PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Winter Semester: 2021 - 22   **Date**: 26.04.2022

Course Code: ECE 303   **Time**: 1.30 PM to 2:30 PM

Course Name: Optical Communication   **Max Marks**: 30

Program & Sem: B.Tech ECE & VI Sem.   **Weightage**: 15%

Instructions:
(i)   Read the all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks.   (7Qx2M= 14M)

1. Optical communication is used for long distance information communication. In optical communication _____ acts as a transmission medium.   (C.O.No.1) [Knowledge]

(i) Coaxial cable   (ii) Waveguide   (iii) Optical fiber cable   (iv) Air

2. Proper selection of material in optical fiber let the light guided inside the core. An optical fiber is made up of _____ material.   (C.O.No.3) [Knowledge]

 (i) Glass   (ii) Plastic   (iii) Copper   (iv) Glass or Plastic

3. Optical fiber in an insulator. Does optical fiber communication mean transferring information in the form of light?   (C.O.No.2) [Knowledge]

(i) Yes   (ii) No

4. Optics started from the concept of physics. The bandwidth in fiber optical communication is represented in terms of _____.   (C.O.No.1) [Knowledge]

 (i) Wavelengths   (ii) Frequencies   (iii) Both a and b   (iv) None of the above

5. Based on the index profile, fibers are of two types. In multimode graded-index fiber the index will change from _____.   (C.O.No.5) [Knowledge]

(i) Index will change as a step   (ii) Cladding to core   (iii) Index change gradually from core to cladding   (iv) None of the above

6. Different types of rays propagate inside the fiber based on their modes and index profile. In a multimode step-index fiber the signal propagates with _____. (C.O.No.4) [Knowledge]

 (i) Zigzag path   (ii) Predictable path   (iii) Both a and b   (iv) None of the above

7. Light propagates with higher speed in rarer medium over denser medium. The ratio of the velocity of light in the air by the velocity of light in a medium is known as   (C.O.No.5) [Knowledge]

 (i) Graded index fiber   (ii) Refractive index   (iii) Step index fiber   (iv) None of the above

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries FIVE marks.   **(2Qx5M=10M)**

8. Light is an EM wave in which signal travels through optical fiber. In your opinion, how does the light signal travel from one end to the other in an optical fiber? Your answer should have proper schematics including optical source and detector. (C.O.No.3) [Comprehension]

9. Acceptance angle is the maximum angle with respect to the axis of the optical fiber at which light can enter the fiber, in order to be propagated through it. There is another parameter i.e. refractive index which measure of the bending of a ray of light when passing from one medium into another. How is the acceptance angle dependent on the refractive index of the fiber which is a material property? (C.O.No.5) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The question carries SIX marks.   **(1Qx6M=6M)**

10. The modes in an optical fiber refer to the "transverse modes" of electromagnetic waves when isolated within a wave guide (optical fiber in this case). Currently, there are 2 commercially used modes: Single-mode fiber and multi-mode fiber. If a fiber with refractive index has $n1=1.48$ and $n2=1.46$ and core radius is 20μm. What will be the number of modes at 1300nm and 1550nm? (C.O.No.5) [Application]

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SCHOOL OF ENGINEERING

TEST 2

Winter Semester: 2021 - 22

Course Code: ECE 303

Course Name: Optical Communication

Program & Sem: B.Tech-ECE, 6th Sem.

Date: 01.06.2022

Time: 1.30 pm

Max Marks: 30

Weightage: 15%

Instructions:

(i)   Read the all questions carefully and answer accordingly.

(ii) Question paper consists of 3 parts.

(iii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO mark.   (7Qx 2M= 14M)

1. Optical frequency is used for long distance information communication in fiber. Long wavelengths take _____ time to reach the destination.   (C.O.No.1) [B.Level : Knowledge]

    (i) Short   (ii) Long   (iii) No-time   (iv)   Same   time   as   of   short wavelengths

2. Proper selection of material in optical fiber let the light guided inside the core. Material dispersion is dependent on _____.   (C.O.No.3) [B.Level : Knowledge]

(i) Numerical Aperture   (ii) Acceptance Angle   (iii) Critical Angle   (iv) Refractive index

3. If I am using optical fiber for sensor kind of application, then what should be the value of relative refractive index difference (Δ) of fiber?   (C.O.No.2) [B.Level : Knowledge]

    (i) Low   (ii) High   (iii) Moderate   (iv) Zero

4. The bandwidth in fiber optical communication is represented in terms of Wavelengths. The scattering loss in inversely proportional to which power of wavelength?

(C.O.No.1) [B.Level : Knowledge]

    (i) First   (ii) Second   (iii) Third   (iv) Fourth

5. Internal quantum efficiency is dependent on _____.   (C.O.No.5) [B.Level : Knowledge]

(i) Radiative Recombination (ii) Non-radiative Recombination (iii)Total recombination (iv) All of the above

6. Spectral width of an optical source is dependent on _____.(C.O.No.4) [B.Level : Knowledge]

(i) Plank's Constant (ii) Ambient Temperature (iii) Wavelength   (iv) All of the above

7. To achieve high internal quantum efficiency which relationship is desirable? (C.O.No.5) [B.Level: Knowledge]

(i) $\tau_{rr} \ll \tau_{nr}$ (ii) $\tau_{rr} \gg \tau_{nr}$ (iii) $\tau_{rr} \leq \tau_{nr}$ (iv) $\tau_{rr} \geq \tau_{nr}$

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries FIVE marks.   **(2Qx5M=10M)**

8. Multimode fibers are those fibers in which light travels through multiple modes. Multiple modes have unequal path length to reach at the other end of fiber which causes inter-modal dispersion. Find the expression of delay parameter in multimode step-index fiber.

(C.O.No.3) [B.Level : Comprehensive]

9. Suppose, I have a semiconductor source (LED) made-up of GAInASP. If the rate of radiative recombination is 15 times higher than the rate of non-radiative recombination then find how the total carrier life-time is related to radiated career life-time.   (C.O.No.5) [B.Level : Comprehensive]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries SIX marks.   **(1Qx6M=6M)**

10. Let's take a semiconductor LED made-up of GaAs whose refractive index is 3.6. How many numbers of photons will be guided in to the fiber out of 10,000 generated photons? Given, the refractive index of the fiber is 0.2.   (C.O.No. 5) [B.Level : Application]

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SCHOOL OF ENGINEERING

END TERM EXAMINATION

Winter Semester: 2021 - 22

Course Code: ECE 303

Course Name: OPTICAL COMMUNICATION

Program & Sem: B.TECH/ECE – VI Sem

Date: 30th June 2022

Time: 09:30 AM to 12:30 PM

Max Marks: 100

Weightage: 50%

Instructions:
(iv) Read the all questions carefully and answer accordingly.
(v) Non-programmable scientific calculator is allowed.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks.   (20Qx 2M= 40M)

1. Optical communication is used for long distance information communication. In optical communication _____ acts as a transmission medium. (C.O.No.1) [B.Level : Knowledge]

   (i) Coaxial cable   (ii) Waveguide   (iii) Optical fiber cable   (iv) Air

2. Optical fiber in an insulator. Does optical fiber communication mean transferring information in the form of light?   (C.O.No.2) [B.Level : Knowledge]

   (i) Yes   (ii) No

3. Light propagates with higher speed in rarer medium over denser medium. The ratio of the velocity of light in the air by the velocity of light in a medium is known as _____.
   (C.O.No.5) [B.Level : Knowledge]

   (i) Graded index fiber   (ii) Refractive index (iii) Step index fiber (iv) None of the above

4. What are the advantages of a fiber optic communication system over a conventional communication system?
   (C.O.No.5) [B.Level : Knowledge]

   (i) Long life   (ii) No risk of fire and sparks   (iii) No radio frequency or electromagnetic interference (iv) All of the above

5. Depending upon the size and structure of core, different rays propagate inside a fiber. How many types of rays are there in an optical fiber?
   (C.O.No.5) [B.Level : Knowledge]

   (i) 1   (ii) 2   (iii) 3   (iv) 4

6. Proper selection of material in optical fiber let the light guided inside the core. Material dispersion is dependent on _____.   (C.O.No.3) [B.Level : Knowledge]

   (i) Numerical Aperture   (ii) Acceptance Angle   (iii) Critical Angle   (iv) Refractive index

7. If I am using optical fiber for signal transmission application, then what should be the value of relative refractive index difference (Δ) of fiber? (C.O.No.2) [B.Level : Knowledge]
         (i) Low   (ii) High   (iii) Moderate   (iv) Zero

8. Internal quantum efficiency gives the number of photons generated. Internal quantum efficiency is dependent on _____. (C.O.No.5) [B.Level : Knowledge]

  (i) Radiative Recombination   (ii) Non-radiative Recombination   (iii) Total recombination

  (iv) All of the above

9. Bandwidth and spectral width are synonymous terms. Spectral width of an optical source is dependent on _____. (C.O.No.4) [B.Level : Knowledge]

(i) Plank's Constant   (ii) Ambient Temperature   (iii) Wavelength   (iv) All of the above

10. Internal quantum efficiency gives the number of photons generated. To achieve high internal quantum efficiency which relationship is desirable? (C.O.No.5) [B.Level: Knowledge]
        (i) $\tau_{rr} \ll \tau_{nr}$ (ii) $\tau_{rr} \gg \tau_{nr}$ (iii) $\tau_{rr} \leq \tau_{nr}$ (iv) $\tau_{rr} \geq \tau_{nr}$

11. There are two types of optical sources such as gas sources and semiconductor sources. The gas sources are advantageous over semiconductor-based sources on which aspects?

(C.O.No.3) [B.Level : Knowledge]

(i) High Power   (ii) Narrow spectral width   (iii) Directional   (iv) All of the Above

12. Indirect bandgap semiconductors are not preferred for optical sources. Which semiconductor material is an example of indirect band-gap semiconductor?

(C.O.No.1) [B.Level : Knowledge]
        (i) InP   (ii) Ge   (iii) As   (iv) GaAs

13. Two types of photodetectors are mainly used for detecting the optical signal. Why the Avalanche photodetector is better than PIN photodetector? (C.O.No.5) [B.Level : Knowledge]
        (i)   It has gain
        (ii)   Low noise
        (iii)   Low cost
        (iv)   All of the above

14. Responsivity indicates the current generation ability of a photodetector. Responsivity is inversely proportional to_____. (C.O.No.4) [B.Level : Knowledge]

(i) Frequency   (ii) Ambient Temperature   (iii) Wavelength   (iv) All of the above

15. LED and LASER are the two types of optical sources available in market. List one advantage of LED. (C.O.No.1) [B.Level : Knowledge]
        (i) Low quantum efficiency (ii) Less output power   (iii) Less cost   (iv) None

16. How the carrier life-time is related to the number of injected carriers in high injection current for LED? (C.O.No.5) [B.Level : Knowledge]
        (i) Equal   (ii) Directly proportional   (iii) Inversely proportional   (iv) less than

17. Two photons are coherent iff they have_____. (C.O.No.2) [B.Level : Knowledge]
        (i) Same energy   (ii) same phase   (iii) same polarization   (iv) All

18. LASER produces monochromatic and coherent light source. Then, LASER operates in the principle of _____. (C.O.No.4) [B.Level : Knowledge]
        (i) Stimulated absorption   (ii) Stimulated emission(iii) Spontaneous emission(iv) All

19. Fabry Perot cavity is an optical oscillator. Figure out the condition of sustain oscillation in Fabry Perot cavity. (C.O.No.3) [B.Level : Knowledge]

      (i) $R_1 R_2 e^{(G-\alpha)2L} = 1$

      (ii) $R_1 R_2 e^{(G-\alpha)2L} = N$

      (iii) $R_1 R_2 e^{(G-\alpha)L} = 1$

      (iv) $N R_1 R_2 e^{(G-\alpha)L} = N$

20. To make the excited charge carriers flow outside the circuit a bias voltage is applied. Why a photo-diode is always reverse biased? (C.O.No.5) [B.Level : Knowledge]

      (i) In reverse bias very small current flows

      (ii) In reverse bias depletion region is formed

      (iii)   In reverse bias avalanche breakdown occurs

      (iv)   In forward bias significant forward current flows even in absence of optical energy

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries TEN marks.   **(3Qx10M=30M)**

21. Acceptance angle tells the light accepting capacity of any fiber. Derive the expression of acceptance angle of a fiber as a function of relative refractive index difference (Δ). Write an observation note on what should be the value of Δ when the fiber is used for sensor kind of application and why? (C.O.No.1) [B.Level : Comprehensive]

22. Multimode fibers are those fibers in which light travels through multiple modes. Multiple modes have unequal path length to reach at the other end of fiber which causes inter-modal dispersion. Find the expression of delay parameter in multimode step-index fiber.

                                            (C.O.No.3) [B.Level : Comprehensive]

23. Recombination takes place when an electron in an upper energy level recombines with a hole present in any energy level of the valency band. This probability is proportional to the energy difference between electron and hole. Find out the expression of probability of photon generation in a PN junction diode. (C.O.No.3) [B.Level : Comprehensive]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries TEN marks.   **(3Qx10M=30M)**

24. Suppose, I have a semiconductor source (LED) made-up of GAInASP. If the rate of radiative recombination is 15 times higher than the rate of non-radiative recombination then find how the total carrier life-time is related to radiated career life-time. (C.O.No.5) [B.Level : Comprehensive]

25. Let's take a semiconductor LED made-up of GaAs whose refractive index is 3.6. How many numbers of photons will be guided in to the fiber out of 10,000 generated photons? Given, the numerical aperture of the fiber is 0.2. (C.O.No. 5) [B.Level : Application]

26. Mr. Tony has installed a solar panel on his roof top to generate electric current for his household appliances. Suppose, sunlight of power 10W and frequency 800nm falls on the solar panel during early morning what is the amount of current flowing into his home. Let, the refection coefficient of solar panel is 0.2, attenuation coefficient is 0.3, and the length of the cavity for solar panel is 2mm. (C.O.No. 5) [B.Level : Application]