Code: AE20 **Subject: MICROWAVE THEORY & TECHNIQUES**
Time: 3 Hours **Max. Marks: 100**

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each que**

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stion carries 16 marks.

- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or best alternative in the following: (2x10)

a. The wavelength corresponds to UHF frequency range is:

(A) 30 GHz to 300 GHz **(B)** 3 to 30 GHz
(C) 0.3 TO 3 GHz **(D)** 300 to 3000 GHz

b. In multicavity Klystron, additional cavities are inserted between the buncher and catcher cavities to achieve:

(A) higher gain **(B)** higher frequency
(C) higher efficiency **(D)** higher bandwidth

c. In a transmission line maximum and minimum value of voltage standing wave ratio (VSWR) is:

(A) 1 and 0 **(B)** Infinity and 1
(C) Infinity and 0 **(D)** +1 to –1

d. Scattering parameters can be measured with the help of:

(A) Spectrum Analyser **(B)** Oscilloscope
(C) Network Analyser **(D)** Transmission line Analyser

e. Side lobes in antenna pattern cause:

(A) reduced bandwidth **(B)** reduced antenna gain
(C) ambiguity in direction finding **(D)** increased antenna gain

f. Type of radar that is used to eliminate clutter in navigational application is:

(A) Pulse radar **(B)** MTI radar
(C) Monopulse radar **(D)** Tracking radar

g. A 1000 Volts source and a detector of sensitivity of 1 mVolts are connected to a long haul transmission link of attenuation of 1 dB per 100 m. The maximum link length is:

(A) 10 km **(B)** 12 km
(C) 15 km **(D)** 24 km

h. A magnetron in which no effort is made to separate the dominant mode (mostly the π mode) from other mode is said to be unstrapped.

(A) True **(B)** False.

i. Depending on the material parameters and operating condition, a Gunn Effect oscillator can be made to oscillate in four frequency modes.

(A) True **(B)** False.

j. Free space wavelength is greater than guided wavelength.

(A) True **(B)** False.

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Define polarization of EM wave. Briefly explain vertical, horizontal, left hand and right hand circular polarization. **(4)**

b. Distinguish between the characteristic impedance and the input impedance of a line. Under what conditions will they be same? In a lossless line how can input impedance be made purely inductive, capacitive, infinite and zero? **(6)**

c. Find the reflection coefficient, standing wave ratio, and fraction of incident power delivered to load when a transmission line of characteristic impedance 50 Ohms is terminated in a load (25 + j25) Ohms. **(6)**

Q.3 a. What is a microstrip line? Compare micro strip line with strip lines. Write advantages and disadvantages of both. **(4)**

b. A microstrip line has following parameters:
$\varepsilon_r = 5.23$, h = 07 mil, t = 2.8 mil, w = 10 mil
Calculate the characteristic impedance of above microstrip line. **(6)**

c. For the dominant mode propagated in an air filled circular waveguide, the cut-off wavelength is 10 cms. Find
(i) Required size or cross-section area of guide,
(ii) Frequencies that can be used for this mode of propagation. **(6)**

Q.4 a. What is a microwave cavity resonator; explain it with suitable diagram and equivalent circuit? Where does it find applications? **(4)**

b. An air filled rectangular cavity has following dimensions a = 4 cms, b = 2 cms and c = 5 cms. Designate the first five TE and TM modes of oscillations. Find their resonant frequencies. **(6)**

c. What do you understand by stub matching? Derive the expression for double stub matching for two S.C. stubs whose length are adjustable independently but whose positions are fixed. **(6)**

Q.5 a. Name microwave devices which make use of Faraday rotation. Explain the construction and working of Circulator and Gyrator. **(6)**

b. Explain the working of Rat race junction. **(5)**

c. In a phase shift measurement setup, without waveguide components (whose phase is to be measured) the guide wavelength measured is 7.5 cms and reference null is 7.2 cms and the reference null was 9.3 cms. Determine the phase shift. **(5)**

Q.6 a. Describe how an ordinary voltmeter can be made to read VSWR. What are the drawbacks of this method? **(5)**

b. A 25 dB isolator is added in series at the output of a signal generator to reduce the possibility of frequency pulling due to an affected system VSWR mismatch of 1.75. If signal generator power output is 234 mW, what is the value of reflected signal received at the generator? **(5)**

c. Write short notes on:
(i) Spectrum Analyser
(ii) Wave Meter **(6)**

Q.7 a. Explain factors affecting range of Radar. **(4)**

b. Draw the neat labelled block diagram of a MTI (moving target indicator) radar system and explain its working. **(6)**

c. Find the S parameters for a waveguide component if the measured VSWR IS 1.3 when the component is terminated with a matched load. It is also found that the power to the matched load is 60 mW for an input power of 100 mw. The same results are obtained when component is reversed. **(6)**

Q.8 a. Define fading? Explain various types of fading. **(4)**

b. An earth station uses a 30 meter dish with circular aperture for receiving satellite signals at 4 GHz down link frequency. If the G/T ratio of earth station is 20 dB, calculate the system noise temperature. **(5)**

c. Explain the operation of a varactor diode. Discuss the constructional details, equivalent circuit and figure of merit. Write its applications? **(7)**

Q.9 a. Explain how a tunnel diode can be used as an amplifier and as an oscillator with the help of necessary circuit diagrams. **(4)**

b. Discuss the working of two cavity klystron amplifier and derive expression for the efficiency of above amplifier starting from basic principles. **(12)**