

Code: AE20

Subject: MICROWAVE THEORY & TECHNIQUES

AMIETE – ET (OLD SCHEME)

Time: 3 Hours

DECEMBER 2011

Max. Marks: 100

NOTE: There are 9 Questions in all.

- Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.
- 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.

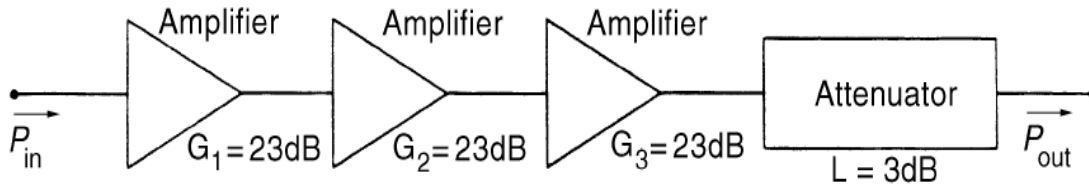
Q.1 Choose the correct or the best alternative in the following: (2 × 10)

- a. Impedance inversion may be obtained with
- (A) a short-circuited stub (B) an open circuited stub
(C) a quarter wave line (D) a wave line
- b. In order to couple two generators to a waveguide system without coupling them to each other, one could not use a
- (A) Rat race (B) E-plane T
(C) Hybrid ring (D) Magic T
- c. For low attenuation, the best transmission medium is
- (A) flexible waveguide (B) ridged wave-guide
(C) rectangular waveguide (D) coaxial line
- d. A PIN diode is
- (A) A metal semiconductor point-contact diode.
(B) A microwave mixer diode.
(C) Often used as a microwave detector
(D) Suitable for use as a microwave switch.
- e. The gain bandwidth frequency of a microwave transistor f_T , is the frequency at which
- (A) Alpha of transistor falls by 3dB
(B) Beta of transistor falls by 3dB
(C) Power gain of transistor falls to unity
(D) Beta of transistor falls to unity

f. The main disadvantage of the two-hole directional coupler is

- (A) low directional coupling (B) poor directivity
(C) narrow bandwidth (D) high SWR

g. Calculate the output power of given circuit, if input power is 1mW



- (A) 0 dBm. (B) 66 dBm.
(C) 10 dB (D) None of these

h. A wave guide can be considered as

- (A) Band pass filter (B) Band stop filter
(C) Low pass filter (D) High pass filter

i. If in a rectangular waveguide for which $a = 2b$, the cutoff frequency for TE_{02} mode is 12 GHz, the cutoff frequency for TM_{11} mode is

- (A) $3\sqrt{5}$ GHz (B) 3 GHz
(C) 12 GHz (D) $6\sqrt{5}$ GHz

j. _____ is directly measured in sweep reflectometer

- (A) SWR (B) Impedance
(C) Return loss (D) reflection coefficient

Answer any FIVE Questions out of EIGHT Questions.

Each question carries 16 marks.

Q.2 a. Starting from the two time harmonic Maxwell's curl equation in cylindrical co-ordinates. Express the transverse field components E_r , E_θ , H_r , and H_θ in terms of the longitudinal components E_z and H_z . What equation must E_z and H_z satisfy. (8)

b. Explain Rectangular Cavity Resonators and derive an expression for its resonant frequency. (8)

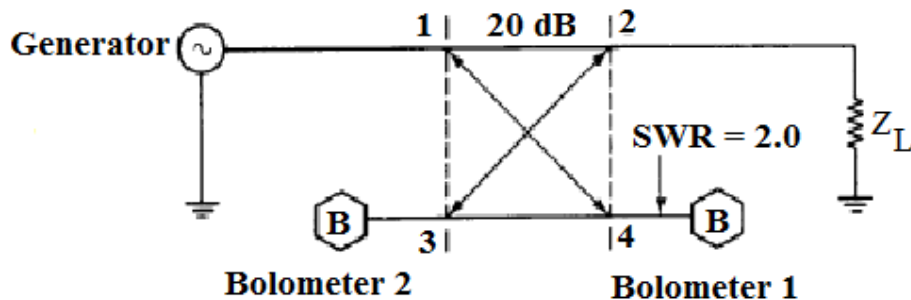
Q.3 a. A 200 volt (rms) generator having an internal resistance of 200Ω is feeding a lossless transmission line. The characteristic impedance and the length of the line are 200Ω and 10 m respectively. The line is terminated in a resistive load of 100Ω . If the operate frequency is 37.5 MHz. Calculate the

- (i) Current drawn from the generator.
- (ii) Magnitude and phase of the current flowing in the load and
- (iii) Power delivered to the load. (8)

b. Briefly explain the stub matching technique. (8)

Q.4 a. What are directional couplers? Define directivity, coupling factor, isolation and insertion loss of directional couplers. Also, discuss in brief Bethe hole coupler and bi-directional couplers. (8)

b. A symmetrical directional coupler with infinite directivity and a forward attenuation of 20 dB is used to monitor the power delivered to a load Z_L . Bolometer 1 introduces a VSWR of 2 on arm 4; Bolometer 2 is matched to arm 3. If Bolometer 1 reads 8mW and bolometer2 reads 2mW, find the amount of power dissipated in the load Z_L and VSWR on arm 2. (8)



Q.5 a. What is scattering matrix? Discuss the following properties of 'S' matrix

- (i) Symmetry property
- (ii) Unitary property
- (iii) Phase shift property (8)

b. Prove with the help of Maxwell's equations that TEM mode cannot exist in rectangular waveguide. (8)

Q.6 a. With the help of two-valley model along with the emphasis of drift velocity, explain the negative resistance property of a gunn diode. (10)

b. Write a short note on MASERS. (6)

Q.7 a. Describe how can the power of a microwave generator be measured using Bolometer. (8)

- (i) A varactor diode has a cut off frequency of 2450 MHz. What is the operating Q at a frequency of 54 MHz?
- (ii) A silicon varactor has a zero potential capacitance of 100 pF. If the m factor is $\frac{1}{2}$, what is the capacitance when the applied voltage is -4 V d.c.? Assume a barrier potential of 0.65 V and $K=1$. (8)

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Q.8 a. Briefly explain the concept of Duet propagation. (8)

b. A rectangular air filled copper wave guide with dimension 0.9 inch \times 0.4 inch cross section and 12" length is operated at 9.2 GHz with dominant mode. Find

- (i) Cut-off frequency (ii) Guide wavelength
(iii) Phase velocity (iv) Characteristic Impedance. (8)

Q.9 Write short notes on any **TWO**:

- (i) Critical frequency
(ii) Skip distance
(iii) Maximum usable frequency (2 \times 8)