ROLL NO. _____

Code: AE72/AE120 Subject: MICROWAVE THEORY AND TECHNIQUES

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **June 2018** **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. For a rectangular waveguide to support only the dominant TE mode, which of the following pairs of inequalities has to be satisfied

(A) $b < \lambda < 2b; \lambda > 2a$ **(B)** $a < \lambda < 2b; \lambda < 2a$

(C) $a < \lambda < 2b; \lambda > 2a$ **(D)** $b < \lambda < 2b; \lambda < 2a$

b. Micro strip line supports

(A) TE **(B)** TM

(C) TEM **(D)** Quasi TEM

c. The purpose of slow wave structures used in TWT amplifiers is

(A) to reduce wave velocity

(B) to increase wave velocity

(C) to maintain constant wave velocity

(D) to reduce losses

d. The velocity of a transmission line

(A) increases the velocity along transmission line

(B) depends on the dielectric strength of the material used

(C) is governed by the skin effect

(D) is higher for a solid dielectric than for air

e. The efficiency of a two cavity klystron is about

(A) 80% **(B)** 10%

(C) 40% **(D)** 60%

f. The phase velocity v_p and group velocity v_g are related to C, the free space velocity by _____ relation.

(A) $v_p / v_g = C$ **(B)** $v_p v_g = C^2$

(C) $v_p v_g = C^3$ **(D)** $\sqrt{\frac{v_p}{v_g}} = C$

g. If the parameters of a transmission line are R = 2 Ω/m, G = 0.5 mho/m, f = 1 GHz, L = 8 nH/m and C = 0.23 pF, the propogation constant is:
(A) 0.273 – j0.051 **(B)** 0.051 + j0.273
(C) 0.051 – j0.273 **(D)** 0.273 + j0.051

h. Travelling wave tube amplifier is based on the principle of
(A) electron beam interaction with slow wave structure
(B) electron beam interaction with static magnetic field
(C) electron beam interaction with time varying magnetic field
(D) electron motion

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. A directional coupler is _____ port junction.
(A) 5 **(B)** 3
(C) 2 **(D)** 4

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. Explain Smith Chart. Explain how VSWR can be obtained from it? Give example. **(8)**

Q.3 a. Arrive at the solution of wave equations in a rectangular co-ordinates. Discuss the three distinct cases of propagation constant in the waveguide. **(10)**

b. A TE_{11} mode is propagating through a circular waveguide. The radius of the guide is 5 cm and the guide contains an air dielectric. Find the cut off frequency. Given, for TE_{11} mode, n = 1, p = 1 and $X_{11} = 1.841 = K_c.a$, where a is the radius. **(6)**

Q.4 a. A symmetric directional coupler with infinite directivity and a forward attenuation of 20 dB is used to monitor the power delivered to a load Z_l as shown in Fig 1. Bolometer 1 introduces a VSWR of 2.0 on arm 4; bolometer 2 is matched to arm 3.
If bolometer 1 reads 8 mW and bolometer 2 reads 2 mW, find (i) the amount of power dissipated in the load Z_l (ii) the VSWR on arm 2. **(8)**

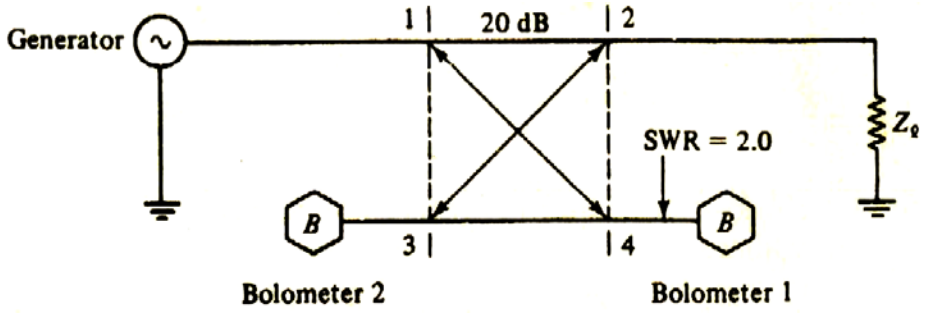

Fig.1

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

Q.5 a. Explain the physical description of Read Diode. **(8)**

b. An IMPATT diode has a drift length of 2 μm. Determine:
(i) Drift time of the carrier (ii) Operating frequency of the diode **(8)**

Q.6 a. Explain the working operation of Reflex Klystron with neat Schematic. **(8)**

b. Explain and analyze the lead Inductance and Interelectrode capacitance effects in a vaccum triode circuit. **(8)**

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. **(8)**

b. Describe the principle of operation for a normal cylindrical magnetron and derive equation for cyclotron angular frequency. **(4+4)**

Q.8 a. Explain the dielectric loss, radiation loss and ohmic loss in a microstrip line. **(8)**

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

Q.9 a. Write a short note on hybrid integrated circuit fabrication. **(6)**

b. Differentiate between discrete circuits, integrated circuits and monolithic microwave integrated circuits. What are the broad categories into which the basic materials used for MMIC fabrication are divided into? Write short notes on each of them. What are the disadvantages of MMICs? **(10)**