February 2018 / IN - SEM (T1)
F. Y. B.TECH. (COMMON) (SEMESTER - II)
COURSE NAME: Engineering Physics
COURSE CODE: ES 10175A
(2017 PATTERN)

Marking scheme

Q. no.	Question	Marks	Distribution	DL	BT	CO
Q1(a)	Enumerate the possible sources of noise and discuss the remedies to reduce them in an auditorium.	[6]	2M each	M	K, C	1
Q1(b)	Describe with help of a diagram a set-up for Ultrasonic non-destructive testing of a mechanical component.	[4]	Diagram - 1M, Explanation - 3M	M	K, C	1
Q1(c)	Calculate the natural frequency of vibration for quartz crystal of thickness 5.5 mm. Given: Density of crystal = 2650 kg/m^3, B = 3.8 $\times 10^{10}$ N/m^2 and S = 4.4 $\times 10^{10}$ N/m^2.	[4]	Formula: $f = \frac{1}{2t}\sqrt{\frac{B+\left(\frac{4}{3}\right)S}{\rho}} = \frac{1}{2\times5.5\times10^{-3}}\sqrt{\frac{\left(3.8+\left(\frac{4}{3}\right)4.4\right)\times10^{10}}{2650}} =$ 5.49×10^5 Hz	L	A	1
Q2(a)	What is piezo-electric effect? Describe with the help of a diagram an oscillator which produces ultrasonic waves using inverse piezo-electric effect. What are the formulae for the frequency of the oscillator and mechanical frequency of piezo-electric crystal? What is the relationship between these two frequencies?	[6]	Piezo-electric effect statement - 1M, diagram and description - 3M, Oscillator frequency and mechanical frequency - 1M, relationship - 1M	M	K, C	1
Q2(b)	Explain what is reverberation time and how is it measured? Draw appropriate diagrams for both.	[4]	Explain reverberation time (with diagram) - 2M How to measure it (with diagram) - 2M	M	A, K	1
Q2(c)	A window opens on a busy street. Street noise results in an intensity level of 60 dB at the window of area 1.58 m^2. How much acoustic power enters the window, via the sound wave. Given threshold sound intensity I_0 = 10^{-12} W/m^2.	[4]	Intensity $I = \frac{P}{A}$ and $I_L = 10log_{10}\left(\frac{I}{I_0}\right)$ $\therefore I = I_0 \times 10^{(I_L/10)} = \frac{P}{A}$ $\therefore P = A \times I_0 \times 10^{(I_L/10)}$ $= 1.58 \times 10^{-12} \times 10^{(60/10)}$ $= 1.58 \times 10^{-6} W$	H	A	1
Q3(a)	Derive the conditions for constructive and destructive interference for reflection from a thin uniform film with thickness t and refractive index μ surrounded by two media with refractive indices μ_1 and μ_2, respectively. Light is incident through medium with refractive index μ_1. Given	[6]	Diagram - 1M, derivation for Δ - 3M, condition for constructive and destructive interference - 1M each	M	K, C	2

	$\mu_1 < \mu$ and $\mu > \mu_2$.					
Q3(b)	Draw a ray diagram for Fraunhofer diffraction from a diffraction grating and define β. Assuming, $E_\theta = E_m\left(\frac{\sin\alpha}{\alpha}\right)\left(\frac{\sin N\beta}{\sin\beta}\right)$, derive the conditions for principal maxima and minima and intensity for principal maxima.	[6]	Ray diagram and definition- 2M, conditions and intensity for principal maxima and minima- 4M	M	K, C	2
Q3(c)	Calculate the angles at which the first dark and the next bright band are formed in the Fraunhofer diffraction pattern of a slit of width 0.2 mm. Given λ = 5890 Å.	[4]	a = 0.2 mm, λ = 5890 Å = 5890 × 10^{-7}mm *Condition for minima:* $a sin\theta = n\lambda$ $\therefore \theta = sin^{-1}\left(\frac{n\lambda}{a}\right)$ n = 1, $\theta = sin^{-1}\left(\frac{1 \times 5890 \times 10^{-7}}{0.2}\right) =$ 0.1687 *degrees* Condition for first secondary maximum is $a sin\theta = (n + {}^1\!/_2)\lambda$ $\therefore\ \theta = sin^{-1}\left(\frac{(n + {}^1\!/_2)\lambda}{a}\right)$ $\theta = sin^{-1}\left(\frac{1.5 \times 5890 \times 10^{-7}}{0.2}\right)$ $= 0.253 degrees$	M	A	2
Q4(a)	Discuss with the help of a diagram, the basic design of a spectrometer, using transmission diffraction grating and an array light detector.	[6]	Diagram – 1M, 1M each for different parts of a spectrometer	M	C, A	2
Q4(b)	With the help of a neat diagram, explain the working of anti-reflection coating (ARC) on the basis of interference from a thin film. Derive (a) the minimum thickness and (b) refractive index of the ARC for normal incidence of light. What is the main purpose of ARC on (i) spectacles made of glass (μ = 1.5) and (ii) Solar cell made of Si (μ = 3.45)?	[6]	Diagram – 1M, Derivation of thickness– 1.5M, Derivation of refractive index– 1.5M, Purpose: spectacles - 1M, Solar cell – 1M	M	C, A	2
Q4(c)	Interference fringes are produced with monochromatic light falling normally on a wedge shaped film of cellophane whose refractive index is 1.4. The angle of wedge is 20 seconds of an arc and the distance between successive fringes is 0.25 cm. What is the wavelength of light used?	[4]	$\beta = \frac{\lambda}{2\mu\theta} \therefore \lambda = 2\mu\beta\theta$ $= 2 \times 1.4 \times 0.25 \times \frac{20}{3600} \times \frac{\pi}{180}$ $\beta = 6.787 \times 10^{-5} cm = 6787$ Å	M	A	2