VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD
Accredited by NAAC with A++ Grade
B.E. (E.C.E.) VII-Semester Main & Backlog Examinations, Dec.-23/Jan.-24
Microwave Engineering

Time: **3 hours**   Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

Part-A (10× 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	List out the microwave signal frequency bands along with their band designations.	2	1	1	1,PSO2
2.	Calculate the attenuation in a parallel plane wave guide, given the power lost per unit length is 4 mW/m and power transmitted is 10mW.	2	3	1	2,PSO2
3.	Why TEM mode does not exist in a hollow rectangular waveguide?	2	2	2	1,PSO2
4.	Calculate the lowest resonant frequency of a rectangular cavity resonator having the dimensions of a=2cm, b=1cm and d=3cm.	2	3	2	2,PSO2
5.	What is meant by faraday rotation in ferrite devices?	2	2	3	1,PSO2
6.	Find the scattering coefficients of a matched isolator with insertion loss 0.5dB and isolation 25dB.	2	3	3	2,PSO2
7.	What is the need for slow wave structures in microwave tubes and illustrate different slow wave structures.	2	2	4	1,PSO2
8.	Compute the velocity of the electron when the applied beam voltage V_0 is 300V.	2	3	4	2,PSO2
9.	Draw the symbol of PIN diode and write the applications	2	1	5	1,PSO2
10.	Find the operating frequency of an IMPATT diode with carrier drift velocity of $V_d =2 \times 10^7$cm/s and drift space charge length of L = 6μm.	2	3	5	2,PSO2

Part-B (5×8 = 40 Marks)

11. a)	Derive the field equations in a parallel plate wave guide for TE mode of operation by applying suitable Maxwell's equations and boundary conditions.	4	1	1	1,PSO2
b)	Calculate the wave impedance for TE_1 mode of a parallel-plate waveguide with a=3 cm, λ_0=3 cm and is filled with a dielectric medium $\mu=\mu_0$ and permitivity ε_r=1.5.	4	3	1	2,PSO2
12. a)	What are the dominant and degenerate modes of a waveguide? Derive the expression for the cut off frequency (f_c) for the rectangular wave guide.	4	1	1	3,PSO2
b)	A rectangular waveguide has a cross section of 4.5cmX3cm and 9GHz signal propagated in it. Calculate the cut off wavelength (λ_c), guide wavelength (λ_g), the group velocity (V_g), phase velocity (V_p) and the characteristic wave impedance (Z_w) for the lowest TM mode wave.	4	3	1	2,PSO2

13. a)	Explain the construction and operation of Magic Tee and derive its scattering matrix.	4	1	3	1,PSO2
b)	Obtain the values of coupling factor, Directivity and isolation in dB when the input to primary waveguide of a directional coupler is 15W and the output is terminated on matched load. Given auxiliary waveguide outputs are 7.5mW and 15μW.	4	3	3	2,PSO2
14. a)	What is meant by velocity modulation and derive the expression for velocity of velocity modulated electron.	4	2	4	1,PSO2
b)	Compute the Hull cutoff voltage of an X–band pulsed cylindrical magnetron with the following operating parameters. Given Magnetic flux density B_0=0.336 wb/m^2, radius of cathode cylinder a=5cm and radius of anode vane edge to center b=10 cm.	4	3	4	2,PSO2
15. a)	Explain different modes of operation of a GUNN diode with neat sketches.	4	2	5	1,PSO2
b)	Give the significance of Avalanche Transit time devices and describe the construction and operation of IMPATT diode.	4	2	5	1,PSO2
16. a)	Explain the significance of TEM mode of propagation through the parallel plane waveguides	4	4	1	1,PSO2
b)	From the expressions of cutoff frequency, phase velocity and phase Constant of a rectangular wave guide, Show that $$\frac{1}{(\lambda_0)^2} = \frac{1}{(\lambda_g)^2} + \frac{1}{(\lambda_c)^2}$$ Where λ_0 is free space wave length, λ_g is wave length measured inside the guide, λ_c is Cutoff wave length of a guide.	4	2	1	1,PSO2
17.	Answer any *two* of the following:				
a)	Explain the operation of a three port circulator and derive its scattering matrix	4	2	3	1,PSO2
b)	Explain the operation of Reflex klystron tube with the help of Applegate diagram	4	2	4	1,PSO2
c)	Design a 50Ω microstrip line, given the substrate dielectric constant of 4.4 and height of the substrate h=1.6mm with a strip thickness of 0.0002μm so as to resonate at 5GHz.	4	3	5	3,PSO2

M : Marks;　L: Bloom's Taxonomy Level;　CO; Course Outcome;　　PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	37.5%
iii)	Blooms Taxonomy Level – 3 & 4	42.5%

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