 Roll No. XB6/LE/58

FIRST SEMESTER **B.Tech.(Group A & B)**

END SEMESTER EXAMINATION ***NOVEMBER-2010***

AP-103 APPLIED PHYSICS-I

Time: 3 Hours *Max. Marks : 70*

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

1[a] Explain 'length contraction' in relatively. Show the reciprocity of length contraction. **6**

[b] With what objective Michelson-Morley experiment was carried out? At what conclusion they arrive at? Briefly discuss the significance of the result of this experiment (Derivation not required). **4**

[c] Show that the momentum of a particle of rest mass m_0 and kinetic energy K can be expressed as

$$p = \sqrt{\frac{K^2}{c^2} + 2m_0K}$$ **4**

2[a] Show that the energy of a damped harmonic oscillator at any instant of time t is given by

$$E = E_0e^{-2rt}$$

where the symbols have their usual meanings Define the relaxation time τ of the oscillator and show

$$\tau = \frac{1}{2r}$$ **6**

[b] With the help of a suitable diagram discuss the 'sharpness of resonance' of a forced oscillator. Hence explain the dependence of the sharpness of the resonance on the damping. **4**

[c] The quality factor of a vibrator is 1500. On starting the vibrations, it executes 250 vibrations per second. Calculate the time in which the amplitude decreases to $\frac{1}{e^3}$ of the initial value. **4**

3[a] Discuss reflection and transmission of waves on a string at a boundary. Hence show that when a wave is completely reflected phase reversal takes place. 6

[b] Explain 'impedance matching' and its significance. Mention the conditions for energy reflection between two strings with an intervening string. 4

[c] Define 'specific acoustic impedance' and show that it is equal to product of density of the medium and the wave velocity. 4

4[a] Define 'interference' and 'fringe'. Explain the need of coherent sources for an interferometer. Name the two methods for obtaining coherent sources. 5

[b] Define chromatic resolving power and obtain an expression for it for a diffraction grating. On what factors the resolving power of a diffraction grating depend. 5

[c] A diffraction grating contains 15000 lines per inch. Find the highest order of the principal maximum visible with light of wavelength 6000Å using this grating. 4

5[a] Discuss Fresnel's diffraction at a straight edge and obtain the expressions for the locations of the bright and dark diffraction bands. Hence point out two differences between diffraction bands and interference bands. 7

[b] What is double refraction? Why quartz is a doubly refracting substance but not glass? Explain. 3

[c] What is the least thickness of a calcite crystal plate which can be used for the production of circularly polarized light of wavelength 5890 Å. For λ=5890Å, μ_0 = 1.658 and μ_E= 1.486. Also, give two other values of thickness which can serve the purpose. 4

6[a] When a beam if light is incident on a rotating Nicol prism, the intensity never diminishes to zero. Is the light plane polarized? Suggest the procedure to find out the nature of polarization of the incident light. 4

[b] What do you mean by achromatism? Show that for a combination of two lenses to be achromatic the separation between the two lenses must be equal to the mean focal lengths of the two lenses. 5

[c] What is an eyepiece and what are its advantages over a simple objective lens. Differentiate between Ramsden's and Huygen's eyepieces. 5

7[a] What do you mean by 'population inversion and lasing action'? Explain the need of population inversion to achieve lasing action. 4

[b] Name the essential components of a laser system and discuss them in the context of a Ne-Ne laser. 5

[c][Define monochromaticity? What is its value for a perfectly monochromatic light? The typical values of $\Delta\nu$ for laser light is 500 Hz and that for ordinary light is 10^{10}Hz. Calculate monochromaticity in each case. What conclusion can you draw? 5

8[a] What is optical fiber? Differentiate between (i) step-ndex (SI) optical fiber and (ii) graded-index (GRIN) optical fiber and discuss light propogation through them. Mention two advantages and two disadvantages of GRIN fibers over SI fibers. 6

[b] What do you mean by 'pulse dispersion' in an optical fiber? Name the types of dispersion and briefly introduce them. 4

[c] A SI multimode fiber has a core of refractive index 1.500 and cladding of refractive index 1.498. Calculate its (i) numerical aperture (ii) intermodal dispersion (iii) dispersion in 15 km length of fiber and (iv) maximum bit rate permissible for he fibre. 4