Total No. of Questions – [3] Total No. of Printed Pages : 2

G.R. No.	

Paper Code - UI18-104 NCB(T1)

OCTOBER 2018 / IN-SEM (T1)

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

COURSE NAME: Engineering Physics - NCB

COURSE CODE: ES10184A-NCB

(PATTERN 2018)

Time: [1 Hour] [Max. Marks: 20]

Instructions to candidates:

1) **Answer Q.1 OR Q.2, Q.3 OR Q.4 and Q.5**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data wherever required**

		Question		Marking scheme	Cognitive	Difficulty	CO
Q1	a	Derive the expression for displacement of a free undamped oscillator.	4	Derivation - 4M	U, C	M	1
	b	The amplitude of a system for the 11th and 27th cycle in free damped oscillations is 1 cm and 1 mm, respectively. Calculate the damping factor ζ.	4	$\frac{2\pi\zeta}{\sqrt{1-\zeta^2}} = \delta = \left(\frac{1}{j}\right) ln\left(\frac{u_i}{u_{i+j}}\right)$ $\zeta^2 = \frac{\delta^2}{4\pi^2+\delta^2}$ $\delta = \left(\frac{1}{16}\right) ln\left(\frac{10}{1}\right) = 0.1439$ $\zeta = 0.0229$	A	M	1
	c	A machine weighing 100 kg is mounted on a spring with stiffness 7.84×10^5 N/m and damper with damping factor 0.2. A harmonic force F = 392sin(314.15t) N acts on the machine. For steady state vibration of the machine, calculate the amplitude of vibration of the machine.	4	$\omega_n = \sqrt{\frac{k}{m}} = 88.5437\ rad/s$ $u_0 = (u_{st})_0 R_d = \frac{F_0}{k} R_d$ $R_d = \frac{1}{\sqrt{\left[1-\left(\frac{\omega}{\omega_n}\right)^2\right]^2 + \left[2\zeta\left(\frac{\omega}{\omega_n}\right)\right]^2}}$ $u_0 = \frac{0.0005}{\sqrt{\left[1-\left(\frac{314.15}{88.5437}\right)^2\right]^2 + \left[2\times0.2\left(\frac{314.15}{88.5437}\right)\right]^2}}$	A	H	1

				$=4.28\times10^{-5}$ m			
Q2	a	With the help of a diagram, define intensity of sound at a distance r from a point source with power P and hence write the expression for intensity level.	4	Diagram - 1M Intensity formula derivation with explanation - 2M Intensity level derivation - 1M	U, C	L	2
	b	A hall has dimensions of length×breadth×height = 20×10×7.5 m^3. If the apparent absorption coefficients are: a(wall) = 0.3, a(ceiling) = 0.2 and a(floor) = 0.5, calculate the reverberation time.	4	$V=1500m^3$ $\Sigma aS=0.3\times2\times(20\times7.5) + 0.3\times2\times(10\times7.5) +0.2\times(20\times10) +0.5\times(20\times10) = 275$ $t = \frac{0.161\times1500}{275}=0.88s$	A	M	2
	c	Calculate the thicknesses of a quartz plate required to produce ultrasonic waves of frequency 10 MHz in the fundamental mode and first harmonic. Given: Density of crystal = 2650 kg/m^3, B = 3.8×10^{10} N/m^2 and S = 4.4×10^{10} N/m^2.	4	$t = \frac{p}{2f}\sqrt{\frac{B+\left(\frac{4}{3}\right)S}{\rho}}$ For p = 1, t = 0.4586mm For p = 2, t = 0.9172mm	A	L	2
Q3	a	Which techniques can be used to determine the size of a crystallite and a grain in a polycrystalline material and how?	4	Crystallite size - Powder XRD, Sherrer formula Grain size - Microscopy by measuring area of grains from digital images either manually or by software	U, C	M	3
	b	What numerical aperture NA of a microscope and how does it determine the resolution? Explain with the help of a diagram.	4	Diagram - 1 NA = μsini, where i is maximum angle of incidence on the objective Resolution $s = \frac{\lambda}{2\times NA}$	U, C	M	3