Neeru Sharma

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST-3 EXAMINATION, JUNE - 2016
B.Tech VIII Semester

COURSE CODE: 11B1WEC834 MAX. MARKS: 35
COURSE NAME: OPTICAL COMMUNICATION SYSTEMS
COURSE CREDITS: 3 MAX. TIME: 2 HRS

Note: All questions are compulsory. Carrying of mobile phone during examination will be treated as a case of unfair means.

1(a) A step index fiber has an acceptance angle of 20° in air and a relative refractive index difference of 3%. Calculate the NA and the critical angle at the core cladding interface. **[2]**

(b) Derive an expression for total power carried by a single mode optical fiber in symmetric mode. **[3]**

2(a) What is the difference between phase velocity and group velocity? Write expression for these. **[2]**

(b) A graded-index fiber with a triangular profile supports the propagation of 500 modes. The core axis refractive index is 1.46 and the core diameter is 75μm. If the wavelength of light propagating through the fiber is 1.3μm, calculate (i) the relative refractive index difference of the fiber and (ii) the maximum diameter of the fiber core which would give single-mode operation at the same wavelength. **[3]**

3(a) With the help of suitable diagrams, distinguish between plane-polarized, circularly polarized and elliptically polarized light. **[2]**

(b) Explain the working of longitudinal electro optic modulator in detail. **[3]**

4(a) What requirements must be met so that a semiconductor DH functions efficiently as an optical amplifier? **[2]**

(b) A typical transverse electro-optic modulator uses a lithium niobate crystal and operates at 550nm. (i) Calculate the length of the crystal required to produce a phase difference of $\pi/2$ between the emergent field components with zero applied voltage. (ii) Calculate the width of the crystal required to produce an additional phase difference of $\pi/2$ between these components with an applied voltage of 20V. (iii) Calculate the half-wave voltage V_π for the crystal. [For lithium niobate n_0=2.29, n_e=2.20, electro-optic coefficient r_{33}=30.8 x 10^{-12}m/V] **[3]**

5(a) Define quantum efficiency and responsivity of a p-n diode. How are the two related to each other? **[2]**

(b) Consider a typical InGaAsP SOA operating at 1.3μm with the following parameters: active region width = 5μm, active region thickness = 0.5 μm, active region length = 200 μm, confinement factor $\Gamma = 0.4$, time constant $\tau_c = 1$ ns, $\sigma_g = 3 \times 10^{-20} m^2$, $N_{tr} = 1.0 \times 10^{24} m^{-3}$, and bias current $I = 100$mA. Calculate (i) P_{sat}, (ii) the zero-signal gain coefficient and (c) the zero-signal net gain. **[3]**

6(a) Distinguish between WDM and DWDM? What is the base frequency and channel spacing specified by ITU for DWDM? **[2]**

(b) It is required to design a broadband WDM 3-dB coupler so that it splits at λ=1310nm and 1550nm. The two step-index fibers used to make the coupler identical and single-moded with a core diameter of 8.2μm, core index $n_1 = 1.45$ and cladding index n_2=1.446. Calculate the position of the output ports with respect to the input port for the two wavelengths. Consider d=10μm. **[3]**

7(a) Explain the major types of devices for multiplexing/demultiplexing. Compare their merits and demerits. **[2]**

(b) How can we change the coupling ratio of a 2 x 2 coupler? A 2 x 2 loss-less coupler is using identical single mode fibers. Calculate the interaction length required to achieve a splitting ratio of 10:90. **[3]**

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