Code No: **R1641044** **R16** **Set No. 1**

IV B.Tech I Semester Regular/Supplementary Examinations, March - 2021

OPTICAL COMMUNICATIONS

(Electronics and Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B

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PART–A *(14 Marks)*

1. a) Define critical angle with the required diagram. [2]
   b) Define scattering. [2]
   c) What is connector return loss. [2]
   d) Define quantum efficiency. [2]
   e) What is probability of error. [3]
   f) What is the need of WDM. [3]

PART–B *(4x14 = 56 Marks)*

2. a) Differentiate between Meridional Rays and Skew Rays. Explain the nature of light. Determine the refractive indices of the core and the cladding material of a fiber if numerical aperture is 0.22 and refractive index difference Δ=0.012. [7]
   b) Find the maximum diameter allowed for a fiber having core refractive index 0.153 and cladding refractive index 1.50. The fiber is supporting only one mode of a wavelength of 1200 nm. [7]

3. Discuss the linear scattering losses in optical fibers w.r.t
   i. Rayleigh Scattering ii. Mie Scattering [14]

4. a) What do you understand by lnter Symbol Interference (ISI) [4]
   b) A multimode graded index fiber exhibits total pulse broadening of 0.1 μs over a distance of 15km. Estimate :
      (i) The maximum possible bandwidth without ISI.
      (ii) Pulse dispersion per unit length. [10]

5. a) Explain the working of p-i-n photodiode. Also explain the factors that limit the speed of response of photodiode. [7]
   b) Discuss the impact ionization in avalanche photodiode. Explain the multiplication factor and photo multiplication factors also. [7]

6. a) Briefly discuss the possible source of noise in optical fiber receivers. Describe the quantum noise in detail. [7]
   b) Sketch the full equivalent circuit for a digital optical fiber receiver. Briefly explain its various parts. [7]

7. Explain the optical power loss model for a point to point link and discuss link power budget. [14]

Code No: **R1641044** **R16** **Set No. 2**

IV B.Tech I Semester Regular/Supplementary Examinations, March - 2021

OPTICAL COMMUNICATIONS

(Electronics and Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
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PART–A *(14 Marks)*

1. a) Define mode filed diameter. [2]
   b) What is material dispersion. [3]
   c) Compare connectors and splicers [2]
   d) Mention all types of LED structures. [3]
   e) Mention different sources of errors. [3]
   f) Mention all types of line codings. [2]

PART–B *(4x14 = 56 Marks)*

2. a) Differentiate single mode fiber and graded index fiber. Explain propagation modes in single mode fibers. [7]
   b) A multimode silca fiber that has a core refractive index n1 = 1.48 and cladding index n2 = 1.48. Compute the numerical aperture. [7]

3. a) Explain the signal distortion in optical waveguide. Discuss group delay and different types of dispersion in optical fiber communication. [10]
   b) What is chromatic dispersion? [4]

4. Write a short notes on
   (i)multimode and single mode fiber joints
   (ii)connector types [14]

5. a) Explain LED Structure with neat sketch. [7]
   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 internal optical 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 power efficiency. [7]

6. Write in brief about: (i) Quantum limit (ii) Laser diode to fiber coupling. [14]

7. a) Discuss in detail the major considerations for optical system design for digital link. [7]
   b) Explain link power budget with necessary expressions. Design an optical fiber link for transmitting 15MBPS of data for a distance of 4 km with a BER of 10^{-9}. [7]

Code No: **R1641044** **R16** **Set No. 3**

IV B.Tech I Semester Regular/Supplementary Examinations, March - 2021

OPTICAL COMMUNICATIONS

(Electronics and Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
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PART–A *(14 Marks)*

1. a) Define cut off wave length. [2]
   b) What is attenuation? [2]
   c) Mention all types of connectors. [2]
   d) Draw the structure of APD. [3]
   e) Define quantum limit. [2]
   f) What is eye pattern? [3]

PART–B *(4x14 = 56 Marks)*

2. a) Draw a black diagram of a digital optical receiver showing its various components. Explain the function of each component. How is the signal used by the decision circuit related to the incident optical power? [10]
   b) What are advantages and disadvantages of OFC? [4]

3. a) Explain about Glass & Chalcogenide glass fiber materials. [10]
   b) A LED operation at 850nm and has a spectral width of 45nm. What is the pulse spreading in nsec/km due to a material dispersion? [4]

4. Clearly discuss fiber alignment and joint losses. [14]

5. a) Explain in detail about laser diode modes and threshold conditions. [7]
   b) Explain the design and working of an edge emitting LED. [7]

6. a) Explain about Equilibrium Numerical Aperture. [7]
   b) Classify the error sources and explain any one of the error in detail. [7]

7. Analyze the Rise time Power Budget of Optical Fibre Communication in terms of analog system design. [14]

Code No: **R1641044** **R16** **Set No. 4**

IV B.Tech I Semester Regular/Supplementary Examinations, March - 2021

OPTICAL COMMUNICATIONS

(Electronics and Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
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PART–A *(14 Marks)*

1. a) Define step index and Graded index fiber. [3]
   b) Differentiate inter and intra model dispersion. [2]
   c) Mention different alignment losses with the required figures. [3]
   d) Define detector response time. [2]
   e) Define Lambertian Pattern. [2]
   f) What are the advantages of WDM? [2]

PART–B *(4x14 = 56 Marks)*

2. a) What is numerical aperture? Derive an expression for numerical aperture and maximum acceptance angle in case of a step index optical fiber in terms of refractive index core and cladding material. [10]
   b) Explain effective refractive index. [4]

3. a) Compare all fiber materials in all aspects [4]
   b) GaAs laser operating at 850nm and has a length of 500 µm, with given refractive index n=3.7. Calculate frequency spacing. [5]
   c) Write a short notes on pulse broadening effect and its remedial measures. [5]

4. Discuss all types of splicing techniques in detail. [14]

5. a) Explain in detail the operation of Avalanche Photo Diode with its structure. [7]
   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 2.5 when the photodiode is operating as described above. [7]

6. a) Derive the power launching efficiency with supporting equations. [7]
   b) What are the two major requirement of a pre-amplifier in optical receiver? Explain how these are achieved in a trans impedance amplifier. [7]

7. Discuss the following
   i) Attenuation measurement [14]
   ii) Eye pattern