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Question Paper Code : 51468

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Seventh Semester

Electronics and Communication Engineering

EC 2402/EC 72/10144 EC 702 – OPTICAL COMMUNICATION AND NETWORKING

(Regulations 2008/2010)

(Common to PTEC 2402 – Optical Communication and Networking for B.E. (Part-Time) Sixth Semester – Electronics and Communication Engineering – Regulations 2009)

Time : Three Hours **Maximum : 100 Marks**

Missing data may be suitably assumed.
Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. What are the conditions for the single mode propagation ?
2. What do you understand by phase and group velocity ?
3. What is chromatic dispersion ?
4. What are the causes for self phase modulation and cross phase modulation ?
5. Compare the characteristics of LED and ILD.
6. A GaAs laser operating at 850 nm has 250 μm length and a refractive index of 3.7. What are the frequency and wavelength spacing ?
7. For a pin photo diode having operating wavelength of 1300 nm, the quantum efficiency is around 90%. Calculate the responsivity of the photo diode.
8. Define Quantum Limit.
9. What are the pumping mechanisms used in erbium doped fiber amplifiers.
10. What is optical code division multiple access mechanism ?

PART – B (5 × 16 = 80 Marks)

11. (a) (i) Explain the ray propagation in the optical fiber based on the ray theory analysis. **(6)**

(ii) Derive the numerical aperture of an optical fiber. **(5)**

(iii) Determine the normalized frequency at 820 nm for a step-index fiber having a 25 μm core radius, $n_1 = 1.48$ and $n_2 = 1.46$. (a) How many modes propagate in this fiber at 820 nm ? (b) How many modes propagate in this fiber at 1320 nm ? (c) How many modes propagate in this fiber at 1550 nm ? (d) What percent of the optical power flows in the cladding in each case ? **(5)**

OR

(b) Using Maxwell's equations, derive the expression for electric and magnetic field components and also arrive boundary condition of the circular waveguide. **(16)**

12. (a) Explain in detail with necessary mathematical expression the various attenuation mechanisms in optical fiber. **(16)**

OR

(b) (i) Describe the mechanism of intermodal dispersion in a multimode step index fiber. Show that the total broadening of a light pulse δTs due to intermodal dispersion in a multimode step index fiber may be given by: $\delta Ts = L(NA)^2/2n_1c$, where L is the fiber length, NA is the numerical aperture, n_1 is the core refractive index and c is the velocity of light in a vacuum. **(10)**

(ii) A multimode step index fiber has a numerical aperture of 0.2 and a core refractive index of 1.47. Estimate the bandwidth-distance product for the fiber assuming only intermodal dispersion and return to zero code when :

- there is no mode coupling between the guided modes.
- mode coupling between the guided modes gives a characteristic length equivalent to 0.6 of the actual fiber length. **(6)**

13. (a) (i) Draw and explain double hetero-structure light emitter with energy band diagram and refractive index profile. **(6)**

(ii) Why is the double hetero-structure preferred for optical fiber communication ? Justify your answer. **(3)**

(iii) Derive with relevant mathematical expression of optical power emitted from LED. **(7)**

OR

(b) Discuss various noise sources available in APD and also derive the expression for the optimum gain at maximum signal to noise ratio. **(16)**

14. (a) (i) Explain in detail with necessary circuit diagram and advantages of Trans impedance amplifier. **(10)**

(ii) Consider a digital fiber optic link operating at a bit rate of 622 Mbps at 1550 nm.The InGaAs pin detector has a quantum efficiency of 0.8. Find the minimum number of photons in a pulse required for a BER of 10^{-9}. Find the corresponding minimum incident power. **(6)**

OR

(b) Explain any two methods used for measurement of refractive index profile of the fiber. **(16)**

15. (a) (i) Explain the layered architecture and transmission formats of SONET. **(8)**

(ii) Explain with neat sketch of two popular architecture of SONET. **(8)**

OR

(b) Explain in detail different types of Broad cast -and -select WDM networks. **(16)**

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