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EC–604

B. E. (Sixth Semester) EXAMINATION, June, 2012

(Electronics & Communication Engg. Branch)

MICROWAVE ENGINEERING

(EC–604)

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : Answer all the questions. Assume suitable data if any missing. Answer must be to the point.

1. (a) The locations of two minimums on a slotted line section are found at 4·45 cm and 7·36 cm. What is the incident frequency for a TE_{10} wave if the cutoff wavelength of the wave guide is 7·0 cm ? 5

   (b) The cutoff wavelength of a waveguide is 1.70 cm and group velocity is $1{\cdot}78 \times 10^{10}$ cm/s. What is the incident frequency to the wave guide ? 5

   (c) Determine the inside diameter needed for a circular wave guide to operate in the TE_{11} mode at a frequency of 12 GHz. 5

   (d) How do TEM and TE wave differ ? 5

Or

   (a) How do the dimensions of wave guide affect the cutoff frequency ? 3

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(b) Find the velocity of a wave travelling down a rectangular wave guide whose outer dimensions are $2 \cdot 0 \times 1 \cdot 0$ inch with a wall thickness of $0 \cdot 064$ inch and a frequency of operation $4 \cdot 4$ GHz. 6

(c) Discuss how wave equations are useful in understanding the propagation of EM waves in wave guides. 7

(d) Explain why both incident and reflected waves are required to propagate an electromagnetic wave through a rectangular wave guide. 4

2. (a) A three-way power divider has an insertion loss of $0 \cdot 5$ dB. If the input power is 0 dBm, what is the output power in dBm and milliwatts at any *one* of the output ports ? 7

(b) A 10 dB directional coupler has a directivity of 40 dB. If the input power is 10 mW, what are the power outputs at three other ports ? Assume that the coupler is lossless and has an insertion loss of $0 \cdot 5$ dB. 8

(c) How does a flap attenuator differ from a vane type ? 5

Or

(a) What is the significance of using isolator in microwave circuits ? 5

(b) Explain the characteristics of a 3 port circulator, listing S-matrix. How can this be used as an isolator ? 7

(c) A 20 mW signal is fed into the series arm of a lossless Magic tee junction. Calculate the power delivered through each port when other ports are terminated in matched load. 8

3. (a) Why are transferred electron devices able to operate at higher frequencies than bipolar transistor ? 4

(b) How does a semiconductor laser differ from a helium-neon gas laser ? 5

(c) What are the advantages of tunnel diode ? 6

(d) How does a tunnel diode operate ? 5

Or

(a) Explain negative resistance. 5

(b) Explain the operation of Gunn diode. 7

(c) Explain the working of Tunnel diode as an oscillator and as an amplifier. 8

By means of an Applegate diagram, explain the operation of a reflex klystron. Show that the theoretical efficiency of reflex klystron is 27·78%. 11

(b) Describe the phenomenon of velocity modulation in a two cavity klystron and explain how microwave power; amplified by the interaction of velocity modulated beam with electromagnetic field in the two cavity klystron. 9

Or

An X-band cylindrical magnetron has the following operating parameters : 20

Anode voltage = 26 Kv
Beam current = 27 A
Magnetic flux density = 0·336 WB/m^2
Radius of cathode cylinder = 5 cm
Radius of can edge to centre = 10 cm

Compute :

(i) the cyclotron angular frequency

(ii) the cutoff voltage for a fixed magnetic flux density.

Derive all the relations used to calculate the above quantities.

5. (a) Explain the method to measure VSWR and reflection coefficient. 9

(b) Explain the operation of calorimetric method of microwave power measurement. 11

Or

(a) Explain a method for the measurement of attenuation at microwave frequencies. 6

(b) Draw the block diagram of network analyser and explain the function of every block. 14