ROLL NO. ___________________

Code: AE72/AE120 Subject: MICROWAVE THEORY AND TECHNIQUES

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **June 2019** **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. Terminal impedance of λ/2 transformer is
(A) terminal impedance
(B) terminal admittance
(C) characteristic impedance of the line
(D) infinite

b. The Smith Chart is
(A) a polar plot
(B) represents complex reflection coefficient
(C) inscribed in a unity circle
(D) All of these

c. Dominant mode in a circular waveguide is
(A) TE_{10} **(B)** TE_{11}
(C) TE_{01} **(D)** TE_{12}

d. If the height of the rectangular waveguide is halved, its cut-off wavelength for the dominant mode will
(A) be halved **(B)** remain unchanged
(C) be doubled **(D)** be ¼ of its previous value

e. Microwave components are characterized by
(A) h-parameter **(B)** z-parameter
(C) s-parameter **(D)** y-parameter

f. Gunn diode function is based on
(A) transferred electron effect **(B)** avalanche transit effect
(C) trapped plasma **(D)** impact ionization

g. In magnetron change in frequency with change in load is known as
(A) frequency pulling **(B)** frequency pushing
(C) mode jumping **(D)** skipping

h. In a multi-cavity klystron, the cavities are placed at
(A) equal distance **(B)** increasing distance
(C) decreasing distance **(D)** None of these

i. In a two cavity klystron the factor that determines the location of the catcher cavity is
(A) where fundamental current component is maximum
(B) where velocity of electrons is minimum
(C) where velocity of electrons is maximum
(D) location of complete bunching formation

j. If the ground plane is brought closer, inductance of a spiral inductor in general
(A) becomes negative **(B)** increases
(C) decreases **(D)** remains constant

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

Q.2 a. Derive an expression for the input impedance Z_{in} of a lossless transmission line in terms of relevant parameters when the line is terminated in load impedance Z_L. **(8)**

b. A lossy coaxial cable operated at a frequency 500 MHz, has the following primary constants: R=2.25 Ω/m, L=1μH/m, C=100pF/m and G=0 mho/m. Determine the input impedance of 10 m length cable with a load of 10Ω. **(8)**

Q.3 a. Define dominant mode in waveguide. Why is wave propagation in a hollow metallic waveguide preferred in dominant mode? Given for propagating TE_{10} mode in a rectangular wave guide (a x b), $H_z = A\cos\frac{\pi x}{a}e^{-j\beta z}$ A/m, where symbols have their usual meanings, find E_y and H_x. Hence determine the expression for the intrinsic wave impedance. **(10)**

b. A rectangular air filled copper waveguide with 0.9 inch X 0.4 inch cross section and 12 inch length in operating at 9.2 GHz in dominant mode. Find cut-off frequency, guided wavelength and characteristic impedance. **(6)**

Q.4 a. Derive an expression for the resonance frequency of a rectangular cavity (a x b x c), made of a rectangular waveguide with internal dimension (a x b) in TE_{101} mode. **(8)**

b. Discuss, how a cavity is excited using a coaxial line? **(2)**

c. A cubical resonator of side a = 3.0 cm made of copper having $\sigma = 5.8 \times 10^7$ s/m resonates at 7.07 GHz. It is filled with a dielectric of constant 2.25 and loss tangent 4×10^{-4}, $\mu_r = 1$. Determine quality factor of the resonator. **(6)**

Q.5 a. With the help of suitable sketch explain the two effects that combine to produce 180° phase between the applied voltage and the resulting current pulse in an IMPATT diode. **(8)**

	b.	For an IMPATT diode with carrier drift velocity $v_d = 2 \times 10^7$ cm/s, Drift region length L=6 μm, efficiency η=15% and break down voltage V_{BD}=90V calculate (i) the maximum CW output in watts and (ii) the resonant frequency in GHz.	**(8)**
Q.6	a.	Using applegate diagram, show, how bunching occurs under favourable conditions in a reflex klystron?	**(6)**
	b.	A reflex klystron is operating in 10 GHz with 600 V beam voltage. If the repeller voltage is 250 V, determine optimum repeller space for 1¾ mode.	**(6)**
	c.	A helical TWT has diameter 2 mm with 50 turns per centimeter. Calculate the axial phase velocity and anode voltage at which the TWT can operate.	**(4)**
Q.7	a.	Describe the construction of a multi cavity cylindrical magnetron and obtain the Hull cut-off condition.	**(8)**
	b.	A pulsed cylindrical magnetron is operated with the following parameters: Anode voltage = 25 kV; Beam Current = 25 A; Magnetic Density = 0.34 Wb/m^2; Radius of cathode = 5 cm. Calculate (i) the angular frequency (ii) the Hull cut-off voltage (iii) the Hull cut-off magnetic flux density.	**(8)**
Q.8	a.	Draw the cross sectional view with associated field lines of strip line and microstrip line.	**(3)**
	b.	Design a microstrip line of characteristic impedance 50Ω. The thickness and relative permittivity of the substrate are 1.4 mm and 2.55 respectively.	**(5)**
	c.	Describe different types of losses associated with microstrip line.	**(8)**
Q.9	a.	List the processes involved in MMIC fabrication.	**(8)**
	b.	How can you realize a planar capacitor?	**(2)**
	c.	Describe the different configurations to realize inductor used in MMIC.	**(6)**