ROLL NO. _____

Code: AE72/AE120 Subject: MICROWAVE THEORY AND TECHNIQUES

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **JUNE 2016** 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.**
- **Smith chart to be provided to the students on demand.**

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

a. The time required for the wave to travel 2m of length of line for L=10μH/m and C=30pf/m.
(A) 20ns **(B)** 34.64ns
(C) 2.01ns **(D)** 3.47ns

b. The return loss at port 2 is +40dB. Then reflection coefficient at the port is
(A) 0.01 **(B)** 0.1
(C) 100 **(D)** 10

c. Directivity of directional coupler is
(A) $\frac{\text{Back power}}{\text{Coupled power}}$ **(B)** $\frac{\text{Coupled power}}{\text{Back power}}$
(C) $\frac{\text{Incident power}}{\text{Coupled power}}$ **(D)** $\frac{\text{Coupled power}}{\text{Incident power}}$

d. In M type tubes
(A) DC magnetic field is parallel to DC electric field.
(B) There is only dc magnetic field.
(C) DC magnetic field is perpendicular to DC electric field.
(D) There is only DC electric field.

e. Micro strip line supports
(A) TE **(B)** TM
(C) Quasi TEM **(D)** TEM

f. Wavelength of EM wave in the Micro strip line is
(A) $C/f\varepsilon_{eff}$ **(B)** $C/f\varepsilon_{r}$
(C) $C/f\sqrt{\varepsilon_{r}}$ **(D)** $C/f\sqrt{\varepsilon_{eff}}$

g. If S = 3 and Zo=250Ω, then maximum impedance on transmission line is
(A) 150Ω **(B)** 750Ω
(C) 83.33Ω **(D)** 250Ω

h. If S=1 then magnitude of reflection coefficient is
(A) Infinity **(B)** 1
(C) –1 **(D)** Zero

i. The maximum electronic efficiency of reflex Klystron is
(A) 23.7% **(B)** 22.7%
(C) 21.7% **(D)** 20.7%

j. The mean length L between the continuities of bends and twists should be
(A) L= (2n+1) $\lambda_g/4$ **(B)** L=(2n+1) $\lambda_g/2$
(C) L= (2n+1) λ_g **(D)** (2n+1) $\lambda_g/8$

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

Q.2 a. Draw the elementary section of transmission line and derive the expression for line equations. **(8)**

b. Transmission line of length 0.32λ is terminated in load of (90+j60) Ω, have characteristic impedance 75Ω. Find the following using smith chart
(i) Voltage Standing Wave Ratio
(ii) Reflection coefficient at load
(iii) Input impedance
(iv) Distance of first voltage maximum from load
(v) Distance of first voltage minimum from load
(vi) Return loss **(8)**

Q.3 a. Applying Maxwell's equations derive the TE_{mn} field equations in Rectangular wave guide. **(10)**

b. Dominant TE_{10} mode is propagated through a rectangular wave guide of breadth 10 cm operating at 2.5GHz frequency. Find
(i) Cutoff wavelength (ii) Phase velocity
(iii) Group velocity (iv) Guide wavelength
(v) Wave impedance **(6)**

Q.4 a. Define microwave circulator. With neat diagram explain the working of four port circulator using two magic tees. **(8)**

b. Obtain the S-matrix of a four port Hybrid T-network. **(8)**

Q.5 a. With neat energy band diagram, explain Ridley-Watkins-Hilsum (RWH) theory in GUNN diode. **(8)**

b. Draw the equivalent circuit of a parametric amplifier and explain the parametric up-conversion and down- conversion. **(8)**

Q.6 a. With neat schematic and applegate diagram, explain the working of Reflex Klystron. **(10)**

b. A TWT operates under the following parameters: Beam Voltage Vo=3KV, Beam current Io=30mA, characteristic impedance of helix Zo=10Ω, circuit length N=50, Operating Frequency=10GHz. Determine
(i) The gain parameter C.
(ii) The output power gain A_p in dB. **(6)**

Q.7 a. Compare linear beam tubes with cross field tubes. Derive the expression for Hull cutoff voltage in Cylindrical Magnetron. **(10)**

b. A linear Magnetron has the following operation parameters: Anode voltage Vo=15KV, cathode current Io=1.2A, operating frequency F= 8GHz, magnetic flux density Bo=0.015wb/m^2, hub thickness h=2.77cm, distance between the anode and cathode d=5cm. Calculate
(i) The electron velocity of the hub
(ii) Phase velocity for synchronizing surface
(iii) The Hatree anode voltage. **(6)**

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Q.8 a. Draw the schematic diagram and field pattern of micro strip line. Write the expression for characteristic impedance of micro strip line and mention the limitations of the equation. **(8)**

b. A lossless parallel strip line has a conducting strip width w. The substrate dielectric separating the two conducting strips has a relative dielectric constant ε_{rel} of 6 and a thickness d of 4mm.Calculate
(i) The required width w of the conducting strip in order to have a characteristic impedance of 50Ω.
(ii) The strip line capacitance.
(iii) The strip line inductance.
(iv) The phase velocity of the wave in the parallel strip line. **(8)**

Q.9 a. Mention the properties of dielectric and resistive materials used in MMIC's. **(6)**

b. Explain the different techniques used in fabrication of MMIC. (**10)**