ROLL NO. _____

Code: AE78 **Subject: RADAR AND NAVIGATIONAL AIDS**

AMIETE – ET

Time: 3 Hours **DECEMBER 2012** **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. The nominal frequency range of 'S' band is

(A) 1 – 2 GHz **(B)** 2 – 4 GHz
(C) 4 – 8 GHz **(D)** 8 – 12 GHz

b. Expression for doppler shift is

(A) $\frac{2V_r f}{C}$ **(B)** $\frac{2Cf}{V_r}$

(C) $\frac{2f}{CV_r}$ **(D)** $\frac{V_r f}{C}$

c. The maximum range of pulse radar depends on

(A) Pulse duration **(B)** pulse energy
(C) pulse peak power **(D)** pulse repetition rate

d. SONAR is used to detect objects moving

(A) at variable speed **(B)** Supersonic speed
(C) under water **(D)** away from location of RADAR

e. In a RADAR, if pulse echo is received in 100 ms, the distance of target could be

(A) 1500km **(B)** 150km
(C) 15km **(D)** 1.5km

f. In order to double the range of RADAR, the peak transmitted pulse power must be increased

(A) 2 times **(B)** 4 times
(C) 8 times **(D)** 16 times

g. Side lobe in RADAR ANTENNA causes

(A) Reduction in Gain of antenna
(B) Increase in Gain of antenna
(C) Reduction in beamwidth of Antenna
(D) Ambiguity in direction finding

h. The resolution of pulse RADAR can be

(A) Increasing pulse width **(B)** Decreasing pulse width
(C) Increasing pulse amplitude **(D)** Decreasing pulse repetition frequency

i. When peak transmitted power is increased by factor 81. The maximum range will increase by factor of

(A) 81 **(B)** 9
(C) 3 **(D)** $\sqrt{3}$

j. The MTI RADAR Operates at 5 GHz with a pulse repetition frequency of 800 pps. The lowest blind speed is

(A) 48 m/s **(B)** 96 m/s
(C) 240 m/s **(D)** 480 m/s

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

Q.2 a. What is the peak-power of a radar whose average transmitter power is 200 W, pulse width of 1μs and a pulse repetition frequency of 1000 Hz. **(8)**

b. Derive the simple form of radar range equation. **(8)**

Q.3 a. Derive an expression for the probability of false alarm and false alarm time of Radar. **(8)**

b. Briefly explain Radar system losses. **(8)**

Q.4 a. Derive an expression of clutter attenuation. **(8)**

b. Explain with help of block diagram the principle of operation of MTD signal processor. **(8)**

Q.5 a. Show that, the output peak-signal-to-mean-noise ratio from a matched filter depends only on the total energy of the received signal and the noise power per unit bandwidth. **(10)**

b. With a help of block diagram explain I, Q detector. **(6)**

Q.6 a. Derive a radar equation for the detection of a target in surface clutter when the grazing angle is 90°. Assume the antenna employs a pencil beam. **(10)**

b. Derive radar equation for detection of targets in rain. **(6)**

Q.7 a. Define Radiation pattern, Effective aperture, polarization of Antenna. **(8)**

b. List advantages and disadvantages of electronically steerable phased array. **(8)**

Q.8 a. Derive the overall noise figure of a receiver with noise figure F_r that is preceded by an RF device with a loss h_{RF}. **(8)**

b. Explain the important features of
(i) Dielectric Resonator Oscillator (DRO)
(ii) Surface Acoustic Wave Oscillator (SAW) **(8)**

Q.9 a. Explain briefly the limitation to tracking accuracy. **(6)**

b. Write short note on:

(i) Radio Direction Funding Methods.
(ii) LORAN-features. **(10)**