



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.

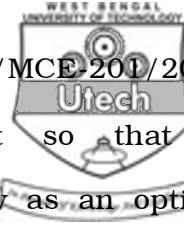
Answer Question No. 1 and any four from the rest.

1. Attempt *all* questions : 7 × 2

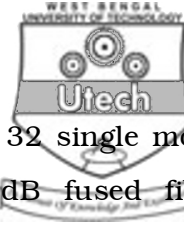
- a) Define numerical aperture (NA) of a fibre. On what factors does it depend ?
- b) What is gain ripple in a SOA ?
- c) Mention two applications of optical amplifier.
- d) What is the difference between spontaneous emission and stimulated emission ?
- e) Differentiate active and passive optical devices.



- f) There is a fibre optic star network containing 10 stations in which station is located at a distance of 500 metres from the star coupler and fibre attenuation is 0.4 dB/km. If excess loss and connector loss in the network be 1.25 dB and 1.0 dB respectively, determine the power margin between the transmitter and the receiver in the star network.
- g) What are the different SONET layers ?
2. a) What are the essential requirements in selecting the material for manufacturing optical fibres ? 3
- b) In what way the photonic crystal fibre differs from the photonic bandgap fibre ? 3
- c) What are the advantages of the optical fibre communication system ? 4
- d) Calculate the NA of a step-index fibre having $n_1 = 1.48$ and $n_2 = 1.46$. What is the maximum entrance angle for this fibre if the outer medium is air with $n = 1.00$? 4
3. a) What is the necessity of optical amplification ? 2
- b) Explain the basic principle of operation of semiconductor optical amplifier. 4



- c) What requirements must be met so that a semiconductor DH functions efficiently as an optical amplifier ? 4
- d) What is 3 dB saturation power of a SOA ? Find out its value. 1 + 3
4. a) Name the most commonly used optical sources in FOC. Why are they so frequently used ? 1 + 2
- b) What are the Einstein's co-efficients ? Derive the threshold condition for laser action. 2 + 3
- c) What is an internal quantum efficiency of an LED ? Derive it. 4
- d) Mention the different loss-mechanisms that the photon may encounter when produced in a semi-conductor. 2
5. a) Define different types of losses of passive linear buses in optical network. Obtain the expression for
- i) Nearest Neighbour Power Budget.
- ii) Largest Distance Power Budget. 10
- b) Briefly explain multichannel amplitude modulation in optical communications. 4



6. a) Consider a commercially available 32×32 single mode coupler made from a cascade of 3 dB fused fibre 2×2 couplers where 5% of power is lost in each element. Determine
- i) The number of 3 dB 2×2 couplers required to construct the 32×32 star coupler.
 - ii) Excess loss
 - iii) Splitting loss. 6
- b) Explain how wavelength division multiplexing and demultiplexing with four wavelengths can be achieved with
- i) Fibre Bragg grating and circulators
 - ii) Dielectric thin film filters. 8
7. a) Find the data rate of STS-3 signal. What is the duration of STS-3 frame ? What is the duration of STS-9 frame ?
- $2 + 1 + 1$
- b) Explain how a four fibre bidirectional line switched ring can be reconfigured in case of node failure ? 4
 - c) Discuss optical crossconnect architecture using optical space switches and no wavelength converters. 6

