(3 Hours) [Total Marks : 100

N.B. -
1. Question No. 1 is compulsory
2. Answer any four out of remaining six questions
3. Assumptions made should be clearly stated
4. Assume any suitable data wherever required but justify the same
5. Figures to the right indicate full marks
6. Illustrate answers with sketches wherever required
7. Answers to questions should be grouped and written together, i.e. all answers to sub questions of individual questions like Q1, Q2, Q3 etc. should be answered one below the other.
8. Use legible handwriting. Use a blue/black ink pen to write answers. Use of pencil should be done only to draw diagrams and graphs.
9. Given $K=1.381 \times 10^{-23}$ J/K, $q= 1.60218 \times 10^{-19}$ C, $h = 6.6256 \times 10^{-34}$ J.s and $c = 3 \times 10^{8}$ m/s

1. A) Explain in brief different types of optical fibers. 5
   B) Show that when cladding is not present for optical fiber the NA is maximum. Then why cladding is used around the core in optical fibers. 5
   C) Describe the importance of OTDR for optical fiber communications. 5
   D) Why manufacturers specify optical fiber bandwidth as bandwidth-length product. 5

2. A) Explain fiber birefringence B_f in single mode fiber and fiber beat length. A single mode fiber has beat length of 8 cm at 1300 nm. Find modal birefringence B_f. 10
   B) Describe the linearly polarized modes as applicable to optical fibers. 10

3. A) Explain any one fiber fabrication process with neat diagram. 10
   B) Describe in brief the 2x2 fiber coupler and explain splitting ratio, excess loss, insertion loss and crosstalk for the same. 10

4. A) Explain the various factors contributing to the attenuation in optical fibers. 10
   B) Explain intramodal and intermodal dispersion in optical fibers. How dispersion affects transmission bandwidth of optical fibers. 10

5. A) Explain spontaneous and stimulated emission for optical sources. Describe the structure of a distributed feedback (DFB) laser diode. 10
   B) Describe the different materials used for fabrication of optical sources. 10

6. A) Explain with neat sketch the avalanche photodiode (APD). A given silicon avalanche photodiode has a quantum efficiency of 65 percent at a wavelength of 900 nm. Suppose 0.5 µW of optical power produces a multiplied photocurrent of 10 µA. Find the multiplication M. 10
   B) A 1550 nm single mode digital fiber optic link needs to operate at 622 Mb/s over 80 km without amplifiers. A single mode InGaAsP laser launches an average optical power of 13 dBm into the fiber. The fiber has a loss of 0.35 dB/km, and there is a splice with a loss of 0.1 dB every kilometer. The coupling loss at the receiver is 0.5 dB, and the receiver uses an InGaAs APD with a sensitivity of −39 dBm. Excess noise penalties are predicted to be 1.5 dB. Set up an optical power budget for this link and find the system margin. What is the system margin at 2.5 Gb/s with an APD sensitivity of −31 dBm? 10

7. Write short notes on any two 20
   A) Wavelength Division Multiplexing Systems
   B) Splicing and connectors for optical fiber
   C) Measurement of dispersion