



Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (ECE-O)/SUPPLE/SEM-8/EC-802/2010

2010

OPTICAL FIBRE 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) The material for making an efficient LED should be
 - a) a metal
 - b) a direct band gap semiconductor
 - c) an indirect band gap semiconductor
 - d) an insulator.
- ii) A step-index fibre has a core with a refractive index of 1.5 and a cladding with a refractive index of 1.46. Its numerical aperture is
 - a) 0.156
 - b) 0.244
 - c) 0.344
 - d) 0.486.



- iii) Which of the following is an inherent property of an optical signal and cannot be eliminated even in principle ?
- a) Thermal noise b) Shot noise
- c) Background noise d) Environmental noise.
- iv) Which of the following detectors gives amplified output ?
- a) P-N photodiode b) P-I-N photodiode
- c) Avalanche photodiode d) Photovoltaic detector.
- v) Two optical fibres with numerical apertures 0.17 and 0.2 are to be spliced. What will be the loss at the joint in the forward direction ?
- a) Zero b) 0.41 dB
- c) 1.82 dB d) 2.5 dB.
- vi) Rayleigh scattering coefficient τ_R depends on the wavelength λ of the light as
- a) $\tau_R \propto \log \lambda$ b) $\tau_R \propto \lambda^4$
- c) $\tau_R \propto \lambda$ d) $\tau_R \propto \frac{1}{\lambda^4}$.
- vii) Optical bandwidth is always
- a) greater than the electrical bandwidth
- b) less than the electrical bandwidth
- c) equal to the electrical bandwidth
- d) square of the electrical bandwidth.



xi) A 1×10 coupler has an input signal 0 dBm. The power level at each output port is

- a) 0 dBm b) -1 dBm
- c) -3 dBm d) -10 dBm.

xii) The responsivity of a given P-I-N diode is 0.5 AW^{-1} for a wavelength of $1 \mu\text{m}$. What is the output photocurrent when optical power of $0.2 \mu\text{W}$ at this wavelength is incident on it ?

- a) $1 \mu\text{A}$ b) $0.1 \mu\text{A}$
- c) $10 \mu\text{A}$ d) 1 A.

xiii) Which of the following fibres is suitable for wavelength division multiplexing of signals ?

- a) Dispersion-optimized b) Dispersion-shifted
- c) Dispersion-flattened d) Any fibre.

xiv) For long-haul high speed link design the source-fibre combination of choice should be

- a) LASER-Single mode fibre
- b) LED-Single mode fibre
- c) LED-Multimode fibre
- d) LASER-Multimode fibre.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Define fibre acceptance angle and numerical aperture of a fibre. How are they related ?
3. What do you mean by a drive circuit of an optical source ?
Draw two suitable drive circuits for analog modulation of LED & LASER.
4. Draw the injection current *versus* emitted power curves of LED and LASER. Compare them.
5. How does the graded index fibre reduce intermodal dispersion ?
6. Explain the advantages of coherent detection system over the direct detection system.
7. Explain the operation of a WDM MUX based on Mach-Zehnder interferometer.
8. What do you mean by subcarrier multiplexing ? Explain the basic principle of AM/IM subcarrier multiplexing ?
9. Discuss the topology used in FDDI system for high speed data communication.



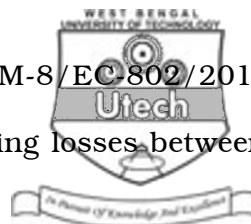
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following questions.

$$3 \times 15 = 45$$

10. a) What do you mean by coupling efficiency in optical fibre communication ? 3
- b) Why are optical isolators used in fibre optic communication link ? 5
- c) Show that the maximum coupling efficiency (η_c) between a source with Lambertian radiation pattern $I(\theta) = I_0 \cos \theta$ and a fibre is given by $\eta_c = (NA)^2$. 7
11. Compare optical direct detection and coherent detection techniques. Describe a simple coherent receiver ASK and derive expression for detected signal current with homodyne detection. 5 + 10
12. a) An 8 km optical fibre link without repeaters uses multimode GIF which has bandwidth-length product of 400 MHz km. Estimate —
- i) total pulse broadening on the link 4
- ii) rms pulse broadening on the link. 4
- b) What is optical power budgeting ? Why is system margin provided ? 7



13. a) What are the different types of coupling losses between two fibres ? 8
- b) Two compatible multimode SI fibres are joined with a small air gap. The fibre axes and end faces are perfectly aligned. Determine the refractive index of the fibre core if the joint is showing a loss of 0.47 dB. 7
14. a) What is the basic difference between a regenerative repeater and an optical amplifier ? 5
- b) Explain the mechanism of amplification in an EDFA with a suitable energy level diagram. 10
15. a) What is an ADD-DROP multiplexer ? With a neat sketch, explain its operation. 7
- b) With a neat sketch, explain the operation of an 8×8 star coupler. 8
16. a) Discuss with the aid of a suitable block diagram, a coherent optical fibre communication system. 11
- b) A 2×2 directional coupler has an input power level of $100 \mu\text{W}$. What is the coupling ratio ? 4
17. Write short notes on any *three* of the following : 3 × 5
- a) Intermodal dispersion
 - b) Raman scattering
 - c) Fibre optic network for LAN
 - d) Eye diagram
 - e) Drive circuits.

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