ROLL NO. ______________

Code: AE75 Subject: OPTOELECTRONICS AND COMMUNI[...]

AMIETE – ET (NEW SCHEME)

Time: 3 Hours **JUNE 2012** Max. Marks: 10[...]

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. The refractive index of a transparent medium is the

(A) ratio of speed of light in medium to that in vaccum.
(B) ratio of speed of light in vaccum to speed of light in medium.
(C) ratio of phase of light in vaccum to phase of light in medium.
(D) ratio of phase of light in medium to phase of light in vaccum.

b. The cutoff value of the normalized frequency V_C to support a single mode in a graded index fiber is given by

(A) $V_C = 2.405\left(1+\frac{2}{\alpha}\right)^{1/2}$ **(B)** $V_C = 2.5\left(1+\frac{2}{\alpha}\right)^{1/2}$

(C) $V_C = 2.405\left(1+\frac{2}{\alpha}\right)^{2}$ **(D)** $V_C = 2.5\left(1+\frac{2}{\alpha}\right)^{2}$

c. The material for making an efficient LED should be

(A) a metal
(B) an insulator
(C) an indirect band gap type semiconductor
(D) a direct band gap type semiconductor

d. Butt jointed and expanded beam are types of

(A) Splices **(B)** Connectors
(C) Detectors **(D)** Fibers

e. After the electric signal produced by the photodetector is amplified and filtered, _________ circuit compares the signal in each time slot with a certain reference voltage known as threshold level.

(A) Precision **(B)** Regenerative
(C) Decision **(D)** Sampling

f. In a semiconductor laser, fluctuations in amplitude or intensity of output produce optical intensity noise. These fluctuations arise from temperature variations or from spontaneous emissions in laser output. The noise resulting from random intensity fluctuations is called

(A) RIN **(B)** PIN
(C) CNR **(D)** TIN

g. One of the principle functions of LINE ENCODING is to

(A) introduce channel interference for coupling
(B) multiplexing
(C) introduce redundancy into data stream to minimize errors
(D) design and detect signals for regeneration

h. WDM can be implemented by

(A) Mach-Zehnder interferometer **(B)** Fiber Bragg grating
(C) Arrayed waveguide grating **(D)** All of the above

i. A 2×2 coupler has an input power level of $100 \mu W$. The power available at output ports 1 and 2 are, respectively $45 \mu W$ and $45 \mu W$. What is the coupling ratio?

(A) 45% **(B)** 50%
(C) 90% **(D)** 100%

j. Non linear effects become pronounced at

(A) high power levels
(B) low power levels
(C) less difference between core cladding index difference
(D) more difference between core cladding index difference

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. What is polarization? Explain different types of polarization of light occurs in optical fibre. What is polarization mode dispersion fibre? **(8)**

b. A step index fiber has a normalized frequency V = 26.6 at 1300 nm wavele... If the core radius is 25 μm, find the numerical aperture of given fibre. **(4)**

c. Explain in brief mechanical properties of optical fibres. **(4)**

Q.3 a. The attenuation is minimum at 1550 nm wavelength but dispersion is higher at this wavelength. Ideally, for achieving a maximum transmission distance of a high capacity link, dispersion should be null at wavelength of minimum attenuation. To achieve this, what types of complicated index profiles are designed? Draw any four. **(8)**

b. What is the difference between material dispersion and waveguide dispersion? Are they both intermodal or intramodal dispersion? What is the difference between intermodal dispersion and intramodal dispersion? Which dispersion is more significant in which kind of fiber? **(8)**

Q.4 a. The condition to first reach the lasing action threshold is the point at which optical gain is equal to total loss in the cavity. Derive this condition. Draw a fabry-perot resonator and explain how lasing action takes place. **(10)**

b. A GaAlAs Laser has a cavity length of 0.5 mm, an effective loss coefficient α of 1.5mm^{-1}, uncoated facet reflectivities of 0.35. Calculate $g_{threshold}$ when confinement factor $\Gamma = 0.8$. What is the change in g_{th} if reflectivity of one of facets in increased to 1. **(6)**

Q.5 a. List a few principal requirements of a good connector design. What are the different connector types? **(8)**

b. A GaAs optical source with a refractive index of 3.6 is coupled to a silica fiber that has a refractive index of 1.48. If the fiber end and the source are in close physical contact, find the Fresnel reflection at the interface, $P_{coupled}$ and power loss L in decibels. **(8)**

Q.6 a. Explain the following terms:
(i) Shot noise
(ii) Intersymbol interference
(iii) Bit error rate
(iv) Receiver sensitivity **(8)**

b. A transmission system sends out information at 200,000 b/s. During the transmission process, fluctuation noise is added to the signal so that at the decoder output the signal pulses are 1 V in amplitude and rms noise voltage is 0.2V.
(i) Assuming that one's and zero's are equally likely to be transmitted, what is the average time in which an error occurs?
(ii) How is this time changed if the voltage amplitude is doubled with rms noise voltage remaining the same?

Given:- For $\frac{V}{2\sigma} = 2.5, \rho_e = 7 \times 10^{-3}$ errors/bit

For $\frac{V}{2\sigma} = 5, \rho_e = 3 \times 10^{-7}$ errors/bit **(8)**

Q.7 a. Suppose we want to frequency division multiplex of 60 FM signals. If 30 of these signals have a per-channel modulation index $m_i = 3$ percent and other 30 signals have $m_i = 4$ percent, find the optical modulation index of the laser. **(8)**

b. What is subcarrier multiplexing? Show how we can simultaneously send analog and digital signals by frequency division multiplexing them on different subcarrier frequencies. Draw a neat diagram. **(8)**

Q.8 a. What are link power budget and rise time budget analysis? **(10)**

b. A popular RZ code used in fiber optic systems is optical Manchester code. This is formed by direct modulo-2 addition of baseband (NRZ-L) signal and a double frequency clock. Draw the pulse train for the data string 001101111001 (Manchester code) **(6)**

Q.9 Write short notes of any **TWO**:-

(i) Fiber Grating Filters
(ii) The 2×2 waveguide couplers
(iii) Network topologies for optical fibre **(2×8)**