

**RF AND MICROWAVE ENGINEERING
(ECEN 4101)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Dominant mode of propagation in a Rectangular waveguide is
(a) TE₁₁ (b) TM₁₁ (c) TE₁₀ (d) TM₁₀.
- (ii) The Q factor measures
(a) frequency selectivity (b) energy stored in a cavity
(c) energy dissipation (d) all of these.
- (iii) In microwave frequencies, a cavity may be considered as a
(a) low pass filter (b) band pass filter
(c) high pass filter (d) band stop filter.
- (iv) Directional couplers are mainly used to
(a) measure power (b) combine power
(c) split power (d) all of these.
- (v) A magic T-junction is a combination of
(a) one H-plane T-junction and one E-plane T-junction
(b) one H-plane T-junction and two E-plane T-junction
(c) two H-plane T-junction and one E-plane T-junction
(d) two H-plane T-junction and two E-plane T-junction.
- (vi) The dominant mode is defined as the mode having
(a) the lowest cut off frequency
(b) the highest cut-off frequency
(c) the cut-off frequency equal to the frequency of the propagating signal
(d) no frequency dependence.

- (vii) The cut-off wavelength of the dominant mode propagating down a rectangular waveguide of dimension $a \times b$ will be
 (a) $2a$ (b) a (c) $2b$ (d) b .
- (viii) Which of the following microwave tubes has a repeller electrode?
 (a) Multi-cavity klystron (b) Helix travelling wave tube
 (c) Coupled-cavity TWT (d) Reflex klystron.
- (ix) The major advantage of a TWT over a klystron lies in its
 (a) higher bandwidth (b) higher gain
 (c) higher frequency (d) all of these.
- (x) Which of the following is used for its negative resistance characteristics?
 (a) Point contact diode (b) Schottky diode
 (c) IMPATT diode (d) Tunnel diode.

Group – B

2. (a) Explain dominant and degenerate modes in a rectangular waveguide with examples.
- (b) The dominant modes TE_{10} is propagated in rectangular guide of dimensions $6 \text{ cm} \times 4 \text{ cm}$. The distance between maximum and minimum is 4.47 cm . Find signal frequency of the dominants mode.
- (c) Establish the relationship between guide wavelength (λ_g), free space wavelength (λ_0) and cut off wavelength (λ_c) in rectangular waveguide.

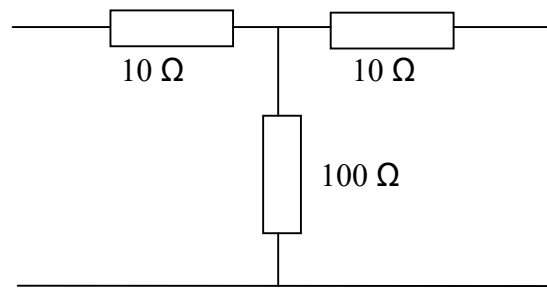
4 + 4 + 4 = 12

3. (a) TEM mode cannot exist in a rectangular waveguide. Explain.
- (b) What do you mean by group velocity and phase velocity? Derive the relevant mathematical expression for phase and group velocity of rectangular waveguide.

4 + 8 = 12

Group – C

4. (a) Derive the S matrix of a two port network. Explain the significance of each S matrix coefficient.
- (b) Find the S parameter of the following circuit when it is terminated with a matched load of 50Ω .



5 + 7 = 12

5. (a) Explain the operating principle of two hole directional coupler.
 (b) Discuss the operating principle of Magic T junctions. Explain the basic setup for the use of magic T junction as a duplexer.

5 + 7 = 12

Group - D

6. (a) What is Gunn effect? Describe the RWH theory to explain Gunn effect.
 (b) Draw and explain the high frequency equivalent circuit of MESFET.
7. (a) Describe the high frequency limitations of conventional Vacuum tubes.
 (b) With a suitable figure, describe the basic construction and operation of a two cavity klystron.

6 + 6 = 12

4 + 8 = 12

Group - E

8. (a) What should be the properties of an ideal filter? What do you mean by filter synthesis? Briefly describe different filter synthesis methods.
 (b) Define the following filter parameters
 (i) Insertion loss (ii) Return loss (iii) Group delay.

6 + 6 = 12

9. (a) Describe the design procedure of a single stage transistor amplifier for maximum gain.
 (b) Define different types of amplifier gains. Find out an expression for the power gain of a transistor amplifier.

6 + 6 = 12

