

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 *ten* of the following :

10 × 1 = 10

- i) Erbium-doped fibre amplifiers are
 - a) the most efficient fibre amplifiers
 - b) the type of fibre amplifier offering the lowest noise figure
 - c) operating in the wavelength region where standard single-mode fibres have lowest losses
 - d) suitable for transparent optical network, since they simply transmit any input signal when not being pumped.

30300 (M.Tech)

[Turn over



- ii) Large mode area single-mode fibres usually have a rather small numerical aperture to
- a) achieve single-mode guidance
 - b) help limiting bending losses
 - c) attenuate higher-order modes via bending
 - d) make them compatible with standard single-mode fibres.
- iii) When a beam of light travels through an optical fibre occurs.
- a) reflection
 - b) refraction
 - c) incidence
 - d) criticism.
- iv) LED is a/an
- a) monochromatic source
 - b) incoherent source
 - c) single mode source
 - d) coherent source.
- v) Which method allows large number of independent, selective channels to exist on a single fibre ?
- a) Frequency Division Multiplexing
 - b) Time Division Multiplexing
 - c) Analogue Modulation
 - d) Phase Modulation.



vi) Which type of optical fibre would be best suited in the Multi Channel Architecture (MCA) ?

- a) Reflective-index b) Step-index
- c) Graded-index d) None of these.

vii) Which of the following photo-diodes has internal gain ?

- a) $p-n$ junction
- b) $p-i-n$ junction
- c) Metal-semiconductor junction
- d) APD.

viii) Pockel effect is with respect to applied voltage.

- a) linear b) quadratic
- c) exponential d) cubic.

ix) Amplified spontaneous emission (ASE) is usually not strong in a Nd : YAG laser, as compared to a fibre laser because

- a) there is no waveguide to confine the randomly emitted fluorescence
- b) most Nd : YAG lasers have a low gain
- c) the emission bandwidth of Nd : YAG is small
- d) Nd:YAG is a four-level laser medium.



- x) Which of the following happens to be the limitations of an optical fibre ?
- I. The architecture of their couplers
 - II. Costs of implementing them
 - III. Modification of the software and hardware on existing systems
 - IV. The difficulty of installing the cable.
- a) II and IV
 - b) I, II and III
 - c) I, III and IV
 - d) I, II, III and IV .
- xi) Which of the following describes a technique to achieve fault tolerance in optical networks with minimum cost ?
- a) Bypassing active elements
 - b) Avoiding the usage of star couplers
 - c) Duplication of system properties
 - d) Topological reconfiguration.
- xii) Which of the following is not true about digital signals used in fibre optic transmission ?
- a) It is more compatible with people
 - b) It is much simpler to design a circuit or detect the signal level
 - c) There is less distortion in the signal as it goes through a system
 - d) It is not difficult to differentiate the on from the off state even if the signal is not reproduced exactly.



GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following.

3 × 5 = 15

2. What is the basic principle of electro-optic modulators ?
3. Explain the technique of digital laser modulation.
4. Briefly discuss Brillouin fibre and Raman amplifier.
5. Explain the working principle of fibre Bragg grating.
6. a) What do you mean by V-parameter ?
b) A single mode step index fibre has a core diameter and numerical aperture of $3\mu\text{m}$ and 0.1 respectively. Calculate the
 - i) normalized frequency of the fibre
 - ii) the number of guided modes. 3 + (1 + 1)

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following.

3 × 15 = 45

7. a) How can the photo-sensitivity of doped silicon fibre be increased ?
b) Discuss three different types of efficiency of semiconductor laser.
c) A double-heterojunction InGaAsP LED emitting at peak wavelength of 1310 nm has radiative and non-radiative recombination time of 30 ns and 100 ns, respectively. The driver current is 40 mA. Calculate
 - i) the bulk recombination lifetime
 - ii) the internal quantum efficiency
 - iii) internal power level. 4 + 5 + (2 + 2 + 2)

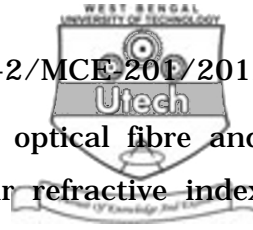


8. a) When an optical signal passes through a fibre, it is attenuated and distorted progressively. What are the factors responsible for attenuation and distortion ?
- b) Establish the relation between material dispersion and wavelength.
- c) A laser source emits light at $0.85 \mu\text{m}$ having a spectral width of $0.003 \mu\text{m}$. The material dispersion coefficient is 0.021 . Find the value of bandwidth distance product.

4 + 8 + 3

9. a) Discuss the principle of operation of a light emitting diode.
- b) What is its internal quantum efficiency ?
- c) Obtain the expression of light intensity from a light emitting diode with respect to current applied to it.
- d) Consider a diffuse light source situated on the fibre axis near the end face, having the intensity (I) distribution pattern $I = I_0 \cos \theta$. Show that the ratio of the optical power coupled to the fibre and that emitted from the diffuse source is $(NA)^2$, where (NA) is the numerical aperture of the fibre.

4 + 3 + 3 + 5



10. a) What do you mean by graded index optical fibre and step index optical fibre ? Draw their refractive index profiles.
- b) What is bit error rate in optical fibre communication ? Obtain the expression of bit error rate from Poisson distribution.
- c) What is evanescent wave ? Obtain an expression for representing the wave.

$$(2 + 2 + 1 + 1) + (2 + 2) + (2 + 3)$$

11. a) What is a Semiconductor laser ?
- b) What is the function of laser cavity ?
- c) Express the threshold condition for lasing.
- d) What is heterojunction laser ?
- e) Discuss the main advantages of heterojunction laser over homojunction laser.

$$2 + 4 + 4 + 3 + 2$$

12. Write short notes on any *three* of the following : 3×5

- a) Avalanche Photo Diode (APD)
- b) Parabolic index optical fibre
- c) Optical fibre coupling
- d) Photonic packet swithcing
- e) Synchronous Optical Networking (SONET).

