

CS/B.TECH/ECE/ODD SEM/SEM-7/EC-703B/2016-17



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**

Paper Code : EC-703B

OPTICAL COMMUNICATION AND NETWORK

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 : $10 \times 1 = 10$
- i) In purely single mode operation pulse broadening is due to
- a) Intermodal dispersion
 - b) Intramodal dispersion
 - c) Large bandwidth
 - d) None of these.

CS/B.TECH/ECE/ODD SEM/SEM-7/EC-703B/2016-17

- 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) $1.320 \mu\text{m}$
 - c) $1.285 \mu\text{m}$
 - d) $1.550 \mu\text{m}$.
- iii) Rayleigh scattering coefficient Γ_r depends on the wavelength λ of the light as
- a) $\Gamma_r \propto \log \lambda$
 - b) $\Gamma_r \propto \lambda^4$
 - c) $\Gamma_r \propto \lambda$
 - d) $\Gamma_r \propto 1/\lambda^4$.
- iv) What is the maximum limit of BER allowed in optical communication system for faithful digital transmission ?
- a) 10^{-9}
 - b) 10^{-19}
 - c) 10^{19}
 - d) 10^9 .
- v) Which of the following detectors gives amplified output ?
- a) *p-n* photodiode
 - b) pin photodiode
 - c) Avalanche photodiode
 - d) Photovoltaic detector.

- vi) Most suitable fibre for WDM applications is
- Dispersion optimization
 - Dispersion flattened
 - ☒ Dispersion shifted
 - None of these.
- vii) Which of the following is true for LASER ?
- Spatial coherence
 - Temporal coherence
 - ☒ Both (a) and (b)
 - None of these.
- viii) Which of the following is an inherent property of an optical signal and cannot be determined even in principle ?
- thermal noise
 - Shot noise
 - ☒ Background noise
 - Environmental noise.
- ix) Which of the following pairs is suitable for making a heterojunction ?
- Si and Ge
 - Si and Ga As
 - GaAs and AlAs
 - ☒ GaAs and GaAlAs.

- x) Erbium doped fiber amplifiers operate at which of the following window(s) ?
- ☒ Low dispersion window (around 1300nm)
 - Low dispersion window (around 1550nm)
 - Both of the windows
 - None of these.
- xi) The most common internal protocol is
- SONET
 - SDH
 - ☒ Ethernet
 - none of these.
- xii) Traditionally optical fibre link is
- Intensity modulated
 - ☒ Frequency modulated
 - Phase modulated
 - None of these.

GROUP - B**(Short Answer Type Questions)**

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

2. a) What are the differences between meridional rays and skew rays ?
- b) Compare between step index fibre and graded index fibre.

2 + 3

3. What is optical power budgeting ? Why is system margin provided ? 3 + 2
4. Write down the operating principle of EDFA. *Erbium doped fibre amplifier*
5. For a 2×2 fibre optic coupler define (i) coupling ratio, (ii) excess loss, (iii) insertion loss and find the phase relation between them.
6. The core and cladding refractive indices of a multimode fibre are 1.503 and 1.5 and the operating wavelength is $1.55 \mu\text{m}$. Calculate the critical radius of curvature at which large bending loss occurs.

**GROUP - C****(Long Answer Type Questions)**

Answer any *three* of the following. $3 \times 15 = 45$

7. a) What are the advantages of LASER diode over LED ?
- b) Why is direct bandgap material used for LED ?
- c) The radiative and non-radiative recombination lifetime of the minority carriers in the active region of a double hetero-junction LED are 60 ns and 100ns respectively. Determine (i) the total carrier recombination lifetime, (ii) the power internally generated within the device when peak emission wavelength is $0.87 \mu\text{m}$ at a drive current of 40A.

$5 + 4 + 6 = 15$

8. a) Explain in brief the basic optical detection principle.
- b) What do you mean by quantum efficiency of a photodetector ?
- c) What do you mean by cut-off wavelength of a photodetector ?
- d) Photons of wavelength $0.90 \mu\text{m}$ are incident on a photodiode at a rate of $5 \times 10^{10}/\text{s}$ and on an average electrons are collected at the terminal of the diode at the rate of $2 \times 10^{10}/\text{s}$. Calculate (i) quantum efficiency and (ii) responsivity of the diode at this wavelength. 6 + 2 + 3 + 4
9. a) What is dispersion ? Deduce an expression for pulse broadening in case of intermodal dispersion.
- b) The n_1 of core and clad is 1.55 and 1.51 respectively. The light is launched into the fibre from air. Determine (i) numerical aperture, (ii) acceptance angle and (iii) multiple time dispersion.
- c) Explain intermodal and intramodal dispersion. What are dispersion-flattened fibres ? 1 + 6 + 4 + 2 + 2
10. a) Discuss receiver sensitivity & BER.
- b) Find out the expression for optical power at the detector to achieve desired error rate. 3 + 4 + 8

CS/B.TECH/ECE/ODD SEM/SEM-7/EC-703B/2016-17

11. Write short notes on any *three* of the following :

3 × 5 = 15

- ✓ a) Topology
 - ✓ b) ISDN
 - c) FDDI
 - ✓ d) PiN photodiode
 - e) OEIC.
-

<http://www.makaut.com>

<http://www.makaut.com>