ROLL NO. _____

Code: AE72 Subject: MICROWAVE THEORY AND TECHNIQUES

AMIETE – ET (Current Scheme)

Time: 3 Hours **JUNE 2015** **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. The relative phase velocity factor is given as

(A) $V_r = V_€/C$ **(B)** $V_r = V_€/C$ .t
(C) $V_r = C/V_€$ **(D)** $V_r = V_€/C$.t

b. If terminating impedance is equal to the characteristic impedance of the line, Then reflection coefficient will be

(A) Unity **(B)** Zero
(C) Greater than Unity **(D)** Infinite

c. TM modes in a circular guide an characterized by

(A) $H_z = \infty$ **(B)** $H_z = 0$
(C) $H_z = -1$ **(D)** $H_z = 1$

d. In resonator, the mode having the lowest resonant frequency is known as the

(A) Dominant Mode **(B)** Degenerative Mode
(C) Regenerative Mode **(D)** Both (B) and (C)

e. What is the other name for magic TEE?

(A) A balun **(B)** Abroad band directional coupler
(C) Hybrid Tee **(D)** Hybrid Ring

f. The purpose of slow wave structures used in TWT amplifiers are

(A) to maintain constant wave velocity
(B) to increase wave velocity
(C) to reduce wave velocity
(D) to reduce losses

g. The applications of High Q-oscillators and amplifier circuits are

(A) Low power transmitters
(B) Parametric amplifier pumps
(C) Police radars and intrusion alarms
(D) All of these

h. The operating frequency of TRAPATT devices are

(A) 4MHz - 1GHz **(B)** 40 KHz – 12MHz
(C) 400 MHz - 12GHz **(D)** 40 MHz - 12GHz

i. The various modes of transferred electron oscillators are

(A) Transit Time Mode
(B) Quenched and delayed domain modes
(C) Limited space charge Accumulation Mode
(D) All these

j. How do you measure microwave frequency?

(A) Wavemeter Method **(B)** Slotted line Method
(C) Downconversion Method **(D)** All of these

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

Q.2 a. Draw the profile of SWR versus reflection coefficient. A transmission line has a characteristic impedance of 50 + j 0.01 Ω and is terminated in a load line impedance of 73-j42.5 Ω.
Calculate: (i) The reflection coefficient (ii) the standing wave ratio. **(8)**

b. Enlists the significant features of the normalized impedance for a lossless line. **(8)**

Q.3 a. For a rectangular waveguide, show that the propagation modes depend on its physical dimensions **(10)**

b. An air-filled circular wave guide has a radius of 2 cm and is to carry energy at a frequency of 10 GHz. Find all the TE_{np} and TM_{np} modes for which energy transmission is possible. **(6)**

Q.4 a. Derive and explain the significance of S Matrix of a Directional Coupler. **(8)**

b. Draw the structure of Hybrid Ring. Obtain its S-matrix. Why is it also called Rat-Race circuit? **(8)**

Q.5 a. Describe in detail the principles of the following terms: Gunn Effect, Two valley model theory and High Field Domain theory. **(10)**

b. An n-type GaAs Gunn diode has the following parameters: **(6)**

$v_d = 2.5 \times 10^5$ m/s

$|\mu_n| = 0.015$ m^2/V.s

$\varepsilon_r = 13.1$

Determine the criterion for classifying the modes of operation.

Q.6 a. Derive an expression for beam-coupling coefficient of the input cavity gap in Klystron and also draw the profile of beam coupling coefficient versus gap transit angle. **(10)**

b. Explain the Amplification process in helix type travelling-wave tube. **(6)**

Q.7 a. Show that the Hartree anode voltage equation is a function of the magnetic flux density and the spacing between the cathode and anode. **(10)**

b. An Amplitron has the following operating parameters: **(4)**

V_0=15 kV, I_0 = 3A, B_0 = 0.2 Wb/m^2

f = 8 GHz, Z_0 = 50 Ω.

Determine: The dc electron-beam velocity, the electron beam phase constant, the cyclotron angular frequency, the cyclotron phase constant and the gain parameter.

Q.8 a. Describe the following characteristics of Microstrip Lines - **(10)**

(i) Effective Dielectric Constant.

(ii) Impedance Equation

(iii) Microstrip Lines – Dielectric Losses

(iv) Microstrip Lines – Ohmic Losses

b. Describe Attenuation Losses taking place in parallel strip lines. **(6)**

Q.9 a. List the basic characteristics required for an ideal substrate material. **(8)**

b. Explain the Etching and photoresist MMIC fabrication technique. **(8)**