



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M.Tech(ECE/Comm)/SEM-2/MCE-201/2012**

**2012**

**PHOTONICS & OPTICAL 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.*

Answer Question No. 1 and any *four* from the rest.

1. Answer any *seven* questions :  $7 \times 2 = 14$

- a) Define numerical aperture ( NA ) of an optical fibre. On what factor does it depend ?
- b) What are the different modes obtained in optical fibres ?
- c) Explain the term "Population Inversion".
- d) Define quantum efficiency and responsivity of a *p-n* photodiode.
- e) Explain the basic principle of operation of semiconductor optical amplifier.

30167 ( M.Tech )

[ Turn over



- f) Give the definition of
- i) Insertion Loss
  - ii) Channel width of WDM system.
- g) An FBG is developed within a fibre core which has refractive index of 1.46. Find the grating period for it to reflect an optical signal with a wavelength of  $1.55 \mu\text{m}$ .
- h) Describe briefly optical isolator.
2. a) Explain the operating principle of a double heterojunction laser with diagrams for layer structure, energy band and the refractive index profile. Explain how the active layer confines charge carriers and optical power.
- b) A GaAs injection DH laser has length of cavity equal to  $200 \mu\text{m}$ . The peak emission wavelength of the device is  $0.85 \mu\text{m}$ . Calculate the number of longitudinal modes emitted and their wavelength separation. The refractive index of GaAs is 3.6. 9 + 5
3. a) With the help of block diagram briefly describe the different key elements of an optical fibre receiver system.
- b) Describe the different types of noises incorporated in the receiver circuit with the help of block diagram.
- c) Derive an expression of signal to noise ratio for analog transmission quantum noise. 4 + 5 + 5



4. a) Discuss the different types of splice/connector losses in optical fibre communication systems. 5 + 4 + 5
- b) Why are optical attenuators used in fibre optic communication link ?
- c) What do link power budget and rise time budget mean ?
5. a) Explain the basic mechanism of amplification in an EDFA with suitable energy level diagram. 7 + 7
- b) With a neat sketch explain the operation of an  $8 \times 8$  star coupler.
6. a) Explain how multiplexing and demultiplexing of four wavelength can be achieved in WDM using fibre Bragg grating and optical circulator.
- b) In a  $2 \times 2$  bioconical tapered fibre coupler the throughput and coupled powers are 230 microwatt and 5 microwatt respectively for input power of 250 microwatt. Calculate
- i) the coupling ratio
- ii) insertion losses
- iii) excess loss of the coupler. 8 + 6



7. a) Explain with suitable diagram the operation of an avalanche photodiode.
- b) What is multiplication factor of an APD ?
- c) The quantum efficiency of a particular RAPD is 80% for the detection at a wavelength of  $0.9 \mu\text{m}$ . When the incident optical power is  $0.5 \mu\text{W}$ , the output current from the device ( after avalanche gain ) is  $11 \mu\text{A}$ . Determine the multiplication factor of the photodiode under these conditions.

5 + 4 + 5

=====