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1M1N17337 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2017

MPHY1B01 – Classical Mechanics

(2017Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Section A

(Answer all questions, each has weightage 1)

1. What is D'Alembert's Principle?
2. What are the generalized coordinates? Discuss the advantages of these coordinates.
3. Explain Legendre transformations and the canonical variables.
4. Discuss infinitesimal canonical transformation.
5. What are Coriolis force? Find the expression for Coriolis force acting on a body of mass 'm' and the velocity 'v' in a rotating frame with angular velocity 'ω'.
6. Show that moment of inertia is a tensor.
7. What are normal coordinates? Explain the normal modes of vibration.
8. What is meant by the principal axis transformation?
9. What is bifurcation?
10. What are universal constants of chaos?
11. What is meant by a singular point of differential equation? Explain different types of singular points.
12. What is inertia tensor ?

(12 x 1 = 12 weightage:)

Section B

(Answer any two questions, each has weightage 6)

13. Discuss the free vibrations of a linear triatomic molecule in term of normal coordinates. Explain the normal modes of vibration.
14. Discuss the motion of a rigid body in terms of the generalized coordinates. Obtain the expression for angular velocity in terms of these coordinates.
15. What are action–angle variables? How they can be used to solve Kepler's problem?
16. Using logistic map, explain fixed points and the period doubling. Explain how bifurcations lead to chaos.

(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,

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

b) Find the Hamiltonian for the Lagrangian,

$$L(x,\dot{x}) = \frac{(\dot{x})^2}{2} - \frac{(x\omega)^2}{2} - ax^3, a = constant.$$

18. Prove that the transformation

$$P = q\,Cot\,p \text{ and } Q = \log \frac{Sin\,p}{q} \text{ is canonical.}$$

Find the generating function of the transformation.

19. Determine whether the transformations

a) $Q_1 = q_1 q_2, P_1 = \frac{p_2 - p_1}{q_2 - q_1} + 1,$

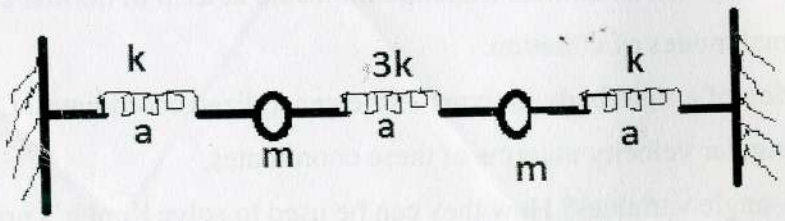
b) $Q_2 = q_1 + q_2, P_2 = \frac{q_2 p_2 - q_1 p_1}{q_2 - q_1} - (q_1 + q_2),$

are canonical.

20. Find the principal moments of inertia about the center of mass of a flat rigid body in the shape of a 45^0 right triangle with uniform mass density.

21. Using action-angle variables, find the frequencies of oscillations of a linear harmonic oscillator.

22. Two particles move in one dimension at the junction of three springs. The springs all have unstretched length 'a'. The force constants and the masses are shown in the figure below. Find the eigen frequencies and the normal modes of the system.



(4 x3 = 12 weightage)

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M1N17338 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2017

MPHY1B02 – Mathematical Physics

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Section A

Answer all the questions, each has a weightage 1

1. Define a vector in terms of its transformation under rotation of coordinates.
2. Represent the vector $\vec{A}$=2yi- zj+3xk in cylindrical coordinates (ρ,φ,z) and find A_ρ, A_φ, A_z.
3. Show that every square matrix can be uniquely expressed as the sum of a Hermitian and Skew Hermitian matrix.
4. Define covariant, contravariant and mixed tensor of rank 2.
5. Define Wronskian of functions. Explain the idea of linear dependence and independence of the functions in terms of the Wronskian.
6. What are the properties of a Hermitian operators?
7. Define the generating function of $P_n(x)$. Show that $P_n(1) = 1$.
8. Show that $\Gamma(n) = (n-1)!$
9. Write and sketch the form of Dirac Delta function.
10. Use convolution theorem to evaluate the inverse Laplace transform of $s^2/(s^2+a^2)$ where 'a' is a constant.
11. Find the Laplace transform of t^n.
12. Express the function $f(x) = x^2$ in terms of Legendre polynomial.

(12 x 1= 12 weightage)

Section B

Answer any two questions, each has a weightage 6

13. Derive the expression for curl in general curvilinear coordinate system. Deduce the curl in spherical polar coordinate system.
14. Obtain the series solution of Bessel's differential equation. Explain the limitations of series solution.
15. Establish the orthogonality of Legendre polynomial.
16. Find a series of sines and cosines of multiples of x, which will represent $x+x^2$ in the interval $-\pi < x < \pi$. Deduce that $\frac{(\pi)^2}{6} = \sum_{n=1}^{\infty} \frac{1}{n^2}$

(2 x 6 = 12 weightage)

Section C

Answer any four questions, each has a weightage 3

17. Show that eigen values of Hermitian matrices are real and the corresponding eigen vectors are orthogonal to each other.
18. Derive the relation between Beta and Gamma functions.
19. Prove that $J_0^2(x) + 2J_1^2(x) + 2J_2^2(x) + \ldots = 1$.
20. Define Poisson's distribution. Outline the characteristics of Poisson's distribution.
21. Derive the recurrence relations $2xH_n(x) - 2nH_{n-1}(x) = H_{n+1}(x)$ and $2nH_{n-1}(x) = H_n'(x)$.
22. Diagonalise the matrix $\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$ by a similarity transformation.

(4 x 3= 12 weightage)

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1M1N17339 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2017

MPHY1B03 – Electrodynamics & Plasma Physics

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

SECTION A
(Answer all questions, each has weightage 1)

1. Express Maxwell's equations in phasor form for a simple non-conducting source free medium.
2. What do you mean by 'retarded potential'?
3. Define skin depth of a conductor? How is it related to the attenuation constant?
4. Define standing wave ratio. How is it related to reflection coefficient?
5. How are ordinary electric networks different from transmission lines?
6. Waves along a lossy transmission line cannot be purely TEM. Explain.
7. What do you mean by quality factor of a cavity resonator? What is its significance?
8. Which operator is invariant under four-vector transformation? Laplacian or D'Alembertian?
9. How can you express the non-homogenous wave equations for scalar and vector potentials in relativistic notation?
10. Demonstrate a situation to show that 'magnetism as a relativistic phenomenon'.
11. Explain Debye shielding.
12. Plasma temperatures are generally thousands of Kelvin. Does it mean that plasma is really hot?

(12 x 1 = 12 weightage)

SECTION B

(Answer any TWO questions, each has weightage 6)

13. Discuss the oblique incidence of electromagnetic waves at a plane dielectric boundary for parallel polarisation.
14. Derive the expressions for R, L, G, C parameters for a transverse electromagnetic wave along a parallel plane transmission line.
15. Express the equation of continuity and Maxwell's equations of electrodynamics in relativistic tensor notation.
16. Describe the motion of charged particles in an electromagnetic field. Hence, arrive at Boltzmann and Vlasov equations.

(2 x 6 = 12 weightage)

SECTION C

(Answer any FOUR questions, each has weightage 3)

17. The electric field of an electromagnetic wave $\mathbf{E} = \mathbf{a}_x E_0 \cos [10^8 \pi (t - z/c) + \theta]$ is the sum of $\mathbf{E}_1 = \mathbf{a}_x 0.03 \sin 10^8 \pi (t - z/c)$ and $\mathbf{E}_2 = \mathbf{a}_x 0.04 \cos [10^8 \pi (t - z/c) - \pi/3]$. Find E_0 and θ.
18. Determine and compare the attenuation constant and skin depth of silver [$\sigma_{Ag} = 6.15 \times 10^7$ (S/m)] at the following frequencies: (a) 60 Hz, (b) 1 GHz.
19. Determine the wave impedance and guide wavelength at a frequency equal to twice the cut-off frequency in a waveguide for TM and TE modes. Compare the values to that of a TEM mode.
20. The attenuation on a 50 Ω distortionless transmission line is 0.01 dB/m. The line has a capacitance of 0.1 nF/m. Find the resistance, inductance and conductance per meter of the line.
21. a) Show that $(\mathbf{E}.\mathbf{B})$ is relativistically invariant.
    b) Show that $(E^2 - c^2B^2)$ is relativistically invariant.
22. Compute Debye length and number of particles in a Debye sphere for $n = 10^{16}$ per m^3 and $k_B T_e = 2$ eV.

(4 x 3 = 12 weightage)

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1M1N17340 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2017

MPHY1B04 – Electronics

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

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

1. Define transconductance and drain resistance of an FET
2. Explain the working of a tunnel diode with the help of energy band diagram
3. Give brief description about the working of charge coupled devices
4. What is input offset voltage of an op-amp and draw a circuit to measure it
5. Explain the pole-zero compensation in an op-amp
6. With a schematic diagram of an ideal inverting operation amplifier with voltage shunt feedback, explain the virtual ground model to calculate the gain
7. Explain the working of an op-amp as scale changer
8. Briefly give the working of cascade counter
9. Explain the instructions of 8085 microprocessor i) LDA addr ii) STA addr
10. Define optical confinement in semiconductor laser and give the expression for optical confinement factor
11. What are the various interrupts in 8085 microprocessor? Which is the highest priority interrupt?
12. What is the function of ALE, and S_0, S_1 pin?

(12 x 1= 12 weightage)

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

13. Explain the operation of a square wave generator using op-amps by drawing the capacitor voltage wave form. Derive the expression for the period of a symmetrical wave. Modify the circuit as a pulse generator and explain the operation
14. Describe the working of a JFET common source amplifier. Derive the expression for the DC drain voltage and the DC drain current.
15. Explain the internal architecture of a 8085 microprocessor with a block diagram
16. Outline the procedure of Karnaugh map method. Find logical expression of truth table given below using Karnaugh map

X	Y	Z	Output
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

(2 x 6 = 12 weightage)

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

17. The device parameters for an n-Channel JFET are: Maximum current I_{DSS} = 10mA, Pinch off voltage, V_p = - 4V Calculate the drain current for (a) V_{GS} = 0 (b) V_{GS} = - 1.0v (c) V_{GS} = - 4V.
18. Draw the circuit diagram of mod-10 counter and explain the working using timing diagram
19. Design a second order high-pass filter at a cut off frequency of 1kHz with a pass band gain of 2. Using frequency scaling technique, change the cut off frequency to 1.6kHz
20. Simplify the following Boolean expression and draw the logic circuit using AND,OR and NOT gates $A = (X + Y)(X + \bar{Y})(\bar{X} + Z)$
21. Explain the operation of the master slave JK Flip-flop
22. The power density of sunlight incident on a solar cell is 100mW/cm^2. Its short circuit current density is 30 mA/ cm^2 and the open circuit voltage is 0.7V. Find percentage change in efficiency if the fill factor of the solar cell decreases from 0.8 to 0.5

(4 x 3 = 12 weightage)