	Utech
Name:	
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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 efficieny and responsivity of a p-n photodiode.
- e) Explain the basic principle of operation of semiconductor optical amplifier.

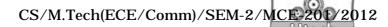
30167 (M.Tech)

[Turn over

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

- 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 μm .
- 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 μm . The peak emission wavelength of the device is 0.85 μm . Calculate the number of longitudinal modes emitted and their wavelength separation. The refractive index of GaAs is 3.6. 9 + 5
- a) With the help of block digram 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

30167 (M.Tech)



- 4. a) Disucss the different types of splice/connector losses in optical fibre communication systems.
 - b) Why are optical attenuators used in fibre optic communication link?
 - c) What do link power budget and rise time budget mean? 5+4+5
- 5. a) Explain the basic mechanism of amplification in an EDFA with suitable energy level diagram.
 - b) With a neat sketch explain the operation of an 8×8 star coupler. 7 + 7
- 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 x 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.

30167 (M.Tech)

3

[Turn over

8 + 6

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

- 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 $0.9~\mu m$. When the incident optical power is $0.5~\mu W$, the output current from the device (after avalanche gain) is $11~\mu A$. Determine the multiplication factor of the photodiode under these conditions. 5+4+5