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 × 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 μm and NA = 0.12, is

      a) 0.850 μm b) 1.285 μm

      c) 1.320 μm d) 1.550 μm .

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 × 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 μm. 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 Δ = 1.0%. If the material dispersion at 1.55 μm is 7 ps nm^{-1} 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 μW and the average output power is 2.5 μW. 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 unrepeated 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.