Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – WINTER 2018

Subject Code:2161005 Date:04/12/2018

Subject Name:Optical Communication

Time: 02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Differentiate single mode and multimode optical fibers.	**03**
	(b)	Explain about impact of attenuation and dispersion on signal while its propagation through optical fibers. List out various types of attenuation effects occurring in optical fiber.	**04**
	(c)	Compare a conventional communication system with an optical fiber communication system. With proper block diagram describe working of an optical fiber communication system in detail.	**07**
Q.2	**(a)**	Define terms: (a) Skew ray propagation (b) Meridional ray propagation (c) Total internal reflection with reference to optical fibers.	**03**
	(b)	A multimode step index fiber having a core diameter of 80 µm and a relative index difference of 1.5% is being operated at a wavelength of 0.85 µm. Core refractive index value of that cable is 1.48 Calculate value of: (i) Normalized frequency of fiber and (ii) Total number of guided modes for that optical cable.	**04**
	(c)	Classify linear scattering losses occurring in optical fibers and describe them in details.	**07**
		OR	
	(c)	Describe various Nonlinear scattering losses while signal propagation through optical fiber in optical communication systems.	**07**
Q.3	**(a)**	Discuss in brief about various dispersion phenomena occurring while signal propagation through optical fiber in optical communication systems.	**03**
	(b)	Differentiate LEDs and LASERs as optical sources.	**04**
	(c)	List out factors which decide the performance of optical reception in optical communication systems. Explain the principle, characteristics and operation of avalanche photodiode.	**07**
		OR	
Q.3	**(a)**	With the help of necessary figure properly explain DWDM in detail	**03**
	(b)	List out optical sources used in optical communication systems. Explain about any one of them with necessary figures.	**04**
	(c)	Draw neat sketch for OVPO Technique implementation for optical fiber fabrication process. Describe OVPO Technique in detail.	**07**
Q.4	**(a)**	A Laser diode has lateral $\varnothing$ =0°and transverse $\varnothing$ =90° half power beam widths of 2θ =70°and 35° respectively. Calculate transverse and lateral power distribution coefficient for this diode.	**03**
	(b)	The radiative and non-radiative recombination life times of minority carriers in the active region of a double heterojunction LED are 60ns and 100 ns respectively. Determine the total carrier recombination life time and optical power generated internally, if the peak emission wavelength is 0.87µm, and the drive current is 40 mA.	**04**
	(c)	Give classification of couplers used in optical fiber communication systems. Describe each one of them briefly.	**07**
		OR	

Q.4	**(a)**	Describe significance of use fiber connectors in optical communication link. List out various optical connectors.	**03**
	(b)	The radiative and non-radiative recombination life times of minority carriers in the active region of a double heterojunction LED are 50 ns and 100 ns respectively. Determine the total carrier recombination life time. When the peak emission wavelength is 0.86µm, and the drive current is 60 mA for that working structure.	**04**
	(c)	Define term splicing with reference to optical fiber link. Classify various techniques of splicing and describe them briefly with suitable figures.	**07**
Q.5	**(a)**	Discuss briefly the fabry parrot cavity resonator LASER with neat sketch.	**03**
	(b)	Explain working principle of EDFA used in fiber optical systems in detail.	**04**
	(c)	Write short note on Optical Time Domain Reflectometry (OTDR) method used in optical communication systems.	**07**

OR

Q.5	**(a)**	List out differences between graded index and step index fiber cables. Define Term V number for optical fiber cable.	**03**
	(b)	Explain in detail about Raman amplifiers used in optical communication systems.	**04**
	(c)	Write short notes on Synchronous Optical Fiber Networks (SONETs)	**07**

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Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2018

Subject Code:2161005 **Date:08/05/2018**

Subject Name:Optical Communication

Time:10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Explain the basic principal of Optical Fiber. Compare Optical Fiber with Co-axial cable as a communication channel.	**03**
	(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 meter. Assume that wavelength is 0.1 micrometer. Determine normalized frequency for fiber.	**04**
	(c)	Define and explain following terms: 1) Critical Angle 2) Numerical Aperture 3) Meridional Ray 4) Dark Current 5) Bending Losses 6) Response Time 7) Monochromatic Source	**07**
Q.2	**(a)**	Discuss linear scattering losses in optical fiber with respect to, (1) Rayleigh Scattering (2) Mie Scattering	**03**
	(b)	Explain the importance of cladding in optical fiber communication. Justify the statement: "Light travels faster in cladding than core."	**04**
	(c)	What is dispersion? Discuss various types of dispersions and their effect on performance of optical fiber. Derive the equation for intermodal dispersion.	**07**
		OR	
	(c)	Discuss in detail, different types of Attenuation Losses related to optical fiber communication.	**07**
Q.3	**(a)**	What is graded index fiber? How it is superior to step index fiber?	**03**
	(b)	Calculate the rms pulse broadening per km due to intermodal dispersion for the multimode step index fiber of 6 km optical link with the 86.7 ns rms pulse broadening for an optimum near parabolic profile graded index fiber with the 1.5 core axis refractive index and 1% relative refractive index difference.	**04**
	(c)	List the important parameters of photo detectors. Briefly explain the principal of optical detection. Discuss the major advantages of APD over P-i-n photodiode.	**07**
		OR	

Q.3	**(a)**	Technically explain the term spontaneous emission and stimulated emission.	**03**
	(b)	A p-n photodiode has a quantum efficiency of 50% at a wavelength of 0.9 micro meter. Calculate: (1) Its responsivity at 0.9 micrometer. (2) The received optical power if the mean photocurrent is 10^{-6} A.	**04**
	(c)	Define quantum efficiency. Derive an expression for responsivity and prove that responsivity is directly proportional to the quantum efficiency at a particular wavelength.	**07**
Q.4	**(a)**	Explain population inversion.	**03**
	(b)	Define and explain following with reference to LASER. (1) Mode Hoping (2) Frequency Chirp	**04**
	(c)	Describe the working principal and functioning of Raman amplifier with neat diagram.	**07**
		OR	
Q.4	**(a)**	Define and explain internal quantum efficiency and differential quantum efficiency of a LASER.	**03**
	(b)	Compare LASER and LED as an optical Source.	**04**
	(c)	Discuss and compare link power budget and rise time budget methods for design of optical link.	**07**
Q.5	**(a)**	List the major types of optical couplers and explain any one.	**03**
	(b)	Determine the power internally generated within the device when the peak emission wavelength is 0.87 micrometer at a drive current of 40 mA. The internal quantum efficiency of the device is 0.625.	**04**
	(c)	What is splicing? Explain various fiber splicing techniques in detail.	**07**
		OR	
Q.5	**(a)**	Explain the basic principles of WDM and DWDM with respect to optical fiber system.	**03**
	(b)	What is the use/application of OADM, optical circulators, wavelength converter and OTDR in optical communication?	**04**
	(c)	Write a technical note on optical receivers.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VI (New) EXAMINATION – WINTER 2019

Subject Code: 2161005 Date: 12/12/2019

Subject Name: Optical Communication

Time: 02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Give the comparison of Step Index and Graded Index Fibers.	**03**
	(b)	Briefly Describe the block diagram of Optical Communication Systems.	**04**
	(c)	A multimode step index fiber has a refractive index difference of 1% and a core refractive index of 1.5.The number of modes propagating at a wavelength of 1.3μm is 1600.Calculate the acceptance angle, numerical aperture and the diameter of the fiber core.	**07**
Q.2	**(a)**	Explain the significance of Carrier confinement related to the optical source.	**03**
	(b)	A typical LED emits light at a center wavelength of 920nm with $\Delta\lambda$=20nm, Calculate the Δf.	**04**
	(c)	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).	**07**
		OR	
	(c)	Define signal attenuation and how is it mathematically expressed. Explain the Bending losses (Micro bending losses, Macro bending losses).	**07**
Q.3	**(a)**	Mention difference between Electrical bandwidth and optical bandwidth.	**03**
	(b)	"The optical power launched into a fiber does not depend on the wavelength of the source but only on it's brightness" Justify.	**04**
	(c)	Briefly discuss the possible sources of noise in optical receivers.	**07**
		OR	
Q.3	**(a)**	Mention difference between Indirect band gap material and direct band gap material.	**03**
	(b)	What is equilibrium numerical aperture. Give the significance of the same.	**04**
	(c)	Explain detection process in the p-n photodiode. Define the quantum efficiency and responsivity of a photo detector.	**07**
Q.4	**(a)**	Define with reference to eye diagram: (1) Width of eye opening (2) Timing jitter.	**03**
	(b)	Discuss optical power loss model for a point to point link.	**04**

	(c)	Explain the performance of passive linear bus and also prove that optical power available at a particular node decreases with increasing distance from source.	**07**

OR

Q.4	**(a)**	Define Q factor for digital transmission through optical cable.	**03**
	(b)	Consider a 30-km long optical fiber that has an attenuation of 0.8 dB/km at 1300 nm. If 200 μW of optical power is launched into the fiber find out the optical output power Pout.	**04**
	(c)	Write short notes on Syncronous optical fiber networks(SONET).	**07**
Q.5	**(a)**	Discuss the Cut back technique for attenuation measurement.	**03**
	(b)	Write short note on EDFA .	**04**
	(c)	For a 2x2 fiber coupler show that the phase of the driven fiber always lags 90° behind the phase of the driving fiber. Also define the following related to optical coupler: (1) splitting ration (2) Excess loss (3) Insertion loss (4) Crosstalk	**07**

OR

Q.5	**(a)**	Explain any one method for optical dispersion measurement.	**03**
	(b)	Write short note on Raman Amplifier.	**04**
	(c)	Explain Mach-Zehnder Interferometer (MZI) multiplexer in detail.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI(NEW) – EXAMINATION – SUMMER 2019

Subject Code:2161005 Date:21/05/2019

Subject Name:Optical Communication

Time:10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Define : Skew ray, Meridional ray.	**03**
	(b)	Compare single mode and Multi mode step index and graded index optical fiber	**04**
	(c)	List the factors that decide the performance of optical reception and explain it. Also draw and explain eye diagram in detail.	**07**
Q.2	**(a)**	Explain various fiber modes	**03**
	(b)	Explain scattering loss in optical fiber.	**04**
	(c)	Explain with neat and clean diagram : The plasma activated chemical vapor deposition (PCVD) technique for the production of optical fiber	**07**
		OR	
	(c)	A multimode step index fiber with a core diameter of **100** μm and a relative index difference of **1.5%** is operating at a wavelength of **0.85** μm. If the core refractive index is **1.485**, calculate: (i) Normalized frequency of fiber (ii) Total number of guided modes.	**07**
Q.3	**(a)**	Compare Direct band gape and Indirect band gape materials	**03**
	(b)	Explain structure of Edge double hetero junction LED	**04**
	(c)	Derive the equation for the power launched from LED Source in to a S.I. fiber	**07**
		OR	
Q.3	**(a)**	Compare LED and LASER diode as a light source in fiber optic communication	**03**
	(b)	Explain structure of Surface LED	**04**
	(c)	Derive LASER rate equation	**07**

Q.4	**(a)**	Define the following terms related to photo detector. (1) Responsivity (2) Quantum efficiency (3) Cut off wavelength	**03**
	(b)	Discuss the fiber splicing techniques with necessary sketches.	**04**
	(c)	Explain Optical Time Domain Reflectometry (OTDR) method with its benefits over other techniques	**07**

OR

Q.4	**(a)**	Explain nature of light and its various polarization	**03**
	(b)	Explain principal of P i N photo detector with its energy band diagram	**04**
	(c)	Discuss the need of optical Amplifier and also describe the architecture and amplification mechanism of Erbium Doped Fiber Amplifier. (EDFA)	**07**
Q.5	**(a)**	Explain : Snell's law.	**03**
	(b)	Discuss system features of WDM and explain WDM in brief also Draw diagram of a typical WDM link containing various components	**04**
	(c)	Explain in detail : SONET/SDH	**07**

OR

Q.5	**(a)**	Short note : Dispersion in fiber cable	**03**
	(b)	Explain the three key transient process involved in LASER action.	**04**
	(c)	Explain reach through avalanche photo diode structure with its electric field and multiplication concept.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2020

Subject Code:2161005 Date:01/02/2021

Subject Name:Optical Communication

Time:02:00 PM TO 04:00 PM Total Marks: 56

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Briefly describe the block diagram of Optical Communication System.	**03**
	(b)	Explain in brief the transmission windows of OC.	**04**
	(c)	Describe double crucible Method for fiber fabrication.	**07**
Q.2	**(a)**	Define the following w.r.to propogation modes in OFC: (i) Transverse Propagation Constant(ii) V Number(iii)Group Velocity	**03**
	(b)	Compare Single Mode and Multi Mode fibers.	**04**
	(c)	Describe fiber Bending Losses in brief.	**07**
Q.3	**(a)**	Compare LED and LASER as fiber optic source.	**03**
	(b)	Determine the normalized frequency at 850 nm for a step index fiber has a core radius of 25μm,core refractive index of 1.48 and cladding refractive index of 1.46. How modes propagate in this fiber at 1320 nm and 1550nm.	**04**
	(c)	Describe different lensing schemes used in optical cable	**07**
Q.4	**(a)**	Compare SLED (Surface emitting)and ELED(Edge emitting) as fiber source.	**03**
	(b)	A multimode graded index fiber exhibits total pulse broadening 0.1 μsec over a distance of 12 km. Calculate(i)Optimum bandwidth on the link assuming no inter symbol interference.(ii) pulse broadening per unit length.	**04**
	(c)	Explain various losses taking place at fiber to fiber joints.	**07**
Q.5	**(a)**	Explain in brief dark current noise in photo detector.	**03**
	(b)	Describe the structure of P-I-N photo detector in brief.	**04**
	(c)	Explain different techniques of splicing in brief.	**07**
Q.6	**(a)**	Briefly describe temperature effect on Gain of APD.	**03**
	(b)	Explain APD in brief.	**04**
	(c)	Derive the equation for the power launched from LED source in to a S.I. Fiber.	**07**
Q.7	**(a)**	How will you measure intermodal dispersion in frequency domain?	**03**
	(b)	Mention the requirement of good optical switch.	**04**
	(c)	Discuss optical power loss model for a point to point link.	**07**

Q.8	**(a)**	How will you measure chromatic dispersion?	**03**
	(b)	Compare SOA and EDFPA.	**04**
	(c)	Briefly explain wavelength converter in optical components .	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VI EXAMINATION – SUMMER 2020

Subject Code: 2161005 Date:28/10/2020

Subject Name: Optical Communication

Time: 10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Mention the advantages of Optical Communication System.	**03**
	(b)	Mention the importance and significance of Optical Windows used for optical communication Purpose.	**04**
	(c)	Describe Any one Method for fiber fabrication.	**07**
Q.2	**(a)**	Define the following w.r.to Optical source and Detectors (i) Response Time(ii) Quantum Efficiency(iii)Sensitivity	**03**
	(b)	Compare S.I. and G.I. fibers.	**04**
	(c)	Describe fiber scattering Losses in brief.	**07**
		OR	
	(c)	Discuss intermodal dispersion in optical fibers.	**07**
Q.3	**(a)**	Compare LED and LASER as fiber optic source.	**03**
	(b)	Determine the normalized frequency at 850 nm for a step index fiber has a core radius of 20μm,core refractive index of 1.46 and cladding refractive index of 1.43. How modes propagate in this fiber at 1320 nm and 1550nm.	**04**
	(c)	Describe different lensing schemes used in optical cable	**07**
		OR	
Q.3	**(a)**	Briefly Explain working of ELED(Edge emitting) as fiber sourc and its Major advantage over SLED.	**03**
	(b)	A multimode graded index fiber exhibits total pulse broadening 0.1 μsec over a distance of 10 km. Calculate(i)Optimum bandwidth on the link assuming no inter symbol interference.(ii) pulse broadening per unit length.	**04**
	(c)	Derive the formula to compute loss for axial mis alignment taking place at fiber to fiber joints.	**07**
Q.4	**(a)**	Explain in brief dark current noise in photo detector.	**03**
	(b)	Describe the structure of APD (Avalanche photo detector)in brief.	**04**
	(c)	Explain different techniques of splicing in brief.	**07**
		OR	
Q.4	**(a)**	Briefly describe temperature effect on Gain of APD.	**03**
	(b)	Explain PIN as photo detector in brief.	**04**
	(c)	Derive the equation for the power launched from LED source in to a G.I. Fiber.	**07**

Q.5	**(a)**	How will you measure intermodal dispersion in frequency domain?	**03**
	(b)	Mention the requirement of good optical switch.	**04**
	(c)	Discuss optical power loss model for a point to point link.	**07**

OR

Q.5	**(a)**	How will you measure chromatic dispersion?	**03**
	(b)	Compare SOA and EDFPA.	**04**
	(c)	Briefly explain Couplers in optical components.	**07**

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