(vi) The core of Dispersion Compensating Fiber (DCF) is fabricated using the core material
(a) $P_2O_5 - SiO_2$ Core (b) $GeO_2 - SiO_2$ Core
(c) $P_2O_5 - B_2O_3 - SiO_2$ Core (d) $B_2O_3 - SiO_2$ Core

(vii) In a $LiNbO_3$ based phase modulator, the phase shift $\Delta\Phi$ is related to index change Δn and wavelength λ by
(a) $\Delta\Phi \alpha \lambda/\Delta n$ (b) $\Delta\Phi \alpha \lambda\Delta n$
(c) $\Delta\Phi = \Delta n/\lambda$ (d) $\Delta\Phi = (\Delta n/\lambda)^2$

(viii) The value of system margin in a optical link for power budget calculation is typically taken to be
(a) 6dB (b) 2dB (c) 10dB (d) 15dB

(ix) A power level of 0 dBm corresponds to
(a) 0 mW (b) 0.1 mW (c) 1mW (d) 10 mW

(x) The basic line rate for an STM-N (Synchronous Digital Hierarchy, SDH level) is 39813.12 Mb/s. The SDH level is
(a) STM-4 (b) STM -16 (c) STM -64 (d) STM -256

Group - B

2. (a) What is meant by the term "Threshold current" in a semiconductor laser? Draw the variation of the light intensity vs. drive current in a semiconductor laser and locate the threshold current in the diagram.

(b) The threshold current of a semiconductor laser diode increases by a factor 2.3 when the temperature is increased by 42^0C. Find the characteristics temperature T_0 of the laser in the equation $I_{th} = I_{tho} \exp(T/T_o)$ where T is the temperature, I_{th} is the threshold current & I_{tho} is a constant

6 + 6 = 12

3. (a) Draw the variation of refractive index profile in the core of a single mode dispersion shifted optical fibre.

(b) Draw and explain the variation of absorption coefficient with wavelength for suitable semiconductors which can be used for fibre optic communication in the wavelength rage from 0.8 μm to 1.6 μm.

6 + 6 = 12

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Group - C

4. (a) Draw a block schematic showing a digital point-to-point link. Show the link power budget considering the optical power loss model of the link.

(b) In an optical link operating at 1399 nm, the laser diode emits 1mW of power from an attached fiber flylead to the link. A p-i-n photodiode with a sensitivity of -20dBm operates at 2.5 Gb/s. Two connectors each of 1 db loss is connected at the two ends of the link. Find the maximum link length possible considering that the optical fiber has a loss of 0.45 dB/km and the system margin of 6 dB.

6 + 6 = 12

5. (a) What do you understand by dispersion compensation? Discuss how dispersion compensation is carried out.
Draw the refractive index profile of a dispersion compensation fiber. Find the value of Figure-of-Merit (FOM) of a DCF.

(b) Draw a block schematic diagram showing a long haul system optical link with In-Line amplifiers and hence explain its important features.

6 + 6 = 12

Group - D

6. (a) Draw the block schematic of coherent lightwave communication system. Derive an expression for the photocurrent in a homodyne system. Discuss how the S/N ratio of a homodyne system can be substantially improved?

(b) Draw and explain the principle of operation of $LiNbO_3$ waveguide modulator in MAC gender configuration for ASK modulation format.

6 + 6 = 12

7. (a) What do you understand by the term wavelength division multiplexing (WDM)? Discuss a typical arrayed waveguide grating (AWG) which can be used as a multiplexer or a demultiplexer or a drop insert element.

(b) What is a tunable filter? Show the spectral profile of a fibre Bragg grating filter. Discuss how the wavelength can be adjusted.

6 + 6 = 12

Group - E

8. (a) Discuss the functional concept of an optical add drop Multiplexer (OADM) for SONET / SDH applications.

   (b) Draw a block schematic diagram showing DWDM deployment of n wavelength in an OC-192 (STM 64) trunk ring.

6 + 6 = 12

9. (a) What do you understand by the term Soliton communication? Distinguish between fundamental and higher order Soliton.

   (b) Discuss the temporal changes in a narrow high intensity pulse that is subject to scar effect as it propagates through a non linear dispersive fibre that has positive group velocity dispersion (GVD) parameter.

6 + 6 = 12

2016

PHOTONICS AND OPTICAL COMMUNICATION (ECEN 5201)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following: **10 × 1=10**

   (i) Which of the following material is suitable for fabricating an LED at 850 nm
   (a) Si (b) InGaP (c) Ge (d) GaAs

   (ii) Which of the following material is suitable as an optoelectronic detector at 1550 nm
   (a) Si (b) GaAs (c) Ge (d) CdS

   (iii) The dark current (in units of nA) for a germanium APD lies in the range of
   (a) 0.1 to 1.0 (b) 1.0 to 10.0
   (c) 50 to 500 (d) 2000 to 5000

   (iv) The no. of modes in a multimode step index fiber is typically given by (in terms of V, the modified frequency parameter) as
   (a) $\frac{V}{2}$ (b) $\frac{V^2}{4}$ (c) $\frac{V^2}{3}$ (d) $\frac{V^2}{2}$

   (v) The rare earth material suitable for doping glass fibers for operation as an optical amplifier at 1550 nm is
   (a) Ytterbium (Yb) (b) Praseodymium (Pr)
   (c) Thulium (Tm) (d) Erbium (Er)