20. Determine the output voltage of an op-amp for input voltages of V_1=150 μV, V_2=140 μV.The amplifier has a differential gain of 4000 and the values of CMRR are i) 100 ii) 10^5
21. What is the simplified Boolean equation for the following logic equation expressed by minterms. Y=F(A,B,C,D)=∑m(7,9,10,11,12,13,14,15)
22. Describe how op-amp circuits can be applied for the realization of differential equation of the form $\frac{d^2V}{d^2t} + K_1\frac{dV}{dt} + K_2V - V_1 = 0$

(4 x 3 = 12 weightage)