Printed pages: 02 **Sub Code: EEC 066**

Paper Id: 131816 **Roll No:** [redacted]

B TECH

(SEM-VIII) THEORY EXAMINATION 2017-18

MICROWAVE & RADAR

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections.
2. Assume any missing data.

SECTION A

1. Attempt *all* questions in brief. 2 x10 = 20

a. What are microwaves? Write their frequency range? How are they different from RF wave?
b. What are degenerate modes?
c. What is quality factor in microwave resonator?
d. Write any two properties of E-plane tee microwave device.
e. Define VSWR in microwave.
f. What is the condition for sustained oscillation in Reflex Klystron?
g. Explain V-I characteristics of tunnel diode.
h. Explain basic principle of radar system with suitable diagram.
i. What is Doppler Effect?
j. Explain the term Blind speed?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. What is a micro strip line? Compare micro strip line with strip lines. Write advantages and disadvantages of both. How does the characteristics impedance of micro strip line change with change in width to height ratio?
b. What is directional coupler? What are the different types of directional coupler? Explain the working principle of 2-hole directional coupler. Also determine its S-matrix.
c. (i) Discuss the salient features of microwave measurements. Describe a voltage standing wave ratio (VSWR) meter.
(ii) What is meant by insertion loss and attenuation? Discuss any one method for measurement of attenuation using microwave test devices.
d. What is velocity modulation? How is it achieved in a two cavity klystron? Describe the construction and working of a reflex klystron.
e. Explain MTI radar with suitable block diagram. Also give its applications. Compare Pulse Doppler Radar & MTI radar with block diagram.

SECTION C

3. Attempt any one parts of the following: 10 x 1 = 10

a. How are waveguides different from normal two wire transmission line? Discuss the similarities and dissimilarities. Show that for a TE_{01} mode, a frequency of 6 GHz will pass through the waveguide of dimension a = 1.5 cm, b = 1 cm if a dielectric with ε_r = 4 is inserted into the waveguide.

b. Derive all electric and magnetic field components in transverse magnetic mode of rectangular waveguides. Show that the TM_{01} and TM_{10} modes in rectangular waveguide do not exist.

4. Attempt any one parts of the following: 10 x 1 = 10

a) Explain the construction, working and application of microwave isolators. A rectangular cavity resonator has dimension a = 7.5 cm, b = 4 cm and c = 16 cm calculate cut-off wave number and phase constant.

b) What do you mean by microwave cavities? Describe the rectangular cavity resonator. Explain it with suitable diagram and equivalent circuit. Where does it find applications?

5. Attempt any one parts of the following: 10 x 1 = 10

a) What are the limitations of conventional active devices at microwave frequencies? Explain in detail.

b) What is travelling wave tube? Explain the principle of operation and construction of T.W.T. Also write its limitations.

6. Attempt any one parts of the following: 10 x 1 = 10

a) With the help of suitable diagram, explain principle of operation of TRAPATT diodes. Also write its characteristics and applications.

b) Explain the working of IMPATT Diode. An IMPATT diode has the following parameters:

Carrier drift velocity	: $V_d = 2\times10^7$ cm/s
Drift-region length	: L = 6 μm
Maximum operating voltage	: V_{omax} = 100 V
Maximum operating current	: I_{omax} = 200 mA
Efficiency	: η = 15%
Breakdown voltage	: V_{bd} = 90 V

Compute: (i) the maximum CW output power in watts: (ii) the resonant frequency in gigahertz.

7. Attempt any one parts of the following: 10 x 1 = 10

a) Derive radar range equation. Radar is operating at 10GHz with the peak power of 500KW, the power gain of antenna is 5000 & minimum power of the receiver is 10^{-14}. Calculate the maximum range of radar if the effective area of antenna is $10m^2$ & radar cross-section is $4m^2$.

b) What do you mean by radar clutter? Explain various types of radar clutters. How they affect the performance of radar?