	b. With a neat diagram, describe the construction and working operation of magnetron and derive the Hull cut off electric and magnetic field equation.	10	4	1	1
27. a.i.	List out properties of 'S' matrix.	5	3	2	2
	ii. Derive the 'S' matrix for direction coupler.	5	3	2	2
	(OR)				
	b. Mention the types of power dividers used in microwave communication, elaborate WILKINSON power divider in detail.	10	4	2	4
28. a.i.	Using a slotted line, the following results were obtained: distance of first minimum from the load = 4cm, distance of second minimum from the load =14 cm VSWR =1.5. If the line is lossless and $Z_0 = 50\Omega$. Find the load impedance.	5	4	3	3
	ii. Mention the methods used to measure the attenuation of microwave device and elaborate any one technique in detail.	5	4	3	3
	(OR)				
	b. Identify the device which helps in both phase and magnitude related microwave measurements with a neat sketch explain the working of the same.	10	4	3	4
29. a.	Sketch the functional block of optical receiver module and elaborate the function of each module.	10	3	4	2
	(OR)				
b.i.	A graded-index fiber has a core with parabolic refractive index profile of diameter 30 μm, NA =0.2, $\lambda = 1\mu m$. Estimate the normalized frequency/V number and there by the number of modes the fiber can support.	5	4	4	4
	ii. With a neat sketch, illustrate the working principle of PIN photo diode.	5	3	4	2
30. a.i.	Mention the key system requirements and consideration for analyzing a point-to-point optical link.	5	4	5	5
	ii. Make a power budget analysis for a short local system length = 5 km, where the required data rate is 20 Mbs. BER is 1×10^{-9} and it is operating at $\lambda = 850nm$. The Si PIN photodiode has a receiver sensitivity of about couple of 50 μm into multimode fiber with a core diameter of 50 μm the connector loss is 1 dB per splicing loss and fiber attenuation loss for the fiber is $3.5\,dB/km$, check the feasibility.	5	4	5	5
	(OR)				
	b. Elaborate the following				
	(i) Optical isolators	5	3	5	2
	(ii) Optical couplers	5	3	5	2

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Reg. No.														

B.Tech. DEGREE EXAMINATION, DECEMBER 2022
Sixth and Seventh Semester

18ECC302J – MICROWAVE AND OPTICAL COMMUNICATIONS
(For the candidates admitted from the academic year 2018-2019 to 2019-2020)

Note:
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part - B** should be answered in answer booklet.

Time: 2½ Hours Max. Marks: 75

PART – A (25 × 1 = 25 Marks)
Answer **ALL** Questions

		Marks	BL	CO	PO
1.	An X-band pulsed cylindrical magnetron has the following parameters: operating parameters anode voltage is 26 kV, beam current is 27 A magnetic flux density $0.336 Wb/m^2$, radius of cathode cylinder 5 cm radius of vane edge to center is 10 cm. Find the hull cutoff voltage for fixed magnetic flux density? (A) 144.50 kV (B) 139.50 kV (C) 149.50 kV (D) 134.50 kV	1	2	1	4
2.	GaAs is used in the fabrication of Gunn diodes because (A) GaAs is cost effective (B) Less temperature sensitive (C) It has low conduction band electrons (D) Less forbidden energy gap	1	1	1	1
3.	In Tunnel diode, the tunneling phenomenon is due to (A) Minority carrier effect (B) Transit time effect (C) Frequency effect (D) Majority carrier effect	1	1	1	1
4.	The frequency of operation of an FET is limited by (A) Drain to source voltage (B) Gate to source voltage (C) Gate length (D) Effective area of an FET	1	2	1	4
5.	The semiconductor diode which can be used in switching circuits at microwave range is (A) PIN diode (B) Tunnel diode (C) Varactor diode (D) Gunn diode	1	1	1	4
6.	If the reflection coefficient of a 2 port network is 0.8. Then the return network loss in the network is (A) 6.5 dB (B) 0.15 dB (C) 1.93 dB (D) 10 dB	1	1	2	2
7.	Isolation of a directional coupler is a measure of the (A) Power delivered to the uncoupled port (B) Power delivered to the coupled port (C) Power delivered to the second port (D) Power not delivered	1	1	2	2

8. The diagonal elements of S-matrix for a perfectly matched network is — 1 2 2 4
   (A) Unity (B) Zero
   (C) Infinity (D) Undefined

9. Which is the dominant mode in rectangular wave guide? — 1 2 2 4
   (A) TE_{10} (B) TE_{11}
   (C) TM_{01} (D) TM_{11}

10. If the microwave network is lossless then the S-matrix of the microwave network is — 1 1 2 4
   (A) Unitary (B) Symmetric
   (C) Identify matrix (D) Zero matrix

11. In a double minimum method — 1 2 3 4
   (A) $\lambda_g/(d_1-d_2)$ (B) $\lambda_g/\pi(d_1-d_2)$
   (C) $\pi(d_1-d_2)$ (D) $\pi\lambda_g/(d_1-d_2)$

12. If the diode impedance is 40Ω and the terminated line characteristic impedance is 50 Ω for a shunt configuration switch, then the insertion loss of the switch is — 1 2 3 4
   (A) 2.2 dB (B) 4.2 dB
   (C) 8.4 dB (D) 3.6 dB

13. Cut-off wave length for dominant mode in rectangular waveguide is — 1 1 3 3
   (A) More than free space wavelength (B) Less than free space wavelength
   (C) Zero (D) ∞

14. Microwave oven operates at frequency of — 1 2 3 4
   (A) 2.45 GHz (B) 24.5 GHz
   (C) 245 MHz (D) 245 GHz

15. The Calorimetric technique is used to measure the microwave power in the range of _____ — 1 1 3 3
   (A) 0.01 mW to 10 mW (B) >10 W
   (C) 10 mW to 1 W (D) >100 W

16. When the input and output power in an optical fiber is 120 μW and 3 μW respectively and length of the fiber is 8 km, what is the signal attenuation per km for the fiber? — 1 2 4 4
   (A) 3 dB/ km (B) 2 dB/ km
   (C) 1 dB/ km (D) 4 dB/ km

17. _____converts the received optical signal into an electrical signal. — 1 1 4 2
   (A) Detector (B) Attenuator
   (C) Laser (D) LED

18. Which one of the following is not a guided medium of transmission? — 1 1 4 2
   (A) Fiber-optic cable (B) Coaxial cable
   (C) Twisted-pair-cable (D) Atmosphere

19. What is the temperature dependence of threshold current? — 1 2 4 2
   (A) $J_{th} = J_{tho}\exp\left(\frac{T}{T_0}\right)$ (B) $J_{th} = J_{tho}\exp(T_0 < T)$
   (C) $J_{th} = J_{tho}\exp(T_0/T)$ (D) $J_{th} = J_{tho}\exp(T_0/k)$

20. Numerical aperture is used to obtain — 1 2 4 4
   (A) Angle of incidence (B) Acceptance angle
   (C) Refractive indexes (D) Relationship between acceptance and refractive indexes

21. A number of three-port single mode fiber couplers are used in the fabrication of a ladder coupler with 16 output ports. The three-port couplers each have an excess loss of 0.2 dB along with a splice loss of 0.1 dB, at the interconnection of each stage, determine excess loss. — 1 1 5 5
   (A) 1.9 dB (B) 1.4 dB
   (C) 0.9 dB (D) 1.1 dB

22. The method for transmitting microwave analog signals over an optical fiber link have become _____technique. — 1 1 5 5
   (A) RF over fiber (B) AF over fiber
   (C) Analog modulator (D) Digital modulator

23. FWM in DWM systems influenced by two factor — 1 1 5 5
   (A) Channel spacing and fiber dispersion (B) Channel spacing and fiber attenuation
   (C) Fiber attenuation and optical power (D) Fiber dispersion and optical power

24. The three major groups of the optical system are — 1 2 5 2
   (A) Components, data rate and response time (B) Source, data rate, and receiver
   (C) Transmitter, cable and receiver (D) Source, link and detector

25. Which method determines the dispersion limitation of an optical link? — 1 1 5 2
   (A) Link-power budget (B) Rise-time budget
   (C) Losses time (D) Photodetector noise

PART – B (5 × 10 = 50 Marks) — Marks BL CO PO
Answer **ALL** Questions

26. a.i. Illustrate with a neat diagram, describe any two modes of operation of Gunn diode. — 5 4 1 4

   ii. Mention the avalanche transit time devices. Explain how plasma is formed in TRAPATT diode. — 5 4 1 1

(OR)