**SIDDARTHA INSTITUTE OF ENGINEERING AND TECHNOLOGY:: PUTTUR (AUTONOMOUS)**
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**QUESTION BANK (DESCRIPTIVE)**

**Subject with Code** Fiber Optic Communication (18EC0438)     **Course & Branch**: B.Tech & ECE

**Year &Sem:** IV-B.Tech & I-Sem                                **Regulation:** R18

# UNIT –I INTRODUCTION

| | | | |
|---|---|---|---|
| **1.** | a) Define the Snell's law | [L1][CO1] | [2M] |
| | b) List the elements of Ray optics | [L1][CO1] | [2M] |
| | c) Write shot note of Circular Waveguides | [L2][CO1] | [2M] |
| | d) Write any two different between step index & graded index fiber. | [L2][CO1] | [2M] |
| | e) List out any two the merits and demerits of optical fiber communication | [L1][CO1] | [2M] |
| **2.** | Explain the Elements of Optical Communication System with neat sketch. | [L2][CO1] | [10M] |
| **3.** | a) Explain about the Evolution of optical fiber systems. | [L2][CO1] | [4M] |
| | b) Illustrate on Reflection and Refraction with neat sketch. | [L2][CO1] | [6M] |
| **4.** | a) List the applications of optical fiber communication. | [L2][CO1] | [5M] |
| | b) A light wave is travelling in a semiconductor medium (GaAs) of refractive index 3.6.It is incident on a different semiconductor medium (AlGaAs) of refractive index 3.4 & angle of incidence is 80°. Calculate numerical aperture & acceptance angle. Will it result in total internal reflection? Comment on the result. | [L3][CO1] | [5M] |
| **5.** | a) Consider multimode fiber that has a core refractive index of 1.488 and core cladding index difference of 2.0%. Evaluate numerical aperture, critical angle and acceptance angle. | [L3][CO1] | [5M] |
| | b) List out the merits and demerits of optical fiber communication. | [L1][CO1] | [5M] |
| **6.** | a) Define critical angle and also derive the expression for critical angle. | [L3][CO1] | [5M] |
| | b) Describe the single mode step Index fiber with neat sketch. | [L2][CO1] | [5M] |
| **7.** | a) Describe the Multimode Step Index fiber with neat sketch. | [L2][CO1] | [5M] |
| | b) Fiber has normalized frequency 26.6 & operating wavelength 1300nm, if the radius of the fiber core is 25µm.Compute the numerical aperture. | [L3][CO1] | [5M] |
| **8.** | a) Compare step index & graded index fiber. | [L2][CO1] | [5M] |
| | b) Describe the multimode Graded Index fiber with neat sketch. | [L2][CO1] | [5M] |
| **9.** | a) Write short notes on Mode theory of Circular Waveguides. | [L1][CO1] | [4M] |
| | b) Calculate number of modes of an optical fiber having diameter of 50µm & n1 =1.48 & n2=1.46having operating wavelength 0.82µm. | [L3][CO1] | [6M] |
| **10.** | a) Explain about the Snell's law and significance of numerical aperture. | [L2][CO4] | [5M] |
| | b) Illustrate on ray optics in detail with neat diagrams. | [L2][CO1] | [5M] |
| **11.** | a) Elaborate about the total internal reflection with the help of suitable | [L6][CO1] | [4M] |

| | | | |
|---|---|---|---|
| | optical cable setup. | | |
| | b )Develop the Expression for Acceptance angle and Numerical aperture. | [L3][CO1] | [6M] |

## UNIT –II
## TRANSMISSION CHARACTERISTIC OF OPTICAL FIBERS

| | | | |
|---|---|---|---|
| | a) Define Information Capacity. | [L1] [CO2] | **[2M]** |
| | b) What are the various types of losses in optical fiber. | [L1] [CO2] | **[2M]** |
| 1. | c) Discuss Core and Cladding Losses. | [L2] [CO2] | **[2M]** |
| | d) What is mean by attenuation? | [L1] [CO2] | **[2M]** |
| | e) Write the working Principle of OTDR. | [L1] [CO2] | **[2M]** |
| 2. | Demonstrate any two types of Losses in Optical Fiber Communication System. | [L2] [CO2] | **[10M]** |
| 3. | a) Explain the Design Optimization of Single mode fibers. | [L2] [CO2] | **[5M]** |
| | b) How to minimize the micro bending losses in the fiber? | [L1] [CO2] | **[5M]** |
| 4. | a) How attenuation is caused by scattering losses & bending losses? | [L1] [CO2] | **[5M]** |
| | b) Explain in detail about the Mechanisms which cause's Absorption. | [L2] [CO2] | **[5M]** |
| 5. | a) Define linear scattering. Explain about Rayleigh & Mie scattering. | [L2] [CO2] | **[5M]** |
| | b) Develop the expression for waveguide dispersion. | [L3] [CO2] | **[5M]** |
| 6. | Explain dispersion occurring in multimode fibers in detail with expressions. | [L2] [CO2] | **[10M]** |
| 7. | a) Distinguish between intrinsic & extrinsic Absorption. | [L2] [CO3] | **[5M]** |
| | b) Determine the theoretical cutoff wavelength for single mode fiber. | [L3] [CO2] | **[5M]** |
| 8. | a) What is attenuation? Explain in detail. | [L2] [CO2] | **[5M]** |
| | b) Develop the expression for material dispersion. | [L3] [CO3] | **[5M]** |
| 9. | Analyze pulse broadening in graded index waveguides. | [L4] [CO2] | **[10M]** |
| 10. | a) Develop the expression for total dispersion in single mode fiber | [L3] [CO3] | **[5M]** |
| | b) How refractive index profile optimizes the design in a single mode fiber? | [L1] [CO2] | **[5M]** |
| 11. | Illustrate on the two main causes of Intra Modal Dispersion. | [L2] [CO3] | **[5M]** |
| | Explain the phenomenon of Rayleigh scattering in scattering loss. | [L2] [CO3] | **[5M]** |

## UNIT –III

## FIBER OPTICAL SOURCE AND COUPLING

| 1 | a) Define direct bandgap materials and indirect bandgap materials | [L1] [CO5] | **[2M]** |
|---|---|---|---|
|   | b) Write the advantages of LED. | [L1] [CO5] | **[2M]** |
|   | c) Sketch the emitter LED circuit. | [L3] [CO5] | **[2M]** |
|   | d) Define LASER | [L1] [CO3] | **[2M]** |
|   | e) Write the Temperature effects of Laser | [L1] [CO3] | **[2M]** |
| 2 | a) Explain LED Structure with neat sketch. | [L2][CO3] | **[5M]** |
|   | b) A *planar LED* is fabricated from GaAs which has a refractive index of 3.6.(i) Calculate the optical *power* emitted into air as a percentage of the internaloptical power for the device when the *transmission factor* at the crystal-air interface is 0.68.(ii) When the optical power generated internally is 50% of the electric power supplied, determine the external powerefficiency. | [L3][CO3] | **[5M]** |
| 3 | a) Illustrate on light source materials in detail. | [L2][CO2] | **[5M]** |
|   | b) Explain about the surface emitter LED with neat diagram. | [L2][CO3] | **[5M]** |
| 4 | a)Describe about the modulation of LED in detail | [L2][CO3] | **[5M]** |
|   | b)Illustrate on edge emitter LED with neat diagram. | [L2][CO3] | **[5M]** |
| 5 | a) Explain about quantum efficiency and LED power. | [L2][CO3] | **[5M]** |
|   | b) Demonstrate on direct and indirect bandgap materials in detail. |  | **[5M]** |
| 6 | a) Explain about resonant frequencies of LASER Diode | [L2][CO3] | **[5M]** |
|   | b) A GaAs optical source with a refractive index of 3.6 is coupled to a silica fiberthat has a refractive index is 1.48. If the fiber and the source are in closephysicalcontact then find the Fresnel reflection at the interface andpower loss in dB. |  | **[5M]** |
| 7 | a) Develop the expression for modes and threshold condition of LASER. | [L3][CO3] | **[5M]** |
|   | b)What power is radiated by an LED if its quantum efficiency is 3% and the peak wavelength is 670nm? | [L3][CO3] | **[5M]** |
| 8 | a) Illustrate about external quantum efficiency of LASER. | [L2][CO3] | **[5M]** |
|   | b) Develop the rate equation for LASER diode. | [L3][CO3] | **[5M]** |
| 9 | a) Explain in detail the various Characteristics of Light Source | [L2][CO3] | **[5M]** |
|   | b) Describe about Temperature effects of Laser | [L3][CO3] | **[5M]** |
| 10 | a) Explain in detail about Quantum laser. | [L2][CO3] | **[5M]** |
|   | b) Illustrate about source to fiber power launching. | [L2][CO3] | **[5M]** |
| 11 | a) Explain about Distributed feedback LASER. | [L2][CO3] | **[5M]** |
|   | b) Write short notes on resonant frequencies of optical sources. | [L2][CO3] | **[5M]** |

**UNIT –IV**

## Fiber Optical Receivers

| | | | |
|---|---|---|---|
| 1 | a) Define avalanche multiplication noise in APD diode | [L1][CO4] | **[2M]** |
| | b) List the operating parameters of Si, Ge, InGaAs for PIN diode | [L1][CO4] | **[2M]** |
| | c) Sketch the schematic representation of a PIN photodiode circuit | [L3][CO4] | **[2M]** |
| | d) State the signal transmission for an optical receiver. | [L1][CO4] | **[2M]** |
| | e) List out the quantum limit in optical receiver. | [L1][CO4] | **[2M]** |
| 2 | a) Explain in detail the operation of Avalanche Photo Diode with its structure. | [L2][CO4] | **[5M]** |
| | b) A photo diode has a quantum efficiency of 65% when photons of energy of 1.5 x 10-19 J are incident upon it. (i) Find the operating wavelength of the photodiode, (ii) Calculate the incident optical power required to obtain a photo current of 2.5nA when the photodiode is operating as described above. | [L3][CO3] | **[5M]** |
| 3 | a) Explain about avalanche multiplication noise in APD diode. | [L2][CO4] | **[5M]** |
| | b) Summarize the *comparisons of* photo detectors. | [L2][CO4] | **[5M]** |
| 4 | a) Explain the principle behind the operation of an PIN photo diode. | [L2][CO4] | **[5M]** |
| | b) Explain the simple energy band diagram for a PIN photodiode with neat diagram. | [L2][CO4] | **[5M]** |
| 5 | a) Illustrate how noises are entered into photo detector. | [L2][CO4] | **[5M]** |
| | b) Analyze photo detector receiver with simple model and equivalent circuit. | [L4][CO4] | **[5M]** |
| 6 | a) Develop the equation for S/N ratio of an optical fiber. | [L3][CO2] | **[5M]** |
| | b) List the operating parameters of Si, Ge, InGaAsfor avalanche photo diode. | [L1][CO2] | **[5M]** |
| 7 | a) Develop the expression for response time of a photodiode. | [L3][CO4] | **[5M]** |
| | b) Explain the working of depletion layer photocurrent with diagram. | [L2][CO4] | **[5M]** |
| 8 | a) Explain the digital signal transmission for an optical receiver? | [L2][CO4] | **[5M]** |
| | b) How the receiver configuration works in optical receiver? | [L1][CO4] | **[5M]** |
| 9 | a) List the operating parameters of Si, Ge, InGaAs for PIN diode. | [L2][CO4] | **[5M]** |
| | b) A given silicon avalanche photodiode has a quantum efficiency of 65% at a wavelength of 900nm.Suppose 0.5μW of optical power produces a multiplied photocurrent of 10μA. Calculate the multiplication M. | [L3][CO4 | **[5M]** |
| 10 | a) Explain the mechanism of error sources and disturbance in the optical pulse detection with diagram. | [L3][CO4] | **[5M]** |
| | b) Demonstrate any one type of Preamplifier in detail. | [L3][CO4] | **[5M]** |
| 11 | a) Explain about the probability of error in detail. | [L2][CO4] | **[5M]** |
| | b) Illustrate on the quantum limit inoptical receiver | [L2][CO4] | **[5M]** |

## UNIT –V
## OPTICAL FIBER SYSTEM DESIGN &TECHNLOGY

| | | | |
|---|---|---|---|
| **1** | a)List the types of budget in optic | [L1][CO5] | **[2M]** |
| | b)Write the applications of the Optical amplifier | [L1][CO5] | **[2M]** |
| | c)List the differs between the optical multiplexing and de-multiplexing techniques | [L1][CO5] | **[2M]** |
| | d)Define the *link budget calculations* | [L1][CO5] | **[2M]** |
| | e)Draw the diagram of the optic *de-multiplexingtechnique.* | [L2][CO5] | **[2M]** |
| **2** | a) Explain Optical Fiber System Design Specification. | [L2][CO5] | **[6M]** |
| | b) Explain the Rise Time Budget analysis with basic elements. | [L2][CO5] | **[4M]** |
| **3** | a)What is bandwidth budget. | [L1][CO5] | **[6M]** |
| | *b)* Describe about power budget with examples | [L2][CO5] | **[4M]** |
| **4** | . a) Describe about link budget calculations | [L2][CO5] | **[5M]** |
| | *b)* 2*2 biconical fiber coupler has an optical input power level of P0=400μw, the output power at the other 3 ports are P1=180μw, P2=170μw, P3=12.6nw. Find performance parameters**.** | [L3][CO5] | **[5M]** |
| **5** | a)Summarize on system performance using rise time budget of digital systems. | [L3][CO5] | **[5M]** |
| | b) Explain the significance of system consideration in point-to-point fiber links**.** | [L2][CO5] | **[5M]** |
| **6** | a) Illustrate on line coding with neat diagrams. | [L2][CO5] | **[3M]** |
| | b) Analyze the system performance using link power budget of digital systems. | [L4][CO5] | **[7M]** |
| **7** | *a)*Explain optical multiplexing and de-multiplexing techniques | [L2][CO5] | **[3M]** |
| | b)Explain about Optical amplifier and applications | [L2][CO5] | **[7M]** |
| **8** | a)Explain about bandwidth budget. | [L2][CO5] | **[5M]** |
| | b) An optical transmission system is constrained to have 600 GHZ channel spacing.How many wavelength channels can be utilized in the1536 to 1556 nm spectral band? | [L2][CO5] | **[5M]** |
| **9** | a)Draw the diagram of *optical multiplexing explain each blocks* | [L2][CO5] | **[5M]** |
| | b) LED spectral width of 40nm has rise time of 15ns, $t_{mat}$ is 21ns, $t_{rx}$is 14ns and $t_{mod}$ is 3.9ns. Find total system rise time. | [L3][CO5] | **[5M]** |
| **10** | Explain optical amplifier and it applications. | [L2][CO5] | **[10M]** |