



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.

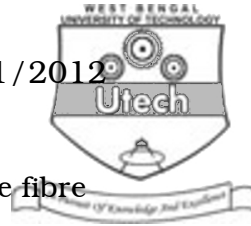
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *seven* of the following : $7 \times 2 = 14$

- i) Most suitable fibre for WDM applications is
 - a) dispersion optimized
 - b) dispersion shifted
 - c) dispersion flattened
 - d) none of these.
- ii) The cut-off wavelength of a step-index single-mode fibre with a core diameter of $8.2 \mu\text{m}$ and $\text{NA} = 0.12$, is
 - a) $0.850 \mu\text{m}$
 - b) $1.285 \mu\text{m}$
 - c) $1.320 \mu\text{m}$
 - d) $1.550 \mu\text{m}$.



- iii) Single mode fibre has
 - a) less modal noise than multi-mode fibre
 - b) larger value of V-number than multi-mode fibre
 - c) leaky mode due to radiation loss
 - d) larger value of output intensity than multimode.
- iv) In comparison to LED, Laser has
 - a) no tuning arrangements
 - b) higher emission efficiency
 - c) narrow spectral width
 - d) provision for confinement.
- v) Which of the following semiconductors can be used to fabricate LED ?
 - a) Si
 - b) Ge
 - c) GaAs
 - d) None of these.
- vi) Which of the following has more sensitivity ?
 - a) *p-i-n* diode
 - b) APD
 - c) neither (a) nor (b)
 - d) either (a) or (b).
- vii) Photodetector is a
 - a) triangular device
 - b) square law device
 - c) linear device
 - d) none of these.
- viii) The V no. of an optical fibre is 50. The no. of modes in the fibre is approximately
 - a) 50
 - b) 1000
 - c) 1250
 - d) 2500.
- ix) Intermodal dispersion is zero for
 - a) single mode fibre
 - b) multimode step index fibre
 - c) multimode graded index fibre
 - d) plastic fibre.



GROUP – B

(Long Answer Type Questions)

Answer any *four* of the following. $4 \times 14 = 56$

2. a) What are the key requirements for analyzing a link ? 2
- b) What are the advantages of Laser diode than LED as optical source ? 2
- c) The refractive index of the core of an optical fibre is 1.55 and that of clad is 1.51. The light is launched into the fibre from air. Determine
 - i) numerical aperture
 - ii) acceptance angle and
 - iii) multiple time dispersion. 6
- d) A multimode fibre has a core refractive index of 1.5. The relative refractive index difference is 3 per cent. The operating wavelength is $0.80 \mu\text{m}$. Calculate the critical radius of bending. 4
3. a) Discuss, with neat diagrams, the methods of obtaining the following :
 - i) Dispersion shifted single-mode fibres
 - ii) Dispersion flattened single-mode fibres. 3 + 3
- b) In a step-index single-mode fibre, core refractive index = 1.48 and $\Delta = 1.0\%$. If the material dispersion at $1.55 \mu\text{m}$ is $7 \text{ ps nm}^{-1} \text{ km}^{-1}$, estimate the required core radius for achieving zero total dispersion at this wavelength. 5
- c) What is the need for AGC circuit in an optical receiver system ? 3
4. a) Deduce an expression for internal quantum efficiency of an LED. 4
- b) What do you mean by responsivity of a photo-detector ? Deduce an expression for responsivity of a photodetector. 2 + 3
- c) Explain the operation of Nd doped fibre laser. 5



5. a) What are the different kinds of absorption losses take place in optical fibre ? Explain in brief. 6
- b) Give a comparison between Stimulated Raman Scattering and Stimulated Brillouin Scattering. 4
- c) The average optical power launched into a 10 km length of fibre is $100 \mu\text{W}$ and the average output power is $2.5 \mu\text{W}$. Calculate the signal attenuation per km of the fibre and the total signal attenuation for the entire length. 4
6. a) Explain in brief the different kinds of three and four port optical coupler. 4
- b) Explain in brief Link Power Budget and Rise Time Budget. 3 + 3
- c) The rms pulse broadening within a fibre system is 0.6 ns/km . Calculate the dispersion equalization penalty over an unrepeatd length of 8 km at a bit rate of 25 Mbits/sec. Consider with mode coupling and without mode coupling both. 4
7. a) Distinguish between WDM and DWDM systems. Draw the block diagram and explain the working principle of a WDM system. 2 + 5
- b) A 2×2 directional coupler uses two identical lossless single-mode fibres. Establish the theory behind the operation of such a coupler. Determine the interaction length so that the input power P_0 is divided equally at two-output ports. 7
8. Write short notes on any *two* of the following : 7 + 7
 - a) Polarization Maintained Single Mode Fibre
 - b) Photonic Packet Switching
 - c) Erbium-doped Fibre Amplifiers
 - d) Coherent detection principle
 - e) Fibre Bragg Grating.

