Registration No: | | | | | | | | | | |

Total Number of Pages: 02 **B.Tech.**
PET5J001

5th Semester Regular Examination 2017-18
Fiber Optics and Optoelectronic Devices
BRANCH: ECE, ETC
Time: 3 Hours
Max Marks: 100
Q.CODE: B458

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)**

a) In an optical fiber communication system, which among the following is not a typical transmitter function?
a) Coding for error protection b) Decoding of input data
c) Electrical to optical conversion d) Recoding to match output standard

b) In single-mode fibers, how does the fraction of energy traveling in the cladding?
a) As a crescent wave b) As a gibbous wave
c) As an evanescent wave d) All of the above

c) If a light travels in a certain medium and it gets reflected off an optically denser medium with high refractive index, then it is regarded as _____

d) The transverse electric (TE) wave exists
a) $E_z \neq 0, H_z = 0$ c) $E_z = 0, H_z = 0$
c) $E_z = 0, H_z \neq 0$ d) $E_z \neq 0, H_z \neq 0$

e) In spontaneous emission, the light source in an excited state undergoes the transition to a state with _____.
a) Higher energy b) Moderate energy
c) Lower energy d) All of the above

f) _____ Photodiode create extremely low electric field as compared to _____ Photodiode.

g) What does the acronym LASER stand for?
a) Light Absorption by Stimulated Emission of Radiation
b) Light Amplification by Stimulated Emission of Radiation
c) Light Alteration by Stimulated Emission of Radiation
d. None of the above

h) Bandwidth-length product represents the _____ capacity of optical fiber.

i) Which among the following represent/s the measure/s to minimize the inhomogeneity's for Mie scattering reduction?
a) Extrusion Control
b) Increase in relative R.I. difference
c) Removal of imperfections due to glass manufacturing process
d) All of the above

j) Which color of light has the shortest wavelength ?
a) Yellow b) Blue c) Red d) Green

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

a) Enlist various blocks of optical fiber communication system.

b) Differentiate between phase and group velocity.

c) Write different applications of step Index fiber and Graded Index fibers.

d) A multimode step index fiber with a core diameter of 80 m and a relative index differenceof 1.5% is operating at a wavelength of 0.85 μm. If the core refractive indexis 1.48, estimate: (a) the normalized frequency for the fiber; (b) the number of guidedmodes.

e) Compare the APD & RAPD type optical detector.

f) How emission and absorption of radiation for LASER diode take place?

g) Give the major reasons which have led to the development of optical amplifiers.

h) With a schematic sketch compare the different fiber types based on the following points (i) index profile (ii) fiber cross section and ray paths (iii) typical dimensions.

i) What is the material used for the fabrication of sources having operating wavelength in the range of 0.8-0.9μm?

j) What do you understand by dispersion shifted fibers?

Q3 **a)** How is the normalized frequency (V) parameter is related to the radius of the core in optical fiber? What is the value for a single mode to exist? How is it related to the number of modes (M) in a multimode fiber when (M) is quite large? **(10)**

b) List various special features of offered by optical fiber communication system over conventional communication system. **(5)**

Q4 **a)** A silica optical fiber with a core diameter large enough to be considered by ray theoryanalysis has a core refractive index of 1.50 and a cladding refractive index of 1.47. **(10)**

Determine: (a) the critical angle at the core–cladding interface; (b) the *NA* for thefiber; (c) the acceptance angle in air for the fiber.

b) What are the factors responsible for optical power loss on fiber optic communication? **(5)**

Q5 **a)** Consider graded-index fibers having graded index profiles α=2.0, cladding refractive indices η_2=1.478, wavelength λ=1550 nm, radius of curvature R= 2.5 cm and index differences Δ=0.01.Then compare the ratio of the effective number of modes to the total number of modes (M_{eff}/M_{∞}) when a=25μm and 50μm. **(10)**

b) Define the mode-field diameter (MFD) in a single-mode fiber and indicate how this parameter relates to the spot size. **(5)**

Q6 **a)** Describe the two main SOA types and indicate their distinguishing features with neat figures. **(10)**

b) A photodiode has a quantum efficiency of 65% when photons of energy 1.5×10^{-19} Jare incident upon it. **(5)**

(a) At what wavelength is the photodiode operating?

(b) Calculate the incident optical power required to obtain a photocurrent of 2.5 μA when the photodiode is operating as described above.

Q7 **a)** An analog optical fiber communication system requires an SNR of 40 dB at thedetector with a post-detection bandwidth of 30 MHz. Calculate the minimum opticalpower required at the detector if it is operating at a wavelength of 0.9 μm with aquantum efficiency of 70%. State any assumptions made. **(10)**

b) With a schematic diagram explain the structure of Fabry-Perot resonator cavity. Define resonant frequency of the cavity. **(5)**

Q8 **a)** What are optoelectronic modulators? Explain the principle of operation for acousto-optic modulator with neat figures listing their limitations. **(10)**

b) What are semiconductor materials chosen to fabricate optical sources? How is the wave length of emission related to the mole-fraction in a heterojunction semiconducting material used to fabricate optical sources? **(5)**

Q9 **a)** Discuss the working principle of PIN photo detector with physical structure, equivalent circuit, field distribution and energy diagram. **(10)**

b) Write brief explanatory note on Rayleigh scattering losses. **(5)**