

Total No. of Questions – [10]

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U118-104NCB(ESE)

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F. Y. B. TECH. (COMMON) NCB (SEMESTER - I)

COURSE NAME: Engineering Physics (NCB)

COURSE CODE: ES10184A-NCB

(PATTERN 2018)

Time: [2 Hours]

[Max. Marks: 50]

Instructions to candidates:

- 1) Attempt Q.1, Q.2, Q.3, Q.4 OR Q.5, Q.6 OR Q.7, Q.8 OR Q.9 and Q.10
- 2) Figures to the right indicate full marks.
- 3) Use of scientific calculator is allowed.
- 4) Use suitable data where ever required.

- Q1(a) Draw the displacement of a free damped oscillator as a function of a time for the damping factors $\zeta = 1$, $\zeta > 1$ and $\zeta < 1$ in the same diagram. Compare their behaviours on the basis of damped angular frequency ω_D . [4]

OR

- Q1(b) Given deformation response factor $R_d = u_0/(u_{st})_0 = \frac{1}{\sqrt{[1-(\frac{\omega}{\omega_n})^2]^2 + [2\zeta(\frac{\omega}{\omega_n})]^2}}$, discuss the response of a damped forced oscillator for angular frequency ω of the external force compared to the natural frequency ω_n being $\omega \ll \omega_n$, $\omega \approx \omega_n$ and $\omega \gg \omega_n$. [4]

- Q2(a) What is the minimum thickness that can be detected for a specimen of sapphire if an ultrasonic pulse containing 9 cycles of 50 MHz is used. Given, for sapphire, density = 3980 kg/m³, Bulk modulus = 25×10^{10} N/m², Shear modulus = 14.5×10^{10} N/m². [4]

OR

- Q2(b) As a thumb rule, a speaker can be heard clearly if the intensity level of the speaker is 10dB above the noise. What is the power the speaker should generate to be heard by a person at a distance of 6.5m, if the background noise is uniform in the room and its intensity level is 50 dB? Corresponding to this power, what is the intensity level at 1 meter from the speaker? [4]

- Q3(a) Schematically draw the geometry of an X-ray Diffractometer for Debye-Sherrer method and discuss its construction and working. [6]

OR

- Q3(b) With the help of a neat diagram explain the principle, construction and working of a compound microscope. [6]

- Q4(a) With the help of an example, discuss the concepts of accuracy and precision of a measurement. What do the systematic and random errors lead to - decrease in accuracy or precision? [6]

- Q4(b) If the values of band gap E_g of a semiconductor, measured (in units of eV) by 10 students, are 0.65, 0.73, 0.77, 0.69, 0.60, 0.71, 0.62, 0.81, 0.74 and 0.66, calculate the mean and the standard error in the mean as $\bar{E}_g \pm \sigma_m$ from the rms value of the residuals. [4]

OR

- Q5(a) Derive an expression for the slope and intercept of a line best fitted to a given set of data by method of least squares. [6]

- Q5(b) If $Z = A \ln B$, then calculate $Z \pm \Delta Z$ if $A \pm \Delta A = 9.40 \pm 0.04$ and $B \pm \Delta B = 1230 \pm 20$. [4]

- Q6(a) Discuss three ways in which sensors can be classified. [6]

- Q6(b) Draw a Full Wheatstone bridge and derive the expression for its output voltage. [4]

OR

- Q7(a) Discuss the principle of an accelerometer with a neat diagram and explain how strain gauges can be used. [6]
- Q7(b) In a differential capacitor sensor, with initial gap between the plates $d = 100 \mu\text{m}$, what is the displacement Δd if an output voltage $V_{\text{out}} = 100 \text{ mV}$ is observed for a biasing voltage amplitude of $V_0 = 5\text{V}$? [4]
- Q8(a) Explain with the help of neat diagrams, principle, construction and working of a CO_2 laser. [6]
- Q8(b) What is the diffraction limited beam divergence of Nd:YAG laser ($\lambda = 1.06 \mu\text{m}$) having an output aperture of 0.8 inch? [4]
- OR**
- Q9(a) Explain in detail which of the laser characteristics like monochromaticity, coherence, directionality, intensity are useful or not in industrial applications of cutting, drilling and welding. [6]
- Q9(b) Find the intensity of a laser beam of 10^4 W power, having a beam diameter of 1.8 mm. Assume intensity to be uniform across the beam. [4]
- Q10(a) If $Z = \frac{A}{B}$ then $\frac{\Delta Z}{Z}$ is [1]
- (i) $\frac{\Delta A}{A} + \frac{\Delta B}{B}$
- (ii) $\frac{\Delta A}{A} - \frac{\Delta B}{B}$
- (iii) $\left(\frac{\Delta A}{A}\right)^2 + \left(\frac{\Delta B}{B}\right)^2$
- (iv) $\left(\frac{\Delta A}{A}\right)^2 - \left(\frac{\Delta B}{B}\right)^2$
- Q10(b) Zero error is [1]
- (i) random error
- (ii) human error
- (iii) systematic error
- (iv) all of the above
- Q10(c) Johnson noise voltage is related with temperature T as proportional to [1]
- (i) T
- (ii) T^2
- (iii) $T^{1/2}$
- (iv) $T^{-1/2}$
- Q10(d) Lasers have high intensity because they are [1]
- (i) monochromatic
- (ii) coherent
- (iii) directional
- (iii) efficient
- Q10(e) The wavelength of CO_2 laser corresponds to [1]
- (i) X-rays
- (ii) Ultraviolet
- (iii) visible
- (iii) Infrared
- Q10(f) Which of the following is a necessary condition for lasing action [1]
- (i) metastable state
- (ii) pumping
- (iii) population inversion
- (iv) all of the above