QP Code:PH1T01B-4 **(Pages: 3)**

Reg No : ..... Name : .....

MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM

(Govt. Aided Autonomous Institution)

Second Semester B.Tech. Degree Examination, May, 2026

Course Code: B24PH1T01B

Course Name: ENGINEERING PHYSICS (B)

(For CE and ME Branches)

Max. Marks: 100 Duration:3 Hours

PART - A: 30 Marks (10 Qns x 3 Marks)

Answer all questions

1. Define SHM. Write the differential equation for SHM.
2. State the effect of damping on the angular frequency and time period of an oscillator with relevant equations.
3. Define ideal straight line, sensitivity and non-linearity of sensors.
4. Define Gauge factor of a strain gauge. Write the fractional change in the resistance in terms of the Gauge factor.
5. Differentiate between Schottky and Frenkel defects.
6. List the three types of cubic lattices and the number of atoms per unit cell in each.
7. State magnetostriction effect.
8. Define intensity of a sound wave.
9. What is critical angle? Write the expression for critical angle.
10. List the main components of laser.

PART - B: 70 Marks (5 Qns x 14 Marks)

Answer any One full question from each module.

Module 1

11. a. Derive the differential equation of a DHO and obtain its general solution. (10 Marks)
    b. A particle is executing SHM and it is given by $x = 3cos\omega t + 4sin\omega t$. Find its initial phase and amplitude. (4 Marks)

OR

12. a. Obtain the differential equation for a Forced Harmonicc Oscillator. Find expressions for its amplitude and phase. (10 Marks)

b. Graphically show how the amplitude of a forced harmonic oscillator varies with the driving frequency and damping (4 Marks)

Module 2

13. a. With the help of neat schematic diagrams, discuss in detail the working of capacitive displacement sensors of the variable area and the variable dielectric type. (10 Marks)

b. A parallel plate capacitor with square plates of side $8\ cm$ is used as a displacement sensor. Initially, the plates are separated by $3\ mm$, and the capacitor is filled with a dielectric of relative permittivity 4. The permittivity of free space is $8.85\ pFm^{-1}$. Due to vertical displacement of one of the plates, the capacitance changes by 25% from its initial value. Determine (a) the initial capacitance and (b) the final plate separation. (4 Marks)

OR

14. a. Derive the expression for the Gauge Factor (G) of a strain gauge. (10 Marks)

b. A pressure sensor has an input range of $0\ Pa$ to $2 \times 10^4\ Pa$ and an output range of $4\ mA$ to $20\ mA$. Find the equation to the ideal straight line. (4 Marks)

Module 3

15. a. Describe the three cubic lattices and obtain a) the number of atoms per unit cell, b) the coordination number and c) the packing factor for each (10 Marks)

b. Determine the Miller indices of a plane having intercepts a, $-2b$ and $3c$ along the crystallographic axes. (4 Marks)

OR

16. a. Describe Miller indices. Explain the procedure to determine them. List four properties of Miller Indices. (10 Marks)

b. Sketch the (110), (100), (010) and (111) planes in a simple cubic lattice. (4 Marks)

Module 4

17. a. Explain reverberation and reverberation time. What is the significance of reverberation time? Derive Sabine's formula for evaluating reverberation time and explain the terms. (10 Marks)

b. An auditorium has dimensions 45m x 10m x 8m. The average absorption coefficients of wall, ceiling and floor are 0.8 Sabine, 0.4 Sabine and 0.5 Sabine respectively. Evaluate reverberation time of the hall. (4 Marks)

OR

18. a. Discuss in detail how ultrasonic waves are used in SONAR and NDT. (10 Marks)

Given that the velocity of ultrasonic waves in sea water is equal to $1440\ m/s$,

b. find the depth of a submerged submarine if an ultrasonic pulse reflected from the submarine is received $0.52\ s$ after transmission. (4 Marks)

Module 5

19. a. Establish Einstein's relations. How do they help us explain the conditions necessary for lasing? (10 Marks)

b. A laser emits light at a wavelength of 400nm. Calculate the frequency of the emitted laser light. (4 Marks)

OR

20. a. Describe the working principle of laser. (10 Marks

b. At what temperature are the rates of spontaneous and stimulated emissions equal? (4 Marks)

Take $\lambda = 500nm$.

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