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**PRESIDENCY UNIVERSITY**

**Bengaluru**

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| **End - Term Examinations – JANUARY 2025** |
| **Date:** 09 – 01-2025 **Time:** 09:30 am – 12:30 pm |

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| **School:** SOE | **Program:** B. Tech-ECE | |
| **Course Code :** ECE3061 | **Course Name :** Optical Communication | |
| **Semester**: VII | **Max Marks**: 100 | **Weightage**: 50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** |
| **Marks** | **48** | **22** | **30** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

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| **Answer ALL the Questions. Each question carries 2marks. 10Q x 2M=20M** | | | | |
| **1** | Lasers are transforming defense systems through precision weaponry and countermeasures mention few practical examples | **2 Marks** | **L2** | **CO3** |
| **2** | Mention any two applications of LASER? | **2 Marks** | **L2** | **CO3** |
| **3** | A photodetector has a responsivity of 2.8 A/W. If the incident optical power is 2.95 W, calculate the photocurrent generated by the photodetector. | **2 Marks** | **L2** | **CO3** |
| **4** | The concept of a laser having three windows of operation often refers to the idea of different modes or conditions under which the laser can operate effectively, such as different wavelength ranges. Mention the laser windows of operation. | **2 Marks** | **L2** | **CO1** |
| **5** | A material has a bandgap energy of Eg=5.0 eV. Find the cut-off wavelength for this material. | **2 Marks** | **L2** | **CO2** |
| **6** | How is Snell’s Law used to design optical fibers, ensuring light stays within the core by total internal reflection? | **2 Marks** | **L2** | **CO1** |
| **7** | Total internal reflection (TIR)is used in binoculars and periscopes to reflect light without loss. How do total internal reflection related with TIR ? | **2 Marks** | **L2** | **CO3** |
| **8** | A fiber has a core refractive index of 4.55 and a cladding refractive index of 4.50. Calculate its NA and discuss how it affects the light's acceptance angle. | **2 Marks** | **L2** | **CO1** |
| **9** | How does the critical angle change if the light is passing from diamond (refractive index = 2.42) to air? | **2 Marks** | **L2** | **CO1** |
| **10** | Mention any two characteristics of LASER ? | **2 Marks** | **L2** | **CO3** |

**Part B**

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| **Answer the Questions Total 80 Marks.** | | | | | |
| **11.** | **a.**  **b.** | A photodetector operates at a wavelength of 1350 nm and has a quantum efficiency of 80% (a) Calculate the responsivity of the photodetector. (b) If the incident optical power is 30 mW, determine the photocurrent generated.  A photodiode with quantum efficiency 70% generates a photocurrent of 0.66 mA when the incident light has a wavelength of 1350 nm.  Calculate:  (i) The incident optical power.  (ii) The responsivity of the photodetector**.** | **20 Marks** | **L3** | **CO3** |
| **or** | | | | | |
| **12.** | **a.** | * Explain the working principle of a LASER with a neat diagram. * Principle: Absorption, Spontaneous and Stimulated Emission  1. Population Inversion 2. Components of LASER 3. Step-by-Step Working 4. Diagram 5. Characteristics of LASER Light | **20 Marks** | **L3** | **CO3** |
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| **13.** | **a.** | * Explain about the basic laws of Reflection and Refraction * Define single mode and multimode fibers? Explain. List the advantages of multimode fibers over single mode fibers. Distinguish between step index and graded index fibers * Mention the advantages of optical fibers over copper wires | **20 Marks** | **L3** | **CO1** |
| **or** | | | | | |
| **14.** | **a.**  **b.** | When a light wave travels from a semiconductor medium with a refractive index of 4.6 to a different semiconductor medium with a refractive index of 4.4 and the angle of incidence is 180 degree will this result in total internal reflection analyze on this result.  Total internal reflection (TIR) is the optical phenomenon that allows optical fibers to work, with the aid of the diagram explain how total internal reflection (TIR) phenomenon is achieved in optical fibre? | **20 Marks** | **L3** | **CO1** |

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| **15.** | **a.** | * Define signal attenuation in optical fibers. * Calculate the overall signal attenuation (in dB) for an optical fiber of length 30 km, where the input optical power is 240 µW, and the output optical power is 90 µW. * Using the same fiber, determine the overall signal attenuation (in dB) for a 10 km optical link that includes splice losses of 10 dB at every 1 km interval * Discuss how reducing splice losses or improving the fiber's attenuation coefficient would affect the overall performance of the 20 km optical link. Suggest practical ways to minimize losses in real-world fiber optic systems. | **20 Marks** | **L3** | **CO2** |
| **Or** | | | | | |
| **16.** | **a.**  **b.** | Describe the different types of light scattering, focusing on Raman scattering. Explain its working principle and highlight its applications in material science, medical diagnostics, and environmental monitoring. Include a labeled diagram of the Raman scattering process in your answer."  Explain the structure of a PIN photodiode and describe the function of each region. How does the intrinsic layer improve its performance in light detection? Describe the working principle of a PIN photodiode. How does it generate a photocurrent when exposed to light? Include the role of the depletion region in your explanation." | **20 Marks** | **L3** | **CO2** |

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| **17.** | **a.**    **b.** | Light traveling in air strikes a glass plate at an angle θ1 = 33 degrees, where θ1 is measured between the incoming ray and the glass surface. if the refracted and reflected beams makes an angle of 90 degree with each other, what is the refractive index of the glass? Determine critical angle  A silica fiber has a core refractive index of 3.5 and its cladding refractive index is 3.45 Determine  I. Critical Angle  II. the numerical aperture of the fiber  III. percentage of light collected by the fibre | **20 Marks** | **L3** | **CO1** |
| **Or** | | | | | |
| **18.** | **a.**  **b.**  **.** | Determine the maximum core diameter for an optical fibre with refractive index difference of 0.6 % and a core refractive index of 2.48 in order that it may be suitable for single mode operation for an operating wavelength of 0.7 μm. Further estimate the maximum core diameter for a single mode operation when the relative refractive index difference is reduced by a factor of 20.Assume V- number as 2.405  A step index multimode fiber with a NA of 0.6 supports approximately 1000 modes at an 1550 nm wavelength . Determine the diameter of its core ? How many modes do the fiber supports at 1320nm and at 850 nm? | **20 Marks** | **L3** | **CO1** |

**\*\*\*\*\* BEST WISHES \*\*\*\*\***