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

DECEMBER 2010

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.**
- **The answer sheet for the Q.1 will be collected by the invigilator after half an hour of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: **(2 × 10)**

a. The wavelength corresponds to UHF frequency range is:

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

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

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

c. What is the length of the slot required on a slotted waveguide section to measure the wave length of microwave whose frequency is 5.4 GHz?

(A) 15.0 mm **(B)** 3.1 cm
(C) 10.0 mm **(D)** 31 cm

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

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

e. When the microwave signals follow the curvature of earth, this is known as

(A) Ducting **(B)** Tropospheric scattering
(C) Faraday effect **(D)** Ionospheric Reflection

f. Which of the following semiconductor material does not exhibit GUNN effect:

(A) Si **(B)** GaAs.
(C) InP. **(D)** CdTe.

g. Scattering parameters can be measured with the help of

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

h. Side lobes in antenna pattern cause:

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

i. If the minimum range of radar is to be doubled, the peak power has to be increased by a factor of:

(A) Two **(B)** Four
(C) Eight **(D)** Sixteen

j. A 1000 Volts source and a detector of sensitivity of 1 milli volts 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

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

Q.2 a. A Transmission Line has a characteristic impedance of $50 + j0.01\Omega$ and is terminated in a load impedance of $73 - j42.5\Omega$. Calculate
(i) Reflection coefficient (ii) VSWR **(4)**

b. Why TEM modes do not propagate in rectangular wave guide? Which is the dominant mode of propagation in rectangular waveguide and why? **(4)**

c. What is Impedance Matching? Explain the various methods of achieving impedance matching. **(8)**

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

b. A microstrip line has following parameters:
$\varepsilon_r = 5.23$, $h = 07$ mils, $t = 2.8$ mils, $w = 10$ mils
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 diagra equivalent circuit? Where does it find applications?

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. 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 m Watt. The same results are obtained when component is reversed. **(6)**

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

b. Explain the working of Rat race junction. **(6)**

c. Describe the method for Microwave frequency measurement. **(4)**

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) VSWR Measurement **(3)**
(ii) Wave Meter **(3)**

Q.7 a. With the help of schematic block diagram, explain Radar transmitter and Receiver system. Derive the expression for Radar range equation. **(10)**

b. A guided missile tracking radar has following specifications:

Transmitted Power= 400 kW
Pulse Repetition Frequency = 1500 pps
Pulse width = 0.8 μsec

Determine:
(i) Unambiguous range
(ii) Duty cycle
(iii) Average power
(iv) Suitable bandwidth of the radar **(6)**

Q.8 a. Explain characteristics, advantages and applications of microwaves. **(5)**

b. Define and derive the coupling factor and directivity of directional coupler. Also compare single hole directional coupler and double hole directional coupler. **(6)**

c. Explain the operation of a varactor diode. Discuss the construction details, equivalent circuit and figure of merit. Also discuss its applications.

Q.9 a. Explain the various modes of operation of Gunn diode. **(6)**

b. Discuss the working of two cavity klystron amplifier and derive expression for the efficiency of above amplifier starting from basic principles. **(10)**