Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

B.Tech (Electronics Engineering) (E-1 2012 Onwards) (Sem.–6)

MICROWAVE AND RADAR ENGINEERING

Subject Code : BTEEE-603B

Paper ID : [72843]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Write briefly :

a) What are the high frequency limitations of vacuum tubes? How they overcome in microwave tubes?

b) List the main disadvantages of two hole directional coupler.

c) Differentiate between transferred electron devices and transistors.

d) Name the errors possible in VSWR and impedance measurement.

e) Differentiate between scanning and tracking.

f) What are the factors that determine the range of radar?

g) Let the generator's transmitting frequency be 3 GHz. A target is moving radially towards generator with a velocity of 360 Km/hour. What is the frequency of the target?

h) Let the maximum range of radar be doubled with all the other factors remaining constant. By what factor the peak power must be increased?

i) What will be the value of PRT when PRF =1500 Hz?

j) What is meant by blind speed?

SECTION-B

2. a) Derive an expression for the efficiency of a two cavity klystron amplifier, starting from basic principles.

   b) A reflex klystron operates at the peak mode of $n = 2$ with $V_0 = 280V$, $I_0 = 22$ mA and signal voltage $V_i = 30V$. Determine (a) the input power (b) output power (c) efficiency.

3. a) Describe the physical structure of an IMPATT diode, identifying its doping profile characteristics.

   b) Explain construction, fabrication and encapsulation of Gunn diode. Mention its characteristics and applications of a Gunn diode.

4. Write a short note on

   a) Microwave Hybrid Circuits

   b) Circulator and Isolator

5. a) Describe how can the power of a microwave generator be measured?

   b) 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.

6. a) What do you understand by maximum theoretical range? Simplify the equation to express the maximum range in km to the following form

$$r_{max} = 48\left[\frac{P_1 D^4 S}{\delta f \lambda^2 (F-1)}\right].$$

   b) An MTI radar operates at 5GHz with a pulse repetition frequency (PRF) of 800pps. Calculate the lowest three blind speeds of this radar.

SECTION-C

7. a) Explain the working of a simple CW Doppler radar with the help of a block diagram.

   b) What is PRF? Explain how the ambiguous range echoes can be recognized by changing the PRF of the radar.

8. a) Derive Scattering matrix for directional coupler using S parameter theory.

   b) What do you mean by insertion loss? A three port circulator has an insertion loss of 1.1 dB, isolation of 20 dB, VSWR = 1.25 when all ports are matched terminated. Find S matrix and output power at port 2 and 3 for an input power of 100 mW at port.

9. Write Short notes on the following :

   a) Angle tracking Systems

   b) Range tracking Systems