

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EC405

Course Name: OPTICAL COMMUNICATION

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks.

Marks

- 1 a) How we can classify optical fibers in accordance with refractive index profile? (5)
Explain with neat diagrams.
- b) What are photonic crystal fibers? Explain the classification of PCF with neat diagrams. (10)
- 2 a) Compare spontaneous emission and stimulated emission of LASER. (5)
- b) Explain the different types of scattering losses. (10)
- 3 a) What is Amplifier Spontaneous Emission Noise? (5)
- b) What is dispersion? Explain the different types of dispersion .Why single mode fiber are used in commercial communication systems? (10)

PART B

Answer any two full questions, each carries 15 marks.

- 4 a) With the help of necessary figures, describe the working of an IMDD system. (5)
- b) Explain the construction and avalanche multiplication of APD with neat diagram and outline the advantages and disadvantages as a detector for optical fibre communications. (10)
- 5 a) Write the concept of link power budget and rise - time budget. (5)
- b) Design an optical fiber link for transmitting 15Mb/s of data for distance of 4 km with BER of 10^{-9} . Assume typical values. (10)
- 6 a) Compare quantum efficiency and responsivity of pin diode. (5)
- b) Write the basic concept of soliton generation, and also write the advantages of soliton based communication system. (10)

PART C

Answer any two full questions, each carries 20 marks.

- 7 a) What are optical Amplifiers? Explain the Working any two with neat diagrams. (8)
b) What are the advantages of SOA over EDFA? (5)
c) What is a grating? A plain transmission grating possesses 5000 rulings /cm. What is the angle of second order diffraction produced by the grating for a wavelength of 1550 nm? (7)
- 8 a) What is a tunable optical filter? (5)
b) Explain the working principle of OTDR. How refractive index is calculated using it? (10)
c) Explain the principle of Raman Amplifier. What are the advantages and disadvantages of Raman amplifier? (5)
- 9 a) Explain add/drop multiplexers. (6)
b) Explain the working of EDFA with necessary diagrams. (8)
c) With block diagram explain free space optical communication system. Write the advantages and disadvantages of the system. (6)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code: EC405

Course Name: OPTICAL COMMUNICATION

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks.

Marks

- | | | |
|---|---|-----|
| 1 | a) Explain the mode theory for propagation of light in optical fiber? | (9) |
| | b) Draw and explain the Outside vapour-phase deposition process in fiber fabrication? | (6) |
| 2 | a) Write the working principle of LASER and compare it with LED using neat diagrams. | (9) |
| | b) A graded index fiber with parabolic refractive index has $n_1=1.48$ and $n_2=1.46$ if core radius is $20\mu\text{m}$. Find the number of modes at 1300nm and 1550nm ? | (6) |
| 3 | a) Explain different types of intramodal dispersion and derive the expression for pulse spread and dispersion factor for each case. | (8) |
| | b) Explain different types of bending losses in optical fibers? | (4) |
| | c) What is meant by Surface emitting LEDs? | (3) |

PART B

Answer any two full questions, each carries 15 marks.

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|---|---|-----|
| 4 | a) Derive an expression for receiver sensitivity and also explain quantum limit . | (8) |
| | b) Explain the physical principles of PIN photodetector? | (7) |
| 5 | a) Discuss the rise-time budget analysis in an optical fiber link and write about its advantages. | (9) |
| | b) A given APD has a quantum efficiency of 65 % at a wavelength of 900nm . If $0.5\mu\text{w}$ of optical power produces a multiplied photocurrent of $10\mu\text{A}$. Find the multiplication factor M ? | (6) |
| 6 | a) Briefly discuss the fundamental receiver operation in optical communication. | (6) |
| | b) Write the advantages of Soliton based communication and explain the generation of soliton wave. | (5) |

- c) A photodiode is constructed of GaAs, which has band gap energy of 1.43 eV at 300 K. What is the cutoff wavelength of this device? (4)

PART C

Answer any two full questions, each carries 20 marks.

- 7 a) Explain the operational principle of an OTDR and write the important performance parameters. (7)
- b) Compare the working between FP-SOAs and TW-SOAs. (8)
- c) Write a short note on Tunable optical filters? (5)
- 8 a) Explain the operation of Erbium-Doped fiber Amplifier. List out the different advantages. (12)
- b) What is meant by Fiber Bragg Grating? Write any one application in detail. (8)
- 9 a) What are the differences between fused fiber coupler and waveguide coupler? (8)
- b) Write the general characteristics and working principle of Raman Amplifier. (8)
- c) Why reconfigurable OADMs are more preferred in metro networks? (4)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh semester B.Tech examinations (S), September 2020

Course Code: EC405**Course Name: OPTICAL COMMUNICATION**

Max. Marks: 100

Duration: 3 Hours

PART A*Answer any two full questions, each carries 15 marks.*

Marks

- 1 a) Define macroscopic and microscopic bending losses. (5)
b) Explain Outside Vapor Phase Oxidation fabrication process with neat diagram. (10)
Compare it with MCVD process.
- 2 a) Explain different types of materials used for making optical fibers. (5)
b) Define attenuation constant. Explain the different attenuation mechanisms in optical fibers. (10)
- 3 a) Explain the following i) total internal reflection ii) axial numerical aperture in a graded index fiber. (5)
b) Explain the working of surface emitting LED with neat diagram. Also explain its emission pattern. (10)

PART B*Answer any two full questions, each carries 15 marks.*

- 4 a) Explain receiver sensitivity and quantum limit of detection of optical receiver. (5)
b) In a coherent optical communication system operating on the basis of homodyne detection, the received optical power is 2 nW and the signal bandwidth is 1 GHz. Taking the quantum efficiency of the detection to be 0.8 and the wavelength as 1500 nm find the SNR in case of shot noise limited performance. (10)
- 5 a) With the help of necessary figures, describe the working of an IMDD system. (5)
b) Explain the working of APD. What do you mean by reach through effect? (10)
- 6 a) A photo detector generates a photo current of $0.25\mu\text{A}$ for an incident optical power of $0.8\mu\text{W}$ at operating wavelength of $0.87\mu\text{m}$. Estimate the quantum efficiency of photo detector at this wave length. (5)
b) Derive the expressions for rise time and power budget analysis. (10)

PART C

Answer any two full questions, each carries 20 marks.

- 7 a) What are the different components used in WDM system? Explain any two. (8)
b) Compare different parameters of any four optical amplifiers. (8)
c) What is Li-Fi technology? (4)
- 8 a) What are the advantages of free space optical communication? (4)
b) Explain the working of EDFA. What are the advantages of EDFA? (10)
c) What do you mean by fiber bragg grating? (6)
- 9 a) How a fault is detected in an optical fiber? Explain the principle with necessary equations. (5)
b) What is TDFA? Explain the working of TDFA. (10)
c) What is tunable optical filter? (5)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Examination (Regular and Supplementary), December 2020

Course Code: EC405**Course Name: OPTICAL COMMUNICATION**

Max. Marks: 100

Duration: 3 Hours

PART A*Answer any two full questions, each carries 15 marks.*

Marks

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| 1 | a) Explain the general light wave system with figure. | (5) |
| | b) Write a short note on scattering losses. | (5) |
| | c) Consider a multimode fiber that has a core refractive index $n_1 = 1.48$ and a cladding index $n_2 = 1.46$. Find (a) critical angle at the core- cladding interface, (b) the N.A. for the fiber, and (c) the acceptance angle in air for the fiber. | (5) |
| 2 | a) Write a short note on photonic crystal fibre with figure. | (5) |
| | b) Briefly explain operation of Surface Emitting LED with figure. | (7) |
| | c) Write a short note on Amplified Spontaneous Emission noise. | (3) |
| 3 | a) Write a short note on bending losses in optical fiber. | (5) |
| | b) Explain the various LED characteristics. | (5) |
| | c) Write a short note on intramodal dispersion. | (5) |

PART B*Answer any two full questions, each carries 15 marks.*

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| 4 | a) Explain the structure of avalanche photodiode with figure. | (6) |
| | b) Consider the photons are incident on a PIN photodiode, which has a responsivity of 0.65A/W . If the optical power level is $10\mu\text{Watts}$. Calculate the photocurrent generated. | (5) |
| | c) Derive expression for Quantum or Shotnoise in photodetector. | (4) |
| 5 | a) Briefly explain the Link Power Budget with figure. | (5) |
| | b) Consider a LED driven circuit has a rise time of 15 ns. Taking a typical LED spectral width of 40nm and has a material dispersion related rise time degradation of 21ns over the 6km link. Consider the receiver has 25MHz bandwidth and has the rise time degradation from the receiver is 14ns. If the selected fiber has a 400MHz.km bandwidth-distance product with q (parameter) = 0.7, and the modal-dispersion-induced fiber rise time is 3.9ns. Find the value of link rise time. | (6) |
| | c) Write a short note on GH effect. | (4) |

- 6 a) Describe the working of IMDD system with figure. (5)
b) Briefly explain design of optical receivers. (5)
c) Write a short note on probability of error in digital receiver performance. (5)

PART C

Answer any two full questions, each carries 20 marks.

- 7 a) Write a short note on EDFA with figure. (8)
b) Explain the various advantages of SOA. (6)
c) Briefly explain Raman Amplifier with figure. (6)
- 8 a) Briefly explain the WDM concept. (7)
b) Write a short on Bragg Grating with figure. (7)
c) Briefly explain tunable filters. (6)
- 9 a) Briefly explain the free space optical communication with block diagram. (7)
b) Consider a fiber grating with the following parameter, $L=0.5\text{cm}$, $\lambda_{\text{Bragg}} = 1530\text{nm}$, $n_{\text{eff}} = 1.48$, $\delta n = 2.5 \times 10^{-4}$ and $\eta = 82\%$. Calculate the coupling coefficient κ and the full bandwidth $\Delta\lambda$ over the maximum reflectivity. (6)
c) Explain the working of OTDR with diagram. (7)
