

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY (VSSUT), ODISHA
Even Mid Semester Examination for Academic Session 2024-25

COURSE NAME: B. Tech

SEMESTER: 2nd

BRANCH NAME: Chem. Eng., CE, ME, MME and PE (A, B, C, K, L, M, N)

SUBJECT NAME: PHYSICS

FULL MARKS: 30

TIME: 90 Minutes

Answer All Questions.

The figures in the right-hand margin indicate Marks. *Symbols carry usual meaning.*

Q1. Answer all Questions.

[2 × 3]

- a) Write any five analogies between mechanical and electrical oscillator.
- b) What is sustained interference? When two coherent waves of amplitude A and intensity I are superimposed at a point and the phase difference between them is $\frac{\pi}{3}$, find the resultant amplitude and resultant intensity.
- c) If \mathbf{r} is the position vector of a point, show that \mathbf{r} is irrotational.

[6+2]

Q2. With a suitable circuit diagram obtain the expression for current for forced oscillations in a series LCR circuit. What is the Q-factor of the series LCR circuit with $L = 2 \text{ H}$, $C = 32 \mu\text{F}$ and $R = 10 \Omega$.

OR

[5+2+1]

Formulate the differential equation and obtain the solution for a damped harmonic oscillator. Discuss the different cases of damping with diagram. Define Q-factor.

[2+4+2]

Q3. With a schematic diagram describe the formation of coherent sources in a thin film. Obtain the conditions for maxima and minima in terms of path difference for the interference. A soap film of refractive index 1.33 is illuminated by the light of wavelength 5890 \AA at an angle of 45 degrees. Find the thickness of the film for first order minima.

OR

[1+5+2]

Sketch the experimental arrangement of Newton's ring experiment. Derive expressions for diameters of Newton's bright and dark ring in reflected light. A Newton's Ring experiment is performed using light of wavelength 600 nm. When an oil is introduced, the diameter of the 12th bright ring reduces from 4.2 mm to 3.5 mm. Find the refractive index of the oil.

[6+2]

Q4. Obtain the expression for resultant intensity in a single slit Fraunhofer diffraction process and show that the intensity of secondary maxima is of decreasing order. What is the highest order spectrum which may be seen with monochromatic light of wavelength 6000 \AA , by means of a diffraction grating with 5000 lines/cm.

OR

[2+2+4]

What is the physical significance of gradient, divergence and curl.

Find the gradient of $f(x, y, z) = x^2y + yz^3 - z^2x$ at $(x = 1, y = 1 \text{ and } z = 0)$.

For the vector field \mathbf{V} defined as, $\mathbf{V} = (x + 2y + 4z)\hat{i} + (2ax + by - z)\hat{j} + (4x - y + 2z)\hat{k}$, where a and b are constants. Find a and b such that \mathbf{V} is both solenoidal and irrotational.