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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)
Sixth Semester, B.E. - Electronics and Communication Engineering
Semester End Examination; June - 2017
Microwave Devices and Integrated Circuits

Time: 3 hrs   *Max. Marks: 100*

Note: Answer **FIVE** full questions, selecting **ONE** full question from each unit.

UNIT - I

1 a. A telephone line has $R = 60$ Ω/km, $L = 2.2$ mH/km, $C = 0.005$ μF/km and $G = 0.05$ $\mho$/km. Determine Z_0, α, β and phase velocity at 1 kHz.   8

   b. Define standing waves and derive equation for amplitude, phase, V_{max} and V_{min} of standing waves. Also sketch the waveform.   6

   c. Derive the equation for the following at microwave frequency :
   i) Phase velocity   ii) Characteristic impedance.   6

2 a. Derive an equation for the line inductance in terms of exponential and hyperbolic function at any point of line from the sending end.   6

   b. A generator of 1V, 1 kHz supplier power to 100 km long line terminated Z_0, the parameter of the line are $R = 10.4$ Ω/km. $L = 0.00367$ H/km, $G = 0.8 \times 10^{-6}$ $\mho$/km. Calculate Z_0, α and β.   6

   c. A load impedance $Z_R = 60 - j80$ Ω is required to be matched to a 50 Ω coaxial line, by using short circuit stub of length L located at a distance 'd' from the load. The wavelength of operation is 1 meter using smith chart. Find 'd', 'L'.   8

UNIT - II

3 a. Explain the operation of Faraday rotation isolator with neat figure.   6

   b. An air filled rectangular wave guide of inside dimension $a = 7$ cm and $b = 3.5$ cm operates in the dominant TE_{10} mode.
   i) Find cutoff frequency
   ii) Determine phase velocity of the wave in the guide at a frequency of 3.5 GHz
   iii) Determine the guide wavelength at the same frequency.   6

   c. Briefly explain the following microwaves devices :
   i) Two hole directional coupler   ii) Rectangular cavity resonator.   8

4 a. A Two cavity Klystron amplifier has the following parameters :
   $V_0 = 1000$ V, $R_0 = 40$ kΩ, $I_0 = 25$ mA, $f = 3$ GHz, $d = 1$ mm, $l = 4$ cm, $R_{SG} = 30$ kΩ
   i) Find the input gap voltage to give maximum voltage V_2
   ii) Find the voltage gain neglecting the beam loading in the output Cavity
   iii) Efficiency of the amplifier neglecting beam loading.   6

b. Derive an expression for output power of four cavity Klystron. 10

c. What are the major differences between TWT and Klystron? 4

UNIT - III

5 a. What are the common properties of S, Z and Y matrices and list the advantages of S over Z and Y. 6

b. Explain the phase shifting property for reciprocal network. 4

c. Two transmission lines of characteristic impedance Z_1 and Z_2 joined at plane PP^1-supress S-parameters in terms of impedances. 10

6 a. With a neat diagram, explain the operation of precision type variable alternator and write S- matrix for the same. 10

b. A 20 MW signal is fed into one of collinear port 1 of a lossless H plane T-junction. Calculate the power delivered through each port when other ports are terminal in matched load. 6

c. List the applications of magic tees. 4

UNIT - IV

7 a. Explain with relevant figures the fundamental concepts of RWH theory. 6

b. Discuss the structure and working of READ diode with neat figure. 7

c. Derive an expression for the power output and efficiency of IMPATT diode. 7

8 a. With the neat diagram explain the principle of operation of TRAPATT diode. List its advantages. 10

b. Explain with a neat diagram the working of tunnel diode and varactor diode. 10

UNIT - V

9 a. Explain the structure of coplanar strip line and shielded strip line. Write equation for its characteristic impedance. 10

b. A lossless parallel strip line has a conducting strip width w. The substrate dielectric separating the two conducting strips has a dielectric constant $\in_r d$ of 6 and a thickness of 4 mm. Calculate;

i) Width of conducting strip in order to have a characteristic impedance of 50 Ω 10

ii) The strip line capacitance

iii) Strip line inductance

iv) The phase velocity of the wave is parallel strip line.

10 a. Explain different techniques involved in fabrication of monolithic microwave integrated circuits. 10

b. Explain the thin film manufacturing technology and accomplishment of circuit definition by,

i) Plate through technique   ii) Etch balk technique. 10

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