

Roll No.

24443

B. Tech. 7th Semester (ECE)

Examination – May, 2015

OPTICAL COMMUNICATION

Paper : ECE-415-F

Time : Three Hours]

[Maximum Marks : 100

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Question No. 1 is *compulsory*. Attempt any *five* questions by selecting at least *one* question from each Section.

1. (a) What is the necessity of cladding for an optical fiber ? 4
- (b) What are the requirements of a good connector ? 3
- (c) Define avalanche effect. 3
- (d) What is Snell's law ? 3
- (e) Define threshold current. 3
- (f) Define population inversion. 4

SECTION – A

2. (a) Draw the block diagram of optical communication system and explain function of each block. 10

- (b) What are the advantages and disadvantages of optical fiber communication over other terrestrial communication link ? 10
3. (a) Show the electromagnetic spectrum region used for optical fiber communications. 6
- (b) Describe with the aid of simple ray diagrams :
- (a) The multimode step index fiber;
- (b) The single-mode step index fiber.
- Compare the advantages and disadvantages of these two types of fiber for use as an optical channel. 14

SECTION - B

4. (a) Define relative refractive index difference for an optical fiber and show how it may be related to Numerical Aperture. 10
- (b) What are the important mechanisms that are responsible for :
- (i) Absorption losses
- (ii) Scattering losses in optical communication system. 10
5. (a) Explain the operation of both optical isolators and optical circulators. Discuss the use of these devices in wavelength division multiplexing systems as three- and four-ports devices. 10

(b) A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47. Determine :

(a) The critical angle at the core-cladding interface;

(b) The NA for the fiber;

(c) The acceptance angle in air for the fiber. 10

SECTION – C

6. (a) Briefly describe what is meant by the following terms when they are used in relation to injection lasers :

(a) Relaxation oscillations;

(b) Frequency chirp;

(c) Partition noise;

(d) Mode hopping. 10

(b) Explain the concept of quantum-dot and quantum wire lasers and describe their operation in comparison with conventional injection laser diodes. 10

7. (a) Explain the characteristics of LED with emphasis on optical output power, output spectrum, modulation bandwidth and reliability. 10

(b) Distinguish between the structures of Edge emitter and Surface emitter LED. 10

SECTION - D

8. (a) What are the Benefits and drawbacks with the avalanche photodiode? 10
- (b) Outline the advantages and drawbacks with the use of the RAPD as a detector for optical fiber communications. 10
9. (a) Discuss the major features of a quantum-dot photo detector and with the aid of a diagram explain the DWELL structure for such a device. 10
- (b) A silicon p-i-n photodiode has a quantum efficiency of 65% at a wavelength of $0.8 \mu\text{m}$. Determine :
- (a) The mean photocurrent when the detector is illuminated at a wavelength of $0.8 \mu\text{m}$ with $5 \mu\text{W}$ of optical power;
- (b) The rms quantum noise current in a post-detection bandwidth of 20 MHz;
- (c) The SNR in dB, when the mean photocurrent is the signal. 10