27. a.	Highlight the importance of the following in microwave measurements and derive its 'S' matrix of 3 port device. (i) E – plane (ii) H – plane	10	3	2	2
	(OR)				
b.	Design an attenuator using a rectangular to circular transition and a circular to rectangular transition. And demonstrate that the attenuation produced by the designed attenuator is given in the dB by A = – 40 log (sinθ) where 'θ' is the angle the resistive card makes with the direction of electric field.	10	4	2	4
28. a.	Two identical 40 dB directional couplers are used to sample incident and reflected power in a waveguide. The value of VSWR is 7.0 and the output of the coupler sampling incident power is 5mW. What is the value of reflected power? And, illustrate the method of measuring the power ranging from 10 W to 50 kW.	10	4	3	4
	(OR)				
b.	Identify the device which provides information about the voltage (or) energy of the signal as a function of frequency. Provide its working principle with suitable block diagrams.	10	4	3	4
29. a.	Enumerate the various attenuation mechanism in an optical fiber with equations and block diagram.	10	3	4	2
	(OR)				
b.i.	A PIN photo diode has a quantum efficiency of 65% for photons of energy 1.52×10^{-19}J. Calculate (1) wave length at which the diode is operating. (2) the optical power required to achieve a photo cement of 3μA, when the wavelength of incidence photon is that calculated from above (1) questions.	5	4	4	4
ii.	Mention the needs of double hetero structure in LED and highlight importance of S-LED with its structure.	5	4	4	4
30. a.i.	Write down the procedure to estimate the rise time budget of a fiber optic point to point link and highlighting the deviation of rise time resulting from modal dispersion.	5	4	5	5
ii.	With suitable expressions, elaborate the link power budget of an optical system of 10 km distance.	5	4	5	5
	(OR)				
b.	Mention the need for multiplexing in optical communications and explain working principle of WDM and DWDM.	10	4	5	5

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Reg. No.														

B.Tech. DEGREE EXAMINATION, MAY 2022
Sixth 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

		Marks	BL	CO	PO
	PART – A (25 × 1 = 25 Marks) Answer **ALL** Questions				
1.	Microwave frequencies are used for earth-space links because they do not suffer (A) Attenuation (B) Fading (C) Refraction by ionosphere (D) Phase distortion	1	1	1	1
2.	Which one of the following microwave tube uses both axial magnetic field and radial electric field? (A) Magnetron (B) Reflex klystron (C) Travelling wave tube (D) Klystron	1	1	1	1
3.	In order to achieve high current density, a compromise in _____ is made in a TRAPATT diode. (A) Size (B) Gain (C) Operating frequency (D) Directivity	1	1	1	1
4.	With the increase in the operating frequency of a BJT, the S_{22} parameter of the transistor _____ (A) Increases (B) Decreases (C) Remains constant (D) Behaves abruptly	1	2	1	4
5.	A reflex klystron functions as _____ (A) Microwave oscillator (B) Microwave amplifier (C) High gain cavity (D) Repeater	1	2	1	4
6.	Scattering matrix for a reciprocal network is _____ (A) Skew matrix (B) Identify matrix (C) Unitary (D) Symmetric	1	1	2	2
7.	Which device is based on Faraday's rotation? (A) Isolator (B) Magic tee (C) H-plane (D) E-plane	1	1	2	2

8. The mode of propagation supported by coupled line coupler is — 1 1 2 2
   (A) TE mode (B) TM mode
   (C) TEM mode (D) Quasi TEM mode

9. In tunnel diode, the tunneling phenomenon is due to — 1 2 1 4
   (A) Minority carrier effect (B) Transit time effect
   (C) Frequency effect (D) Majority carrier effect

10. E-plane tee is also known as — 1 2 2 4
   (A) Adder (B) Subtractor
   (C) Multiplier (D) Divider

11. Isolation of a directional coupler is a measure — 1 1 3 3
   (A) Power delivered to the uncoupled port (B) Power delivered to the coupled port
   (C) Power delivered to the second port (D) No power delivered

12. Which is a dominant mode in rectangular waveguide? — 1 1 3 3
   (A) TE10 (B) TE11
   (C) TM10 (D) TM01

13. In double minimum method — 1 2 3 4
   (A) $\lambda_g / (d1 - d2)$ (B) $\lambda_g / \pi(d1 - d2)$
   (C) $\pi(d1 - d2)$ (D) $\pi\lambda g / (d1 - d2)$

14. What instrument that sweeps over a band of frequencies to determine the range of frequencies are being produced by a specific circuit under test? — 1 1 3 3
   (A) Frequency counter (B) Spectrum analyser
   (C) Bolometer (D) Function generator

15. For a Wilkinson power divider of insertion loss L and the coupler is matched to the external circuitry and then the gain of the coupler interms of insertion loss is — 1 1 3 3
   (A) 2L (B) $\frac{1}{2}L$
   (C) L (D) $\frac{1}{L}$

16. Slotted line is a transmission line configuration can be used to determine the — 1 1 3 3
   (A) Magnetic field amplitude (B) Voltage used for excitation
   (C) Load impedance (D) Current measured at the load

17. The band of light wavelengths that are too long to be seen by the human eye — 1 1 4 2
   (A) Ultraviolent (B) Infrared
   (C) Amber (D) X-rays

18. When the input and output power in an optical fiber is 120 μW and 3 μW. the length of the fiber is 8 km. What is the signal attenuation per km? — 1 2 4 4
   (A) 3 dB/km (B) 2 dB/km
   (C) 4 dB/km (D) 6 dB/km

19. The following has more sophisticated structure that P-I-N photodiode — 1 1 4 2
   (A) P-N junction diode (B) Avalanche photodiode
   (C) Laser diode (D) Led diode

20. Condition for the spontaneous emission — 1 1 4 2
   (A) N1=N2 (B) N1>N2
   (C) N2>N1 (D) N1>=N2

21. The bandgap energy of gallium arsenide is — 1 2 4 2
   (A) $E_g = 1.343\ eV$ (B) $E_g = 1.443 eV$
   (C) $E_g = 1.23\ eV$ (D) $E_g = 1.3 eV$

22. Find the numerical aperture if core-cladding index difference is 2% and refractive index N1 is 1.480. — 1 2 4 2
   (A) 0.296 (B) 0.52
   (C) 0.356 (D) 0.13

23. Snell's law related to — 1 2 4 4
   (A) Light reflection (B) Light transmission
   (C) Light refraction (D) Light attenuation

24. When the number of channels is very large and wavelength are spaced close together, then the system is — 1 1 5 2
   (A) WDM (B) WSN
   (C) DWDM (D) TDM

25. What type of WDM system required an optical circulator? — 1 2 5 2
   (A) Mach-zehnder interferometer (B) Tunable optical filter
   (C) Michelson interferometer (D) Fiber bragg grating

PART – B (5 × 10 = 50 Marks)

Answer **ALL** Questions

		Marks	BL	CO	PO
26. a.i.	Write down the working principle of Gunn diode as a Transferred Electron Device with two valley model and V-I characteristics.	5	4	1	4
ii.	Illustrate the construction and explain operation of IMPATT diode.	5	4	1	4
	(OR)				
b.	A two cavity Klystron is operated at 10GHz with V_0=1300 V and I_0=40mA. Gap spacing in either cavity is 2 mm. Spacing between the cavity is 5 cm. (i) Calculate electron velocity. (ii) DC transit time of electron. (iii) Input RF voltage Vi for a maximum output voltage and (iv) The beam coupling coefficient.	10	4	1	1