Code No: 117FE **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year I Semester Examinations, January/February - 2023
MICROWAVE ENGINEERING
(Electronics and Communication Engineering)

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

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a) Why TEM does not exist in rectangular wave guide? [2]
b) A microstrip line has a substrate 1mm thick and with a dielectric constant $e_r = 8$. The strip width W=2.5mm. Find the low frequency effective dielectric constant? [3]
c) Find the Q of a copper rectangular cavity of dimensions a=b=d=10cm for the TE dominant mode. [2]
d) Draw the structure of magic tee and identify the isolated ports. [3]
e) What are the advantages of reentrant cavities? [2]
f) Why the power is occur in the form of modes in Reflex klyston? [3]
g) What are the advantage of having double energy conduction band of Gunn material? [2]
h) What is C-ring? Why it is used? [3]
i) Why isolator is used in microwave bench? [2]
j) What type of slot section is used in Microwave bench and how to sample the microwave power? [3]

PART – B

(50 Marks)

2. A rectangular waveguide has the following characteristics:
b =1.5cm, a = 3.0cm, μr =1, and $\varepsilon_r = 2.25$
a) Calculate the cutoff wavelength and frequency for the TE_{10}, TE_{20} and TM_{11} modes.
b) Calculate λg and Zo at 4.0GHz.
c) Calculate the attenuation constant (in dB/cm) at 3.0GHz for the dielectric-filled guide. What is the total attenuation (in dB) if the guide is 12cm long?
d) What is the total attenuation at frequencies much less than the TE_{10} cutoff frequency? [10]

OR

3. Derive the field equations for rectangular waveguide in TM mode starting from Maxwell's and wave equations. [10]

4.a) Explain the principle of working of rotary phase shifter with neat diagram.
b) What are the different characteristics of two-hole directional coupler? Derive the equations for them. [5+5]

OR

5.a) How Faraday rotation is used for isolator and explain its working with neat diagram.
b) Draw the equivalent circuit of loop coupled cavity and derive the equation for its Q factor. [5+5]

6.a) Compute the gain of a klystron amplifier where the following data apply:
Beam radius=0.3cm, beam current density =100 nA/cm^2, Accelerating voltage =1KV, frequency =3GHz, $G_L=G_0$, cavity width d=0.2cm, cavity conductivity =5.8 x 10^7S/m.

b) What are the slow wave structures? Why they are needed? Draw different types of slow wave structures. [5+5]

OR

7. Explain the electron bunching process in Reflex klystron with neat apple-gate diagram and derive the equation for it power efficiency. [10]

8. Draw the basic structure of 8- cavity magnetron and explain how cross-field is used to generate oscillations and derive the equation for oscillations. [10]

OR

9.a) Draw the V-I characteristics of Gunn diode and how negative resistance region is occurring.

b) Explain principle of working of IMPAAT diode with neat band structure. [5+5]

10. Derive the S-matrix of E-plane and H-plane tee and compare them. [10]

OR

11. Explain the measurement of low and high VSWR at microwave frequencies with neat bench setup. [10]

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