**53 (EC 601) MWEN**

# 2017

## MICROWAVE ENGINEERING

Paper : EC 601

*Full Marks : 100*

Time : Three hours

**The figures in the margin indicate
full marks for the questions.**

*Answer* **any five** *questions :*         5×20=100

1.   *(a)*   Starting from Maxwell's equation derive the electromagnetic field equations in rectangular waveguide for $TE_{mn}$ mode.

     *(b)*   Deduce the expression of the Cutoff frequency for $TE_{10}$ mode in terms of waveguide dimensions.

     *(c)*   Explain why $TE_{10}$ mode is called dominant mode and why wave propagation in a hollow metallic waveguide is preferred in this mode.

                                              10+4+6

2. (a) Derive an expression for the resonant frequency of a rectangular cavity $(a \times b \times l)$ with $a > b < l$ and hence obtain the dominant mode of resonance.

(b) Define '$Q$'-factor of a cavity. Distinguish between 'loaded $Q$' and 'unloaded-$Q$' of the cavity.

(c) Describe critical coupling, over-coupling and under-coupling. Draw the variation of VSWR with coupling co-efficient.

9+5+6

3. (a) What does a Tee Junction mean ?

(b) Explain clearly the operating principle of E-Plane Tee and H-Plane Tee and write down their scattering matrices.

(c) A $20mW$ signal is fed into one collinear port-1 of a lossless H-plane tee junction. Calculate the power delivered through each port when other ports are terminated in matched load.

(d) Describe the Principle of Hybrid Rings (Rat-Race Circuits) and write down its scattering matrix. 7+6+7

4. (a) Discuss the working Principle of a 'Magic-T'.

*(b)* Obtain the Scattering matrix equation of a 'Magic-T' by using the necessary properties of the scattering matrix.

*(c)* Explain why 'Scattering Matrix' representation of a microwave network is preferred over Z-matrix or Y-matrix representation. 7+8+5

5. *(a)* Describe an ideal 'Directional Coupler'. Define 'Coupling' and 'Directivity' in the context of a directional coupler.

*(b)* Mention the principal shortcoming of a two hole directional coupler. Discuss how this shortcomings can be Overcome.

*(c)* Explain with neat sketch the working principle of Faraday Isolator.

6+4+10

6. *(a)* Explain the working principle of a reflex Klystron Oscillator.

*(b)* Explain what is meant by 'velocity modulation' and how this phenomenon is used in the operation of a Klystron tube.

*(c)* Draw the power *vs* repeller voltage and frequency *vs* repeller voltage characteristics of a reflex Klystron. Explain qualitatively. 7+6+7

7. *(a)* Explain the slotted line method for the measurement of unknown impedance.

*(b)* Describe the procedure for measuring *(i)* VSWR (<10) and *(ii)* VSWR (>10) using a VSWR meter in a standard microwave test bench.

10+10

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