2B1N23305 (Pages : 2) Reg. No:.........................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester Integrated M.Sc Geology Degree Examination, November 2023

PHY1IC01 – Properties of Matter & Thermodynamics

(2022 Admission onwards)

Time : 2 hours   Max. Marks : 60

Section A- Short Answer Type

(Answer all questions in two or three sentences, each correct answer carries a maximum of 2 marks, Overall Ceiling 20)

1. Mention any one application of Poisson's ratio.

2. What is yield point?

3. What is flexural rigidity?

4. What is geometrical moment of inertia?

5. Give some examples for surface tension phenomenon.

6. Explain the effect of impurities on surface tension.

7. What are the SI and CGS units of coefficient of viscosity.

8. An ideal gas at 1 atm is slowly compressed to $\frac{1}{8}$ of its initial volume. Find the resulting pressure

9. What are the significances of first law of thermodynamics?

10. State the Kelvin-Planck statement of second law of thermodynamics

11. Absolute entropy of a system cannot be determined. Only the change in entropy can be calculated- Explain

12. Explain the effect of pressure on boiling point of water.

(Ceiling-20)

Section B- Paragraph/ Problem Type
(Answer all questions in a paragraph of about half a page to one page, each correct answer carries a maximum of 5 marks)

13. Calculate the force required to stretch a 2cm diameter steel rod by 0.01 percentage. Young's modulus of steel is $2 \times 10^{11} N/m^2$.

14. Explain the molecular theory of surface tension.

15. A steel wire of 1mm radius is bent to form a circle of 10cm radius. What is the bending moment and the maximum stress. Young's modulus is $2 \times 10^{11} N/m^2$.

16. What amount of energy will be liberated if 1000 droplets of water each $10^{-6} cm$ in diameter coalesce to form one large spherical drop.
    Surface Tension of water = 0.075N/m.

17. A Carnot engine working between two temperatures has an efficiency 12.5%. If the temperature of sink is reduced by $95^0 C$, its efficiency is doubled. Find the temp of source and sink.

18. An ice block of mass 12 Kg is put into a large lake of water at $20^0 C$ so that the final temp: is $20^0 C$. Find the change in entropy of ice, lake water and universe?
    (Cv of water = 4200 J/ Kg, Latent heat of ice =3.36×10^5 J /Kg)

19. What is available energy? Explain how available energy is related with entropy.

(Ceiling- 30)

Section C- Essay Type
Answer any one question. Answer carries 10 marks

20. What is a beam? Derive an expression for bending moment of a beam.

21. What is a heat engine? With the help of Carnot cycle explain and derive equation for efficiency of a carnot engine.

(1x10= 10 marks)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2023

MPH1C01 – Classical Mechanics

(2022 Admission onwards)

Time : 3 hours   Max. Weightage : 30

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

1. Is Lagrangian formulation more advantageous than Newtonian formulation? Why?

2. Determine $[p_x, L_z]$

3. What is non – holonomic constraint? Give an example.

4. Differentiate between stable and unstable limit cycle.

5. Distinguish between space fixed and body fixed co-ordinate systems.

6. What are fundamental Poisson's brackets?

7. Define Hamiltonian. When it is equal to total energy of the system?

8. Explain principle of least action.

                                                  (8 x 1 =8 Weightage)

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

9. Give an account of Hamilton Jacobi theory and solve harmonic oscillator problem using Hamilton Jacobi equation.

10. Discuss the force free motion of a symmetric top and hence obtain an equation for its period.

11. Explain free vibration of linear triatomic molecule.

12. Considering the scattering of charged particles as a central force problem, obtain an expression for the scattering cross section.

                                                  (2 x 5 =10Weightage)

Section C – Problem Questions
(Answer any four questions, Each carry weightage 3)

13. Prove that the transformations $Q = \tan^{-1}(q/p)$ and $P = \frac{1}{2}(p^2 + q^2)$ are

    canonical.

14. Find the time period of oscillation of a compound pendulum by Hamilton's method.

15. Show that Poisson bracket is invariant under canonical transformation.

16. Deduce the Hamilton's canonical equations from variation principle.

17. Solve Kepler problem using Hamilton – Jacobi method.

18. Prove that shortest distance between two points in space is straight line.

19. Show that Poisson bracket of two constants of motion itself a constant of motion

(4 x 3 =12Weightage)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2023

MPH1C02 – Mathematical Physics – I

(2022 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. What is a solenoidal field? Explain using an example.

2. Show that the eigenvalues of self-adjoint differential equations are real.

3. Define the Beta function. Prove that $\beta(m, n) = \beta(n, m)$.

4. What is meant by boundary condition? Explain the three forms Cauchy, Dirichlet, and Neumann conditions.

5. Explain the outer product of two matrices.

6. Define Fourier transform of a function. Explain its physical significance.

7. Define unitary matrix. Explain unitary transformation.

8. Briefly explain Poisson distribution.

$(8 \times 1 = 8 \ \textbf{\textit{weightage}})$

Section B

(4 Essay questions, each answerable within 30 minutes)

(Answer ANY TWO questions, each carry weightage 5)

9. Discuss the separation of variable method to solve the partial differential equations taking Helmholtz equation in spherical polar coordinates as an example.

10. Explain the diagonalization of the matrix $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$.

11. Using orthogonal curvilinear coordinates, derive the expression for the Laplacian operator. Hence express the Laplacian in cylindrical coordinates.

12. What are Legender's polynomials? What is its generating function? State and prove orthogonality condition.

$(2 \times 5 = 10 \ \textbf{\textit{weightage}})$

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

13. Explain Gram-Schmidt orthogonalization procedure for the vectors

$$V_0 = (1,1), V_1 = (1,-2).$$

14. Show that Hermite polynomials satisfy the relation

$$H_{n+1}(x) = 2xH_n(x) - 2nH_{n-1}(x).$$

15. Show that $2J_n'(x) = J_{(n-1)}(x) - J_{(n+1)}(x)$ for Bessel functions.

16. Show that the scalar product is invariant under rotations.

17. The force field acting on a two-dimensional linear oscillator is described by

$\vec{F} = -kx\hat{\imath} - ky\hat{\jmath}$. Compare the work done moving against this force field when going

from (1,1) to (4,4) by the following straight-line paths:

(a) $(1,1) \rightarrow (4,1) \rightarrow (4,4)$

(b) $(1,1) \rightarrow (1,4) \rightarrow (4,4)$

18. Solve the damped harmonic oscillator equation

$$mX''(t) + bX'(t) + kX(t) = 0,$$

for initial position x0 and initial velocity zero using Laplace transform, and

(a) $b^2 = 4km$ (Critically damped)

(b) $b^2 > 4km$ (Overdamped).

19. Show that $\Gamma\left(\frac{1}{2} - n\right)\Gamma\left(\frac{1}{2} + n\right) = (-1)^n\pi$ where n is an integer.

$$(4 \times 3 = 12 \boldsymbol{weightage})$$

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2023

MPH1C03 – Electrodynamics & Plasma Physics

(2022 Admission onwards)

Time : 3 hours   Max. Weightage : 30

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

1. Write the differential form of four Maxwell's equations and explain the terms

2. What are electric and magnetic potentials?.

3. What do you mean by a plane wave. Write the equation for it.

4. How is power flow and Poynting vector related?

5. What are transmission lines. Give their two charecteristics.

6. What are cavity resonators and wave guides?

7. What is Plasma state. Give four examples in daily life where plasma state is observed.

8. What is Debye shielding?

(8 × 1 = 8 weightage)

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

9. Obtain the wave equations for potentials and find the solutions for them

10. Explain the behavior of plane waves in a lossless media and hence derive an expression for the intrinsic impedance for the free space.

11. Discuss the motion of TEM wave along a parallel plate transmission line. Obtain expressions for inductance and capacitance per length

12. Obtain an expression for electromagnetic field tensor.

(2 × 5 = 10 weightage)

Section C

(Answer any four questions. Each carries 3 weightage)

13. A sinusoidal electric intensity of amplitude 250 V/m and frequency 1 GHz exists in a lossy dielectric medium that has relative permittivity of 2.5 and loss tangent of 0.001. Find the average power dissipated in the medium per cubic meter.

14. Obtain electromagnetic boundary conditions

15. Prove that a linearly polarised plane wave can be resolved into a right circular and left circular polarised waves of equal amplitude

16. A narrow band signal propagates in a lossy dielectric medium which has a loss tangent 0.2 a 550 kHz the carrier frequency of the signal. The dielectric constant is 2.5. Find α and β.

17. Determine the wave impedance and guide wavelength at a frequency equal to one half of the cutoff frequency in a wave guide for TM and TE modes.

18. Obtain the four vector form of Lorentz gauge and wave equations for potentials

19. If $B = 0.32$ T and $n = 10^{18}$ /m^3 show that plasma frequency is approximately equal to cyclotron frequency for electrons

$(4 \times 3 = 12$ weightage

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Physics Degree Examination, November 2023

MPH1C04 – Electronics

(2022 Admission onwards)

Time : 3 hours Max. Weightage : 30

Section A

(Answer All questions, each carry Weightage 1)

1. Define common mode rejection ratio.

2. Draw the circuit of an emitter-coupled differential amplifier.

3. Define scale changer.

4. Differentiate between low pass and high pass filters.

5. What is meant by a latch?

6. Discuss the working of charge coupled devices.

7. Compare BJT and FET.

8. Define efficiency of a solar cell.

(8x1 =8 Weightage)

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

9. Draw a neat circuit diagram of opamp integrator and differentiator. Derive the expression for output voltage in each case

10. With a neat diagram and truth table explain the working of a master slave JK flip flop.

11. What are Field effect transistors? Explain the construction, working and characteristics of an n channel JFET.

12. Explain the principle of a laser. Discuss the construction and operation of a semiconductor laser.

(2x5 =10 Weightage)

Section C
(Answer any four questions, each carry weightage 3)

13. Draw a neat circuit diagram of a voltage-divider bias arrangement of an FET.

14. A non-inverting amplifier has an input offset voltage $V_{io} = 1\mu V/^0C$. If $V_s = 0$, determine output voltage. Let input resistance, $R = 1K\Omega$ and feedback resistance, $R_f = 10K\Omega$.

15. Write a short note on Lead compensation.

16. Using JK fip-flops, design a 4-bit shift register that moves incoming data from left to right.

17. Write a short note on LDR.

18. Determine the magnitude of g_m for a JFET with $I_{DSS} = 8mA$ and $V_P = -4V$ at
    (i) $V_{GS} = -0.5V$ and (ii) $V_{GS} = -2.5V$.

19. Draw the logic symbol, truth table and waveform of Mod-8 binary counter with parallel clock input.

(4x3 =12 Weightage)