**SEPTEMBER 2017 / IN - SEM (T1)**
**F. Y. B.TECH. (COMMON) (SEMESTER - I)**
**COURSE NAME : Engineering Physics**
**(2017 PATTERN)**

Marking scheme

| Q. no. | Question | Marks | Distribution | Difficulty level | Cognitive level | CO |
|---|---|---|---|---|---|---|
| Q1(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 – 1M<br>Diagram – 1.5M<br>Description – 2M<br>$f_e - 0.5M$<br>$f_m - 0.5M$<br>$f_e = f_m - 0.5M$ | M | K,C | 1 |
| Q1(b) | With the help of a diagram, define intensity and intensity level of sound at a distance $r$ from a point source with power P. | [4] | Diagram – 1M<br>Intensity – 1.5M<br>Intensity level – 1.5M | M | K | 1 |
| Q1(c) | An auditorium of volume 5500 $m^3$ is found to have reverberation time of 2.5 s. The sound absorbing surface of the auditorium has an area of 750 $m^2$. Calculate the average absorption coefficient of the auditorium. | [4] | $t_r = \frac{0.161 \times V}{\Sigma aS}$, $\therefore \Sigma aS = \frac{0.161 \times V}{t_r} = \frac{0.161 \times 5500}{2.5}$<br>$\Sigma aS = 354.2\ Sabine - m^2$<br>$a_{avg} = \frac{\Sigma aS}{\Sigma S}$<br>$= 0.47\ Sabine\ or\ OWU$ | M | A | 1 |
| 2(a) | Enumerate the possible sources of noise and discuss the remedies to reduce them in an auditorium. | [6] | Three Sources and remedies – 2 marks each | M | K | 1 |
| Q2(b) | With the help of a diagram, define laws of reflection and refraction for sound. What is echo? | [4] | Diagram – 1M<br>Reflection – 1M<br>Refraction – 1M<br>Echo – 1M | L | K | 1 |
| Q2(c) | Calculate the thickness of a quartz plate required to produce ultrasonic waves of frequency 2 MHz. Given: For quartz, Density = 2650 kg/$m^3$, Bulk modulus B = 3.8 $\times 10^{10}$ N/$m^2$ and Shear modulus S = 4.4 $\times 10^{10}$ N/$m^2$. | [4] | Formula: $t = \frac{1}{2f}\sqrt{\frac{B+\left(\frac{4}{3}\right)S}{\rho}} = \frac{1}{2\times2\times10^6}\sqrt{\frac{\left(3.8+\left(\frac{4}{3}\right)4.4\right)\times10^{10}}{2650}}$<br>$= 3.02 \times 10^{-3}\ m = 3.02\ mm$ | L | A | 1 |
| Q3(a) | With the help of a neat diagram, derive an expression for fringe width | [6] | Diagram – 2M<br>Derivation – 4M | M | K,C | 2 |

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| | for interference due to reflection from a thin wedge shaped film when illuminated by an extended source of monochromatic light. | | | | | |
| 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] | Diagram – 2M<br>Condition and intensity for PM – 2M<br>Condition for minima – 2M | M | K, C | 2 |
| Q3(c) | $Si_3N_4$ with refractive index μ = 2.0458 is used as anti-reflection coating (ARC) on Si solar cell. The refractive index of Si is 3.45. Calculate the thickness of $Si_3N_4$ film as ARC. Assume, λ= 5500 Å. | [4] | $t = \frac{\lambda}{4\mu} = \frac{5500 \times 10^{-10}}{4 \times 2.0458} m$<br>$t = 672.1 \times 10^{-10} m$<br>t=0.06721 μm | L | A | 2 |
| Q4(a) | a)Derive the conditions and expressions for intensity of light for principal maximum and minima in Fraunhofer diffraction from a single slit using a phasor diagram. | [6] | Ray diagram – 1M, Phasor diagram – 1M, Condition for PM – 2M, Condition for minima – 2M | M | K, C | 2 |
| Q4(b) | 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 $\mu_1$ and $\mu_2$, respectively. Light is incident through medium with refractive index $\mu_1$. Given $\mu_1 < \mu < \mu_2$. | [6] | Ray diagram – 1M, Geometrical path difference – 2M, Stokes law – 1M, Condition for Constructive – 1M, Condition for destructive – 1M | M | K, C | 2 |
| Q4(c) | A diffraction grating which having 6000 lines/cm is used at normal incidence. Calculate the dispersive power of the grating in the third order spectrum of wavelength region 5500 Å. | [4] | $\theta = sin^{-1}(mM\lambda)$<br>$= sin^{-1}(3 \times 6000 \times 5500 \times 10^{-8})$<br>=81.89<br>$\frac{d\theta}{d\lambda} = \frac{mM}{cos\theta} = \frac{3 \times 6000}{cos 81.89}$<br>$\frac{d\theta}{d\lambda} = 127592.6 \frac{degree}{cm}$<br>$= 0.0013^\circ/Å$ | H | A | 2 |