ROLL NO. _____

Code: AE72 **Subject: MICROWAVE THEORY AND TECHNIQUES**

AMIETE – ET

Time: 3 Hours **DECEMBER 2012** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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 45 minutes 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. A lossless transmission line of Z_o=100Ω is terminated by an unknown impedance. The termination is found to be at a maximum of the voltage standing wave and the VSWR is 5. What is the value of terminating impedance

(A) 500Ω **(B)** 100Ω
(C) 20Ω **(D)** 300Ω

b. The value of series inductance (L) in Henries per Km for minimum attenuation in the loading of the transmission line is given by

(A) L=CR/G **(B)** L=G/CR
(C) $L = \sqrt{CR/G}$ **(D)** $L = \frac{1}{\sqrt{GCR}}$

c. The highest data speed is given by

(A) Coaxial cable link **(B)** Microwave LOS link
(C) Microwave satellite system **(D)** Optical fiber system

d. For a two open-wire transmission line executed by a harmonically oscillating source with exp(-jwt) as the time factor, the voltage on the transmission line satisfy which one of the following relations

(A) $\frac{dv(x)}{dx} = -jwLI(x)$ **(B)** $\frac{dv(x)}{dx} = jwLI(x)$
(C) $\frac{dv(x)}{dx} = jwCI(x)$ **(D)** $\frac{dv(x)}{dx} = -jwCI(x)$

e. Microwave link repeaters are typically 50 Km apart in TV transmission because of

(A) Atmospheric attenuation
(B) Output power tube limitations
(C) Microwave transmission, which is through surface wave
(D) Earth's curvature

f. A microwave junction is supposed to be matched at all ports if in the S matrix all diagonal elements are

(A) zero **(B)** equal but not zero
(C) complex **(D)** equal but not complex

g. A cavity is a

(A) Low pass filter **(B)** High pass filter
(C) Band pass filter **(D)** Band stop filter

h. In laboratory experiments, the output from reflex klystrons are modulated by square wave because

(A) It is easy to generate square wave
(B) Crystal diode operates in the square law region
(C) It prevents frequency modulation
(D) Detector circuit is less complicated

i. In a circular waveguide with radius r, the dominant mode is

(A) TM_{01} **(B)** TE_{01}
(C) TM_{11} **(D)** TE_{11}

j. Which one of the following is a transferred electron device?

(A) BARITT diode **(B)** IMPATT diode
(C) Gunn diode **(D)** Step recovery diode

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

Q.2 a. Define the following terms and find their physical significance with reference to transmission lines. **(8)**
(i) Characteristics impedance
(ii) Stub matching

b. A typical transmission line has a resistance of 8Ω /Km, impedance of 2mH/Km, a capacitance of 0.002 μF/Km and a conductance of 0.07μs/Km. Calculate the characteristics impedance, attenuation constant, phase constant of the transmission line at a frequency of 2 KHz. If a signal of 2 Volt is applied and the line terminated by its characteristics impedance, calculate the power delivered to the load, if line length is 500 Km. **(8)**

Q.3 a. Show that a TEM wave cannot propagate in a circular waveguide. **(8)**

b. Determine the cut off wavelength for the dominant mode in a rectangular waveguide of breadth 10 cms. For a 2.5GHz signal propagated in this waveguide in the dominant mode; calculate the guide wavelength, the group and phase velocities. **(8)**

Q.4 a. What are cavity resonators? Derive the expression for frequency for a rectangular and circulate cavity resonator. **(8)**

b. Write short notes on: **(8)**
(i) Rat Race Circuits (ii) Hybrid Tees

Q.5 a. Explain Gunn effect diodes. **(6)**

b. What are parametric devices? Describe advantages and disadvantages of parametric devices. **(6)**

c. An up converter parametric amplifier has following parameters: **(4)**
Ratio of output frequency over signal frequency, $f_o/f_s=25$, Figure of merit $\gamma Q=10$, Factor of merit figure, $\gamma = 0.4$, Diode temperature, $T_d=350K$. Calculate:
(i) Power gain in dB
(ii) Noise figure in dB
(iii) Band width

Q.6 a. What are limitations of conventional tubes at microwave frequencies? How these limitations can be overcome? **(8)**

b. Differentiate between Klystron from and TWT. **(4)**

c. A reflex Klystron operates at 8GHz at the peak of n=2 mode with $V_o=300V$, $R_{sh}=20K\Omega$ and L=1mH. If the gap transit time and beam loading are neglected, find: **(4)**
(i) repeller voltage
(ii) beam current necessary to obtain an RF gap voltage of 200 V

Q.7 a. What is linear magnetron? Explain its operation **(6)**

b. Derive Hartree anode voltage equation for π mode. **(6)**

c. A linear magnetron has the following parameters Anode voltage, V_o=15KV, Cathode current, I_o=1.2A, operating frequency, f=8GHz, Magnetic flux density, B_o=0.015 wb/m^2, Hub thickness, h=2.77 cm, Distance between anode and cathode, d=5cm. Calculate **(4)**
(i) electron velocity at hub surface
(ii) phase velocity for synchronism
(iii) Hartree anode voltage

Q.8 a. Explain microstrip lines and derive an expression for characteristic impedance for a microstrip line. **(8)**

b. Explain ohmic losses in microstrip lines. **(8)**

Q.9 a. Discuss the discrete, integrated and monolithic microwave. **(8)**

b. Write short notes on: **(8)**
(i) Thin film formation
(ii) Materials used for MMIC