Code No: **RT4104A** **R13** **Set No. 1**

IV B.Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2018

OPTICAL COMMUNICATION

(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 THREE questions from Part-B

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PART–A *(22 Marks)*

1. a) Explain the terms : (i) Cut off wave length (ii) Mode field diameter [4]
   b) What are the requirements of optical fiber? Explain glass and plastic materials in detail. [4]
   c) What is the difference between fusion splicing and mechanical splicing? [4]
   d) What is the importance of double hetero junction in LED structures? [4]
   e) What is called equilibrium numerical aperture? [3]
   f) What is WDM? [3]

PART–B *(3x16 = 48 Marks)*

2. a) Explain about the light guidance in a optical fiber with figures and explain the total internal reflection and numerical aperture with diagrams. [8]
   b) What is normalized frequency? A step index fiber in air has a numerical aperture of 0.16, core refractive index 1.45, and core diameter 60 micro meters. Assume that wavelength is 0.1 micrometer. Determine normalized frequency for fiber. [8]

3. a) Explain the different types of methods to minimize signal distortion in optical fibers. [8]
   b) How does material dispersion occur in an optical fiber? Obtain the expression for group delay τ_{mat} resulting from the material dispersion and from this, deduce the relation for the pulses spread σ_{mat} in terms of material dispersion D_{mat} (λ). [8]

4. a) Explain the losses in end separator connecting different fibers when joining two fibers. [8]
   b) Write a short note on different types of fiber connectors? [8]

5. a) Derive the expressions for quantum efficiency and LED power. [8]
   b) The Radiative and non radiative recombination life times of minority carriers in the active region of a double heterojunction LED are 60 sec and 90 sec respectively. Determine the total carrier recombination life time and optical power generated internally if the peak emission wave length is 870 nm and the drive current is 40 mA. [8]

6. a) Derive an expression for power coupled power from an LED into a relatively smaller step index fiber with equal numerical aperture. [8]
   b) Discuss the dependence of equilibrium numerical aperture and power coupling from a source into a fiber. [8]

7. a) Discuss key system features of WDM. Draw diagram of a typical WDM link containing various components and explain it in brief. [8]
   b) Describe graphical representation of link loss budget with a set of assumed values. [8]

Code No: **RT4104A** **R13** **Set No. 2**

IV B.Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2018

OPTICAL COMMUNICATION

(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 THREE questions from Part-B

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PART–A *(22 Marks)*

1. a) A light ray is incident from medium-1 to medium-2, if the refractive indices of medium-1 and medium -2 are 1.5 and 1.36 respectively then determine the angle of refraction for an angle of incidence of 30^0. [4]
   b) What are the mechanical properties of optical fibers? Explain. [4]
   c) What is meant by splicing? What are the advantages of splicing? [4]
   d) What are the different types of light source materials? [4]
   e) "The optical power launched into a fiber does not depend on the wavelength of the source but only on its brightness". Explain. [3]
   f) What are the line coding techniques in optical communication? [3]

PART–B *(3x16 = 48 Marks)*

2. a) For a multimode step index optical fiber of glass core of refractive index 1.5 and quartz cladding of refractive index 1.46 , determine:
   (i) critical angle (ii) Acceptance angle (iii) Numerical aperture [8]
   b) Explain the basic principal of Optical Fiber. Compare Optical Fiber with Co-axial cable as a communication channel. [8]

3. a) For a 30 km long fiber attenuation 0.8 db/km at 1300 nm. If a 200 µW is launched into the fiber, find the output power. [8]
   b) Differentiate between graded index and step index also define birefringence and V number [8]

4. a) What are the different types of alignments in optical fibers? [8]
   b) Compare multi mode fiber joints and single mode fiber joints? [8]

5. a) Explain the different types of photo detector used in optical system and explain structure and operating principle of any one in detail. [8]
   b) An LED with a circular emitting area of radius 20 µm has a lambertian emission pattern with 100 w/cm2 .sr. axial radiance at 100 mA drive current. How much optical power can be coupled in to a step index fiber having a 100 µm core diameter and numerical aperture of 0.22? How much optical power can be coupled from this source in to a 50 µm core diameter graded index fiber having $\alpha = 2.0$ $n1=1.48$ and $\Delta=0.01$? [8]

6. a) Derive the equation for the power launched from LED Source in to a Graded Index fiber. [8]
   b) Explain the fundamental receiver operation in optical fiber communication. [8]

7. a) State the probable basic requirements of an optical communication system. [8]
   b) Enlist the major design considerations in an optical system. [8]

Code No: **RT4104A** **R13** **Set No. 3**

IV B.Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2018

OPTICAL COMMUNICATION

(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 THREE questions from Part-B
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PART–A *(22 Marks)*

1. a) Explain the following terms : (i) Meridional rays (ii) Skew rays [4]
   b) Explain scattering losses in optical fibers. [4]
   c) Explain the requirements of a good connector design. [4]
   d) Explain population inversion mechanism in optical fibers. [4]
   e) Calculate the optical power coupled into the fiber by an optical source with a bias current of 20mA and a forward voltage of 1.5V.Assume an internal efficiency of the source as 2% and the coupling efficiency of 30%. 0 [3]
   f) Briefly explain TDM, FDM, WDM and SDM used in optical communication system. [3]

PART–B *(3x16 = 48 Marks)*

2. a) Explain electromagnetic mode theory in optical fiber in detail. [8]
   b) Explain the importance of cladding in optical fiber communication. Justify the statement: "Light travels faster in cladding than core". [8]

3. a) Explain in detail the transmission losses due to absorption mechanism in an optical fiber with necessary equations and prove that this loss is a function of wavelength using graphical analysis. [8]
   b) Derive the equation for intermodal dispersion. [8]

4. a) Explain Butt joint connectors with neat circuit diagrams. [8]
   b) Explain the connector return losses in optical fibers. [8]

5. a) A Laser diode has lateral $\emptyset$ =0°and transverse $\emptyset$ =90° half power beam widths of 2θ=60°and 30° respectively what are transverse and lateral power distribution coefficients for this device? [8]
   b) Derive the equation of power coupling from LED source to step index fiber: (i) when source radius is less than fiber radius (ii) when source radius is greater than the fiber radius. [8]

6. a) A continuous 12 km long optical fiber link has a loss of 1.5 dB/km: (i) What is the minimum optical power level that must be launched into the fiber to maintain an optical level of 0.3 μW at the receiving end? (ii) What is the required input power if the fiber has a loss of 2.5 dB/km? [8]
   b) Differentiate between power coupled to step index fiber and graded index fiber? [8]

7. a) Discuss all the criteria to select the set of components sufficing design of a fiber fiber optical link. [8]
   b) What are the differences in specifications, selection of components, performance merit parameters of digital and analog fiber optic receiver? [8]

Code No: **RT4104A** **R13** **Set No. 4**

IV B.Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2018

OPTICAL COMMUNICATION

(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 THREE questions from Part-B

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PART–A *(22 Marks)*

1. a) Explain the terms: (i) Group velocity (ii) Phase velocity [4]
   b) Explain in detail intrinsic absorption losses and extrinsic absorption losses. [4]
   c) Explain (i) V-grove splicing and (ii) elastic tube techniques for fiber splicing. [4]
   d) A GaAs laser operating at 850nm and has a length of 500µm. refractive index n=3.7.Calculate frequency and wave length. [4]
   e) Derive the relation for the optical power launched from a surface emitting LED into a graded index fiber. [3]
   f) Write short notes on multiplexing in fiber optic receivers. [3]

PART–B *(3x16 = 48 Marks)*

2. a) Compare the fiber structure and NA in step index and graded index fibers. [8]
   b) The refractive index of the core of step index fiber is 1.46 and the relative refractive index difference between core and cladding of the fiber is 2%. Estimate (i) Numerical Aperture (ii) Critical angle at the core cladding interface within the fiber. [8]

3. a) Explain core and cladding losses. Explain losses due to bending. [8]
   b) An optical signal at a specific wavelength has lost 55% of its power after traversing 3.5 Km of fiber. What is the attenuation in dB/km of this fiber? [8]

4. a) Explain the procedure of installing fiber connectors in optical fibers. [8]
   b) A step index fiber has a core refractive index of 1.5 and a core diameter of 50µm.Esimate the insertion loss at the joint due o the lateral misalignment assuming a uniform distribution of power between all guided modes when: (i) There is a small air gap at the joint (ii) the joint s considered index matched. [8]

5. a) Draw the light output versus current curve and explain the operation of LASER. [8]
   b) Explain the semiconductor injection laser diode resonating mode. [8]

6. a) Calculate the optical power coupled into the fiber by an optical source with a bias current of 20mA and a forward voltage of 1.5V.Assume an internal efficiency of the source as 2% and the coupling efficiency of 30%. [8]
   b) Estimate the losses encountered while coupling power from a source to a fiber due to mismatch in their numerical apertures and surface areas. [8]

7. a) Discuss the system criteria for design of a point-to-point fiber optic link. [8]
   b) Design of an optical fiber link for transmitting 15 Mb/Sec of data for a distance of 4 Km with BER of 10^{-9}. [8]