



Name :

Roll No. :

Invigilator's Signature :

CS/M.TECH(ECE-COMM)/SEM-2/MCE-201/2012

2012

PHOTONICS AND OPTICAL COMMUNICATION

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A

Answer any *five* of the following questions.

$$5 \times 2 = 10$$

1. a) What is the V-no. of a fibre ?
- b) What is Q -factor of a linear cavity ?
- c) What are the causes of attenuation in optical fibres ?
- d) Why does crosstalk occur in a WDM system ?
- e) What is Intermodal distortion in optical waveguide ?
- f) Why is a ring topology considered reliable ?
- g) What is the scientific meaning of the term
 'monochromatism' ?



GROUP-B

Answer any *five* of the following questions.

$$5 \times 12 = 60$$

2. a) What are the advantages of optical fibre cable over co-axial cable ?
- b) What is meant by acceptance angle for an optical fibre ?
- c) Show how this is related to numerical aperture in case of a graded index fibre.
- d) A silica optical fibre with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47.

Determine the following :

- (i) The critical angle at the core-cladding interface
- (ii) The numerical aperture (NA) for the fibre
- (iii) The acceptance angle in air for the fibre.

$$3 + 2 + 4 + 3$$

3. a) What is Mode Locking ?
- b) Show that, to obtain high power short duration pulses there should be a large number of modes.
- c) Derive the expression for the threshold gain coefficient required to sustain laser oscillations in a given system.

$$2 + 6 + 4$$



4. a) Discuss working principles of Adaptive Optics Imaging system with suitable block diagram.
- b) How can Shack-Hartman sensor measures tilt of the waveform in the sampling zone ?
- c) What are the limitations of Shack-Hartman sensor ?

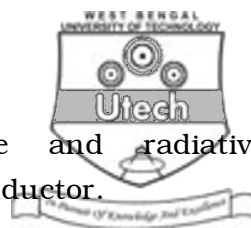
5 + 5 + 2

5. a) Explain detection process in the $p-n$ photodiode. Compare this device with $p-i-n$ photodiode.
- b) Define Quantum efficiency and responsivity of a photo-detector. Derive an expression for the responsivity of an intrinsic photo-detector in terms of the quantum efficiency of the device and the wavelength of the incident radiation.
- c) GaAs has band gap energy of 1.43eV at 300 K. Determine the wavelength above, which an intrinsic photo-detector fabricated from this material, will cease to operate.

(3 + 3) + (2 + 2) + 2

6. a) Show that the overall transfer function of an optical fibre communication system is the product of the transfer function of each block.
- b) Discuss any one topology for multihop light wave networks.

7 + 5



7. a) Distinguish between non-radiative and radiative recombination processes in a semiconductor.

b) Compare surface emitter LED and edge emitter LED.

c) Prove that the coupling efficiency at a planar LED is $(NA)^2$.

d) A GaAs LED has the following parameters :

$$D_n = 30 \text{ cm}^2/\text{V} - \text{s} \quad D_p = 15 \text{ cm}^2/\text{V} - \text{s} \quad N_a = 5 \times 10^{16} \text{ cm}^{-3}$$

$$N_d = 5 \times 10^{17} \text{ cm}^{-3} \quad \tau_n = 10^{-8} \text{ s} \quad \tau_p = 10^{-7} \text{ s}$$

Calculate the injection efficiency of the LED. $2 + 3 + 4 + 3$

8. Write short notes on any *three* : 3×4

a) Fibre Bragg grating

b) Optical Power budget

c) SONET/SDH

d) WDM

e) Erbium-doped fibre amplifier (EDFA).
