ROLL NO. _____

Code: AE72/AE120 Subject: MICROWAVE THEORY AND TECHNIQUES

AMIETE –ET (Current & New Scheme)

Time: 3 Hours **JUNE 2017** **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. In Cavity Magnetron, strapping is used to
(A) Prevent mode jumping
(B) Prevent cathode back heating
(C) Ensure bunching
(D) Improve the phase focussing effect

b. The Cross Field Amplifier (CFA) is a
(A) Linear Amplifier **(B)** Parametric Amplifier
(C) Non linear Amplifier **(D)** Saturated Amplifier

c. A transmission line is called a flat line when its Standing Wave Ratio (SWR) is
(A) 0 **(B)** 1
(C) infinity **(D)** minimum

d. Which of these is not a type of Lithography technology?
(A) Electron beam Lithography **(B)** Conducting beam Lithography
(C) Ion beam Lithography **(D)** X-ray Lithography

e. The standing wave ratio of a pure travelling wave is
(A) Unity **(B)** Infinite
(C) $\lambda/2$ **(D)** λ

f. The factors reducing efficiency of IMPATT diode are
(A) Space charge effect & Reverse saturation current effect
(B) High frequency skin effect & Ionization saturation effect
(C) Both **(A)** & **(B)**
(D) None of these

g If X band pulsed cylindrical magnetron has magnetic flux density $B_o = 0.336\,wb/mt^2$ its cyclotron angular frequency is _____

(A) $\omega_c = {}^{e}/_{m} B_o = 5.91\times10^{10}\,rad$ **(B)** $\omega_c = \frac{em}{B_o} = 11\times10^{10}\,rad$

(C) $\omega_c = emB_o = 5\times10^{5}\,rad$ **(D)** $\omega_c = \frac{mB_o}{e} = 6\times10^{5}\,rad$

h. Which one of the following modes has the characteristic of attenuation becoming less as the frequency is increased and is attractive at microwave frequencies for circular cylindrical waveguides?
(A) TE_{11} mode **(B)** TM_{01} mode
(C) TE_{01} mode **(D)** higher order mode

i. The path length between ports 1 and 2 for the two waves in a hybrid ring is:
(A) 1 **(B)** 3λ/4
(C) λ/2 **(D)** λ/4

j. A certain transmission line has a characteristic impedance of 75 + j0.01 Ω and is terminated in a load impedance of 70 + j50 Ω. The reflection coefficient is _____
(A) 0.8+j40 (B) 0.6+j50
(C) 0.9+j60 (D) 0.08+j0.32

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. Write the characteristics of smith chart and describe the steps involved in determination of normalized impedance using smith chart**.** **(8)**

Q.3 a. An air filled rectangular waveguide has dimensions of a = 6 cm and b = 4 cm. The signal frequency is 3 GHz. Compute the following for the TE_{10} mode; **(8)**
(i) Cut off frequency (ii) Wavelength in the waveguide
(iii) Phase velocity (iv) Group velocity

b. Starting from Maxwell's equations, derive wave equation for rectangular wave guide. **(8)**

Q.4 a. Explain the Waveguide Corners, Bends and Twists in waveguide components. **(8)**

b. A signal of power 32 mW is fed into one of the collinear ports of a lossless H-Plane Tee. Determine the powers in the remaining ports when other ports are terminated by means of matched loads. **(8)**

Q.5 a. 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.

b. Explain the principle of operation of a tunnel diode. Draw its I-V characteristics. **(10)**

Q.6 a. A Reflex klystron operates under the following conditions:
$V_O = 600$ volts, $\alpha = 1$mm, $R_{sh} = 15$ KΩ, $e/m = 1.759 \times 10^{11}$, $f_r = 9$ GHz
The tube is operating at $f_v f_r$ at the peak of the n = 2 mode or $1\frac{3}{4}$ mode. The transit time through the gap and beam loading can be neglected. Find the value of repeller voltage V_r. **(8)**

b. Write the schematic diagram of two cavity klystron amplifier and explain the velocity modulation process. **(8)**

Q.7 a. Explain the principle of operation Forward Wave Cross-Field Amplifier. **(8)**

b. An Amplitron has the following operating parameters:
Anode voltage $V_o = 15$kV
Anode current $I_o = 3$A
Magnetic flux density $B_o = 0.2$ wb/m^2
Operating frequency f = 8GHz
Characteristic impedance $Z_0 = 50\Omega$
Determine:
(i) The dc electron- beam velocity
(ii) The electron- beam phase constant
(iii) The cyclotron angular frequency
(8)

Q.8 a. Derive expression for Quality Factor 'Q' of Micro-Strip Lines and show that it is approximately the reciprocal of the dielectric loss tangent θ. **(10)**

b. Explain ohmic losses in microstrip lines. **(6)**

Q.9 a. List the various techniques by which monolithic microwave integrated circuits can be fabricated. Explain lithography. **(10)**

b. Describe a thin film planar resistor and express the resistance in terms of its parameters. **(6)**