53 (IE 703) FOLI

2013

(December)

FIBER OPTICS & LASER INSTRUMENTS

Paper : IE 703

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer ***any five*** *questions.*

1. *(a)* A graded index fiber has a care with a parabolic refractive index profile which has a diameter of 50 μm . The fiber has a numerical aperture of 0.2.

   Estimate the normalized frequency for the fiber and the number of modes propagating in the fiber when it is operating at a wavelength of 1 μm . 6

(b) Calculate the ratio of stimulated emision rate to the spontaneous emission rate for an incandescent lamp operating at a temperature of 1000K. It may be assumed that the average operating wavelength is 0.5 μm . [given Plank constant $(h)=6.626\times10^{-34}J.S.$ Boltzmann's constant $(K)=1.381\times10^{-23}J/K$] 6

(c) The data for two LED sources are given. If the sources are to be used in a fiber optic system that requires the following operational parameters, which LED would be the best choice ?

System requirements :–

* Bandwidth = 20MHz
* Output power of 10 μW after 1.5km (loss of 3db/km).
* Electrical power maximum of 1- watt
* Fiber Numerical Aperture = 1.2 8

LED characteristics :-

Parameter	*LED 1*	*LED 2*
O/P - power	1mW	2mW
Rise time	1ns	10ns
NA	1.10	1.70
Supply voltage	2.3	3.0
Forward current	10mA	50mA

2. *(a)* What is the difference in mode travel times for a fiber with a core index of 1.5 and V number of 120 ? 5

(b) A fiber has $10mW$ of light power injected into it. Of this $9.3mW$ exits the opposite end of the fiber. This exiting light from the fiber fell upon a detector with a light sensitive area of $5cm^2$. Now determine the irradiance. 5

(c) When 3×10^{11} photons each with a wavelength of 0.85 μm are incident on a photodiode, on average 1.2×10^{11} electrons are collected at the terminals of the device. Determine the quantum efficiency of the photodiode at 0.85 μm . 5

(d) If photons of energy $1.53\times10^{-19}\,J$ are incident on a photodiode resulting in a photocurrent of 6.5 μA and given that the optical power falling on the diode is 10 μW , then calculate the responsivity of the photodiode. 5

3. *(a)* Encode the following 8-bit data into NRZI, Manchester and Miller codes.

Data = 10011101 5

(b) A fiber manufacturer says its brand of fiber has a bandwidth length product of $400KHz$-Km. Could you send a $800kHz$ signal through this fiber over a distance of 0.3 km ? 5

(c) For a GaAs sample emitting at $0.87\,\mu m$, calculate the bandgap energy and the minimum voltage that has to be applied across the junction in order to create a condition for net emission of photons from it. 5

(d) If a fiber had an attenuation of $3dB$ in a length of $1km$, what would be its loss per kilometer ? 5

4. (a) Make a comparison of the characteristics of laser and ordinary light. 5

(b) What is the difference between LIDAR and RADAR ? Draw the block diagram of a typical LIDAR system. 5

(c) Enumerate the two techniques $\rightarrow$ Q-switching and mode locking for achieving pulsed laser. 10

5. *(a)* Sketch and explain the working of Fabry-Perot Laser. 7

(b) Explain in brief how the four-level laser scheme is more efficient than three-level laser. 6

(c) Explain the difference between the glass optical fiber and plastic optical fibers. 7

6. *(a)* Differentiate between the reflection hologram and transmission hologram. 6

(b) Explain why the images of holograms are truly three diamentional. 6

(c) What are the modes in an optical fiber ? 3

(d) How does a PIN detector differ from APD ? 5

7. Write short notes on : ***(any four)*** 4×5=20

(1) Splice

(2) Lasik

(3) Interference

(4) Dispersion loss

(5) APD.
