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Total Number of Pages: 02

B.Tech.
PEI5J003

5th Semester Regular Examination 2017-18
Optoelectronics Device and Instrumentation

BRANCH: AEIE, EIE, IEE

Time: 3 Hours

Max Marks: 100

Q.CODE: B395

Answer Question No.1 and 2 which are compulsory and any four from the rest.

The figures in the right hand margin indicate marks.

Q1 Answer the following questions: multiple type or dash fill up type (2 x 10)

- What mode propagates in a single mode fiber? Make a sketch of this mode.
- Evaluate the NA of a fiber if the refractive indices of its core and cladding are 1.5 and 1.48 respectively. Hence calculate the maximum acceptance cone size
- Calculate the V number of the fiber mentioned in (b) if it has a core diameter of 10 μm and operates at a wavelength of 850 nm?
- Sketch the fundamental mode in a slab waveguide of thickness d ?
- Is Si used a material to build an LED? Justify.
- Why is a photodetector used under reverse bias conditions? Make a sketch to answer.
- What is birefringence? What does it do to a input light beam ?
- How can you use two polarizers to produce no light at a destination though there is a light beam present at the input of a polarizer?
- What is the effect of microbending in a given optical fiber? How is it used in an FoS?
- How do you measure acoustic pressure through an FoS? Make a sketch and explain in one/two sentences.

Q2 Answer the following questions: Short answer type (2 x 10)

- The magneto optic effect is used to measure _____
- An axial misalignment between two fibers result in _____ of a light beam.
- A Sagnac effect based FoS uses _____ for a light beam.
- The responsivity of a photodetector is expressed in _____
- A TEM mode can exist in a waveguide. True or false? Justify.
- A laser behaves as an LED under threshold condiions. True or false? Justify.
- 0 dBm = _____dB.
- A polarizer affects the direction of a light beam. True or false? Justify.
- Are any two modes ortogonal to each other in a fiber? Justify.
- The magneto optic effect is used to measure _____

Q3 a) A 10 THz uniform plane wave travelling in free space makes angles of 30° and 45° with the x- and the z-axes respectively. Write down the expressions for the electric and the magnetic fields of the wave. Hence evaluate the strengths of the three electric field components if the electric field has peak amplitude of 10V/m. It is further given that the y-component is double the strength of the x-component of the electric field. (10)

- Develop an expression for the symmetric modes in a slab waveguide of thickness d . (5)

- Q4 a)** Develop the electric field expressions for the core and cladding of a circular SI waveguide of radius a . Make at least two inferences from your derivations. **(10)**
- b)** Compare the fundamental modes in a slab waveguide and a circular waveguide assuming them to be of same size. Both are SI fibers. **(5)**
- Q5 a)** Derive the threshold condition for oscillation in a LASER. Make neat diagrams and state assumptions in making the derivation. **(10)**
- b)** The band gap energy of $\text{Ga}_{1-x}\text{Al}_x\text{As}$ depends on x through the following approximate expression $E_g = (1.424 + 1.247x)$ eV. Hence calculate the band gap energy and the corresponding cutoff wavelength for $x = 0.2$ and 0.3 . **(5)**
- Q6 a)** Sketch the power characteristics of a 2/2 directional coupler. Hence find out the coupled power at 1300 nm for an interaction length of 1.132 mm given that the refractive indices of the core and the cladding are 1.4532 and 1.45 respectively, the fibre core diameter is 5.0 μm . **(7)**
- b)** Discuss strain measurement with the help of M-Z interferometer with the help of appropriate sketches and expressions. **(8)**
- Q7 a)** How do you measure angular velocity by an FoS? Suggest a suitable scheme with the underlying principle and diagram. **(7)**
- b)** Explain the effect utilized to measure current with the help of FoS. Hence discuss current measurement. Draw a neat diagram and explain the function of each block very neatly. Write down the necessary expressions. **(8)**
- Q8 a)** Explain circular polarization with the help of a neat sketch and hence derive appropriate expressions for it. **(7)**
- b) Write Short notes on any TWO :** **(8)**
- Modes in an optical fiber
 - LEDs
 - Polarizers
 - Optical fiber based liquid level detector