DTU/2K14/A2/240

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FIRST SEMESTER B.Tech. (ALL BRANCHES)

END SEMESTER EXAMINATION Nov-2014

AP-103 Applied Physics-I (Group A & B)

Time: 3:00 Hours *Max. Marks : 70*

Note : Answer any *FIVE* questions.
Assume suitable missing data, if any.

1. (a) Define longitudinal waves and transverse waves. Obtain an expression for the wave equation of longitudinal waves. (6M)
(b). The quality factor in a damped oscillator is 5×10^4. After what time, its energy will fall to $1/10^{th}$ of its initial value? The frequency of oscillator is 300 Hz and use $\log_e 10 = 2.30$. (4M)
(c). Obtain the expression for maximum amplitude in case of forced oscillations and draw curve for sharpness of resonance. (4M)

2. (a). A body moving with velocity v has a mass m. Show that

$$m = \frac{m_0}{\sqrt{(1-\frac{v^2}{c^2})}}$$

where, m_o is the rest mass of the body and c is the speed of light (6M)
(b). How fast must a rocket move relative to an observer in order that its length may appear to the observer to be 99% of its proper length? (4M)
(c). Deduce Einstein's mass energy relation, $E = mc^2$. Give some evidence showing its validity. (4M)

3. (a). Define characteristic impedance with formula. Discuss reflection and transmission of waves on a string at boundary and derive reflection and transmission coefficients. (6M)

(b). An electron (rest mass = 9.1×10^{-31} kg) is moving with speed 0.99c. What is its total energy? Find the ratio of Newtonian Kinetic energy to the relativistic kinetic energy. ($c = 3 \times 10^8$ m/sec) (4M)

(c). Show that in presence of damping, the frequency of an oscillator reduces by $12.5Q^2\%$, where Q is its quality factor. (4M)

4. (a). Define coherence? Deduce expressions for the constructive and destructive interference patterns in terms of path difference. (6M)
(b). Show that interference pattern produced by light obeys law of conservation of energy. (4M)
(c). Two beams of light having intensities "A" and "4A" are superimposing to produce a fringe pattern on a screen. The phase difference between the beams is "$3\pi/2$" and "2π" at points P and Q. Find the difference between the resultant intensities at P and Q. (4 M)

5. (a). Define double refraction? Describe the construction, working condition, limiting conditions and applications of Nicols prism. (6M)
(b). Describe the production and detection of plane polarized, circularly polarized and elliptically polarized light beams. (4M)
(c). Calculate the thickness of half-wave plate for sodium light (589.3 nm), if μ_0=1.54 and the ratio of velocity of ordinary and extraordinary wave is 1.007. (4M)

6. (a). Describe the construction and working condition of Helium-Neon laser with suitable energy level diagram. (6M)
(b). Deduce the relationship between Einstein's coefficients. (4M)
(c). What are spherical and chromatic aberrations. Explain how they can be reduced. (4M)

7. (a). Define numerical aperture and deduce the expression for numerical aperture. (6M)
(b). Distinguish Ramsden's and Huygens eye pieces. (4M)
(c). State and explain Rayleigh's criterion and derive an expression for resolving power of a plane transmission grating using this criterion. (4M)