Code No: R1941041 **R19** **Set No. 1**

IV B.Tech I Semester Regular Examinations, November – 2022
MICROWAVE AND OPTICAL COMMUNICATION ENGINEERING
(Electronics and Communication Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions
ONE Question from Each unit
All Questions Carry Equal Marks
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UNIT-I

1 a) How bunch formation takes place in the drift region in two cavity klystron? Explain. [7]
b) What is the relevance of different modes of operation in Gunn diode? [8]

(OR)

2 a) What are the limitations of conventional active devices at microwave frequencies? [7]
b) Explain the working of cavity magnetron and find out its Hull cut-off magnetic field. [8]

UNIT-II

3 a) What is a magic tee? Why is it called so? Explain the characteristics of the tee considering various input/output conditions. [7]
b) Derive S parameter of hybrid tee if all the tee are matched and power incident from the port 3 only. [8]

(OR)

4 a) Define the coupling factor and directivity of the directional coupler and justify the following statement: The directivity of a two-holes directional coupler is a sensitive function of frequency. [7]
b) Find the coupling coefficient of a directional coupler if the incident power in its main arm is 300 mW and power in its auxiliary arm is 200 W. [8]

UNIT-III

5 a) A multimode step-index fiber has a relative 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 1100. Estimate the diameter of the fiber core. [7]
b) Describe what is meant by the fusion splicing of optical fibers. Discuss the advantages and drawbacks of this jointing technique. [8]

(OR)

6 a) Describe with the aid of simple ray diagrams: (a) the multimode step-index fiber;(b) the single-mode step-index fiber.Compare the advantages and disadvantages of these two types of fiber for use as an optical channel. [7]

b) Briefly describe the types of demountable connectors that may be used with single-mode fibers. Further, indicate the problems involved with the connection of single-mode fibers. [8]

UNIT-IV

7 a) Calculate the ratio of the stimulated emission rate to the spontaneous emission ratefor an incandescent lamp operating at a temperature of 1000 K. It may be assumed that the average operating wavelength is 0.5 µm. [7]

b) Briefly explain the physical principles and comparision of optical sources and detectors? [8]

(OR)

8 a) Briefly describe the two processes by which light can be emitted from an atom.Discuss the requirement for population inversion in order that stimulated emissionmay dominate over spontaneous emission. [7]

b) Explain link power budget in optical system design. [8]

UNIT-V

9 a) Calculate the VSWR of a transmission line operating at 10 GHz. Assume TE_{10} wave propagating inside of a waveguide of dimensions a = 4 cm, b = 3 cm. The distance between twice the minimum power point is 2 mm on a slotted line. [7]

b) Describe the structure and operation of a OTDR. [8]

(OR)

10 a) How is slotted transmission line used in the measurement of frequency and wavelength? [7]

b) Discuss the sensitivity of OTDR in relation to commercial reflectometers.Comment on an approach which may lead to an improvement in the sensitivity ofthis measurement technique. [8]

Code No: R1941041 **R19** **Set No. 2**

IV B.Tech I Semester Regular Examinations, November – 2022
MICROWAVE AND OPTICAL COMMUNICATION ENGINEERING
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Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions
ONE Question from Each unit
All Questions Carry Equal Marks
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UNIT-I

1 a) With relevant diagram explain the working of reflex klystron. [7]
b) What are π-mode oscillations? Explain how oscillations are sustained in the cavity magnetron with suitable sketches, assuming that π-mode oscillations already exist. [8]

(OR)

2 a) Discuss the principle of operation characteristics and application of Gunn diode. [7]
b) How is continuous interaction between the electron beam and RF field ensured in the TWT? Using suitable diagrams show that the favourable interactions are more than the unfavourable interactions, resulting in amplification. [8]

UNIT-II

3 a) Compare hybrid tee with the hybrid ring. Give two applications of hybrid tee. [7]
b) Write a short note on the waveguide corner and bends. With the support of figures, explain the waveguide corners and bends. [8]

(OR)

4 a) Explain the construction and working of directional coupler. Under what conditions does thecoupler give maximum directivity? [7]
b) Discuss various types of waveguide attenuators. Specify the special features of cut-off attenuators. [8]

UNIT-III

5 a) Describe, with the aid of suitable diagrams, three common techniques used for the mechanical splicing of optical fibers. [7]
b) Briefly describe the types of demountable connector that may be used with single mode fibers. Further, indicate the problems involved with the connection of single mode fibers. [8]

(OR)

6 a) A step index fiber has a solid acceptance angle in air of 0.115 radians and a relative refractive index difference of 0.9%. Estimate the speed of light in the fiber core. [7]

b) Briefly indicate with the aid of suitable diagrams the difference between meridional and skew ray paths in step index fibers. [8]

UNIT-IV

7 a) With the aid of suitable diagrams, discuss the principles of operation of the injection laser. [7]

b) Describe with the aid of suitable diagrams the mechanism giving the emission of light from an LED. Discuss the effects of this mechanism on the properties of the LED in relation to its use as an optical source for communications. [8]

(OR)

8 a) Briefly outline the advantages and drawbacks of the LED in comparison with the injection laser for use as a source in optical fiber communications. [7]

b) i) When $3x10^{11}$ photons each with a wavelength of 0.85 μm are incident on a photodiode, on average $1.2x10^{11}$ electrons are collected at the terminals of the device. Determine the quantum efficiency and the responsivity of the photodiode at 0.85 μm. [8]

ii) GaAs has a bandgap energy of 1.43 eV at 300 K. Determine the wavelength above which an intrinsic photodetector fabricated from this material will cease to operate.

UNIT-V

9 a) A slotted line is used to measure VSWR of the load at 8 GHz by double minima method. If the distance between the positions of twice minimum power is 0.5 cm.Find the value of VSWR on the line and magnitude of the voltage reflection coefficient. [7]

b) How is slotted line used for measurement of impedance of an unknown load? [8]

(OR)

10 a) What is bolometer? Give the construction of a thermistor mount and explain the method of microwave power measurement using dual bolometer bridge. What is the function of second bridge? [7]

b) What is reflection meter? How it is used to measure the reflection co-efficient and VSWR of any unknown load? [8]

Code No: R1941041 **R19** **Set No. 3**

IV B.Tech I Semester Regular Examinations, November – 2022
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Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions
ONE Question from Each unit
All Questions Carry Equal Marks
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UNIT-I

1 a) With the aid of a schematic diagram, describe the travelling wave tube amplifier. Discuss in aqualitative way the consequences of locating the attenuator in a TWT (*i*) very close to the outputend of the tube, and (*ii*) very close to gun end of the tube [7]

b) Give the constructional features of two-cavity klystron andexplain its operation. [8]

(OR)

2 a) With schematic diagram, explain the working of travelling wave tube and compare it with multi-cavity klystron. [7]

b) Why is magnetron also called "Extended interaction" tube? Derive the expression forHull cut-off magnetic flux density in cylindrical magnetron. [8]

UNIT-II

3 a) A three port circulator has an insertion loss of 1 dB, isolation 30 dB and VSWR = 1.5. Find the S-matrics. [7]

b) With the help of diagram, explain the working of magic tee. Discuss any of its two applications. [8]

(OR)

4 a) What are scattering parameters? How they can be important at microwave frequencies? Discuss its properties. [7]

b) Explain the operating principle of isolator and discuss its working with relevant diagram. [8]

UNIT-III

5 a) Explain what is meant by a graded-index optical fiber, write the expression for the possible refractive index profile. Using simple ray theory concepts, discuss the transmission of light through the fiber. Indicate the major advantage of this type of fiber with regard to multi-mode propagation. [7]

b) Describe what is meant by the fusion splicing of optical fibers. Discuss the advantages and drawbacks of this jointing technique. [8]

(OR)

6 a) The relative refractive index difference between the core axis and the cladding ofa graded index fiber is 0.7% when the refractive index at the core axis is 1.45.Estimate values for the numerical aperture of the fiber when:(a) the index profile is not taken into account; and(b) the index profile is assumed to be triangular. [7]

b) A multimode step-index fiber has a relative 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 1100. Estimate the diameter of the fiber core. [8]

UNIT-IV

7 a) A photodiode has a quantum efficiency of 65% when photons of energy 1.5 x10^{-19} Jare incident upon it.
(a) At what wavelength is the photodiode operating?
(b) Calculate the incident optical power required to obtain a photocurrent of 2.5 μA when the photodiode is operating as described above. [7]

b) The quantum efficiency of a particular silicon RAPD is 80% for the detection of radiation at a wavelength of 0.9 μm. When the incident optical power is 0.5 μW, theoutput current from the device (after avalanche gain) is 11 μA. Determine the multiplication factor of the photodiode under these conditions. [8]

(OR)

8 a) What is WDM? Explain its working principle and its necessity. [7]

b) Explain the line coding technique in optical system design. [8]

UNIT-V

9 a) Discuss various ways in which the insertion loss or attenuation can be measured. [7]

b) Discuss the sensitivity of OTDR in relation to commercial reflectometers.Comment on an approach which may lead to an improvement in the sensitivity ofthis measurement technique. [8]

(OR)

10 a) With block diagram explain the procedure to measure the impedance of unknown impedance using slotted wave section. [7]

b) Describe the structure and operation of a OTDR. [8]

Code No: R1941041 **R19** **Set No. 4**

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Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions
ONE Question from Each unit
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UNIT-I

1	a)	With the help of schematic diagram, explain the working of cavity mechanism. What is the role of slow wave structure in TWT?	[7]
	b)	With support of diagram explain 8 cavity magnetron. Discuss the role of slow wave structure inTWT.	[8]
		(OR)	
2	a)	How bunch formation takes place in drift region in two cavity klystron? Explain.	[7]
	b)	Discuss principle of operation characteristics and application of Gunn diode.	[8]

UNIT-II

3	a)	Derive the S-matrix of E-plane tee when power is fed from auxiliary port. Consider other ports in the matched condition.	[7]
	b)	Discuss waveguide bends and corners. How do these differ in terms of performance?	[8]
		(OR)	
4	a)	What are unidirectional and bidirectional couplers? Explain their modes of operation.	[7]
	b)	Explain the working of different types of attenuators. Add necessary figures.	[8]

UNIT-III

5	a)	A step-index fiber with a suitably large core diameter for ray theory considerations has core and cladding refractive indices of 1.44 and 1.42 respectively. Calculate the acceptance angle in the air for skew rays which change direction by 150° at each reflection.	[7]
	b)	A multimode graded-indexfiber has an acceptance angle in the air of 8°. Estimate the relative refractive index difference between the core axis and the cladding when the refractive index at the core axis is 1.52.	[8]

(OR)

6 a) A Single-modestep-indexfiber has a core diameter of 7 μm and a core refractive index of 1.49. Estimate the shortest wavelength of light which allows single-mode operation when the relative refractive index difference for the fiber is 1%. [7]

b) Describe, with the aid of suitable diagrams, three common techniques used for the mechanical splicing of optical fibers. [8]

UNIT-IV

7 a) The quantum efficiency of a particular silicon RAPD is 80% for the detection ofradiation at a wavelength of 0.9 μm. When the incident optical power is 0.5 μW, theoutput current from the device (after avalanche gain) is 11 μA. Determine the multiplication factor of the photodiode under these conditions. [7]

b) With the aid of suitable diagrams, discuss the principles of operation of the injectionlaser. [8]

(OR)

8 a) Explain the roll of eye pattern in optical system design. [7]

b) Briefly outline the general requirements for a source in optical fiber communications. [8]

UNIT-V

9 a) Discuss the sensitivity of OTDR in relation to commercial reflectometers.Comment on an approach that may lead to an improvement in the sensitivity of this measurement technique [7]

b) Discuss the precautions to be taken in microwave measurements. [8]

(OR)

10 a) Describe the structure and operation of a OTDR. [7]

b) Describe various methods of impedance measurement. [8]