Reg. No.															

B.Tech. DEGREE EXAMINATION, DECEMBER 2023
OPEN BOOK EXAMINATION
Sixth Semester

18ECC302J – MICROWAVE AND OPTICAL COMMUNICATIONS
(For the candidates admitted from the academic year 2020-2021 to 2021-2022)

- Specific approved THREE text books (Printed or photocopy) recommended for the course
- Handwritten class notes (certified by the faculty handling the course / head of the department)

Time: 3 Hours Max. Marks: 100

Answer **FIVE** questions
(Question No 1 is compulsory)

		Marks	BL	CO	PO
1.a.i.	1. What is mechanical tuning and electronic tuning in a reflex Klystron? 2. How the bunching time can be altered in a reflex Klystron? 3. A reflex Klystron is to be operated at a frequency 10GHz, with dc beam Voltage of 300V, and repeller space of 0.1cm for 7/4 mode. Calculate P_{RFmax} and corresponding repeller voltage for a beam current of 20mA.	10	3	1	1
ii.	In a microwave transit time device, the application of a current pulse creates a high field avalanche zone that propagates faster than the saturated velocity of the carriers confined in the low field region. Identity the device and explain it's various operational regions using a characteristics curve.	5	1	1	1
iii.	A class of heavily doped p-n junction diode with a negative resistance over a portion of their I-V characteristics. Identify the diode and compare it with an ordinary p-n junction diode.	3	1	1	1
b.	The parameters of a two cavity Klystron are given by f= 3.2GHz, d= 10^{-3}m, V_e= 17.79×10^6 m/s. Determine transit angle. (A) 113 radians (B) 11.3 radians (C) 1.13 radians (D) 1130 radians	1	1	1	1
c.	How many modes of operation does n-type GaAs has (A) 1 (B) 2 (C) 3 (D) 4	1	1	1	1
2.a.i.	Identify the microwave component with the side arm parallel to the magnetic field, draw it's schematic and prove that it's diagonal S-matrix demands are not all zeros.	10	4	2	2
ii.	A non-reciprocal device whose power flow only from the n^{th} part to the $(n+1)^{th}$ port in one direction constructed using directional coupler and phase shifters. Identify the device and enumerate it's functionality. Also derive it's S-matrix.	8	4	2	4

b.	The analysis of Wilkinson power dividers is done using (A) Symmetry (B) Even – Odd mode analysis (C) S-matrix approach (D) h- parameters	1	1	2	2
c.	S_{11} of S-matrix represents (A) Reflection co-efficient (B) Transmission co-efficient (C) Voltage gain (D) Power gain	1	1	2	2
3.a.i.	Name the device which provides information about the voltage or energy of the signal as a function of frequency. Also, demonstrate it's working methodology with suitable diagrams.	8	4	3	4
ii.	Consider a microwave source fed to a microstrip load. Both the source and load is not perfectly matched to each other and hence standing waves are produced whose V_{max} is 2.5V and V_{min} is 1V measured from the slotted section at the distance of 8.5cm and 7,5cm respectively. The generator transfers an input power of 15dB and the load produces an output power of 12dB and it reflects 3dB power back to the source. Find the wavelength, SWR, reflection co-efficient, attenuation loss and insertion loss.	10	4	3	4
b.	Most of the power measuring microwave devices measure (A) Average Power (B) Peak Power (C) Instantaneous Power (D) Peak – Peak Power	1	1	3	4
c.	In a microwave power measurement using bolometer, the principle of working is the variation of (A) Inductance with absorption power (B) Resistance with absorption power (C) Capacitance with absorption power (D) Cavity dimensions with heat generated of the power	1	1	3	4
4.a.i.	Why the output of the optical signal is degraded? Explain the various mechanism for the same.	10	3	4	2
ii.	Identify the optical source which has a response time is in terms of milli seconds. Explain the most suitable structure for the same.	8	4	4	4
b.	Find the numerical aperture of core-cladding index difference is 2% and refractive index N1 is 1.480 (A) 0.296 (B) 0.52 (C) 0.356 (D) 0.13	1	2	4	2
c.	If Eg = 1.51eV, find the peak emission wavelength λ in micrometers (A) 0.8211 (B) 1.8724 (C) 1.2177 (D) 0.9831	1	2	4	4
5.a.i.	In a microwave solid state device, a field induced transfer & conduction band electrons from a high mobility lower energy valley to low mobility higher energy valley takes place. Name the device and the phenomenon due to this effect. Illustrate, the principle in which it results in microwave oscillations with diagram	10	3	1	1

ii.	Name the device which uses a dielectric slab to introduce a modification in the phase shift with respect to electric field distribution along the waveguide. Enumerate it's working with a neat diagram.	8	4	2	4
b.	E plane Tee is also known as (A) Adder (B) Subtractor (C) Multiplier (D) Divider	1	2	2	4
c.	Slotted line is a transmission line configuration can be used to determine the (A) Magnetic field amplitude (B) Voltage used for excitation (C) Load impedance (D) Current measured at the load	1	1	3	3
6.a.i.	Light travelling in air strikes a glass plate at an angle A1 = 33°, where Ai is measured between the incoming ray and glass surface. Upon striking the glass, part of the beam is reflected, and part is refracted. If the refracted beams make on angle of 90° with each other. Calculate the refractive index of the glass and the critical angle for the glass.	4	3	4	4
ii.	The coupling factor and isolation of a lossless, symmetric directional coupler at 8dB and 20dB respectively. Determine the scattering matrix of the directional coupler. Also determine the directivity of the device.	10	4	2	4
iii.	Put on your own words to Justify the name Magic Tee, and also prove the additive and difference property of E and H plane.	4	4	2	4
b.	The internally generated optical power in the LED P_{int} = _____? (A) $\eta_{int} = \frac{q\lambda}{hCI}$ (B) $\eta_{it} = \frac{hc}{q\lambda}$ (C) $\eta_{int} = \frac{hCI}{q\lambda}$ (D) $\eta_{it} = \frac{q\lambda}{hc}$	1	1	4	4
c.	The emitted photon is in phase with the incident photon, and the resultant emission is known as (A) Spontaneous Emission (B) Population in version (C) Stimulated Emission (D) Self-Emission	1	1	4	4
7.a.i.	How the maximum link distance is affected by the fibre attenuation and also the same power and photo receiver sensitivity for a given bit rate. Explain with suitable example.	10	3	5	2
ii.	Write the importance of WDM in optical communication. Explain different WDM technology in detail.	8	3	5	2
b.	Which of the following is not considered as an in line devices? (A) Splitter (B) Filter (C) Attenuator (D) Phase Shifter	1	1	6	3
c.	The optical budget is then assembled taking into account of these parameters. (A) $P_i = (P_0 + C_L + M_a + D_L)d_{Bm}$ (B) $P_i = (P_0 + C_L + M_a - D_L)d_{Bm}$ (C) $P_i = (P_0 + CL - M_a + D_L)d_{Bm}$ (D) $P_i = (P_0 - C_L + M_a - D_L)d_{Bm}$	1	2	6	3

* * * * *