ROLL NO. _____

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

AMIETE – ET

Time: 3 Hours **JUNE 2014** **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. If the antenna diameter of a radar system is increased by a factor of 9, then the maximum range will be increased by a factor of

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

b. The pulse repetition frequency in a radar system is determined by

(A) transmitter power
(B) signal/noise ratio
(C) the minimum range at which target is expected
(D) the maximum range at which target is expected

c. The clutter power varies _____

(A) inversely as the square of the range
(B) directly as the square of the range
(C) inversely as the cube of the range
(D) directly as the cube of the range

d. A radar in which the radar beam is steered electronically is

(A) Tracking radar **(B)** MTI radar
(C) Phase Array radar **(D)** Synthetic aperture radar

e. A narrow radar beam width indicates

(A) higher range resolution **(B)** higher cross-range resolution
(C) higher doppler resolution **(D)** poor tracking accuracy

f. The relation between maximum unambiguous range (R_{un}) and pulse repetition frequency (fp) is

(A) $R_{un} = \frac{c}{2f_p}$ **(B)** $R_{un} = \frac{2c}{f_p}$

(C) $R_{un} = \frac{2f_p}{c}$ **(D)** $R_{un} = \frac{f_p}{2c}$

g. A pulse radar with a transmitted pulse width of 10 μsec would have a range resolution of

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

h. The blind speed of an MTI radar can be avoided by changing

(A) carrier frequency **(B)** pulse repetition frequency
(C) antenna rotation **(D)** transmitted power

i. A radar having a maximum range of 120 km will have maximum allowable pulse repetition frequency for unambiguous reception

(A) 1250 **(B)** 330
(C) 2500 **(D)** 8330

j. For a given bandwidth of the receiver in a radar system, high discrimination between targets is achieved, when the

(A) PRF is high
(B) Receiver sensitivity is high
(C) Pulse width is increased
(D) Diameter of antenna aperture is increased

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

Q.2 a. Explain the basic principle of a radar system. Give limitations and applications of radars. **(10)**

b. Calculate the maximum range of a radar system which operates with a peak pulse power of 600KW if its antenna is 5 m^2, minimum detectable signal is 10^{-13}W and radar cross-sectional area of the target is 20m^2. **(6)**

Q.3 a. Derive an expression for maximum detectable signal to noise ratio. **(6)**

b. Briefly explain the signal processing losses in radar system. **(6)**

c. Explain following in signal detection: **(4)**
(i) Threshold detection
(ii) Missed detection

Q.4 a. Explain the operation of MTI radar with the help of block diagram. **(8)**

b. Write short notes on: **(8)**
(i) Blind speeds
(ii) Doppler frequency shift

Q.5 a. Derive an expression for matched filter frequency response using Schwartz in-equality. **(8)**

b. Explain I, Q detector with the help of block diagram. **(8)**

Q.6 a. Derive the radar equation for detection of a target in surface clutter at low grazing angle. **(8)**

b. Explain the effect of wind on the magnitude of sea clutter. **(8)**

Q.7 a. Define the directive gain, power gain and aperture efficiency of radar antenna. **(6)**

b. Why does a parabolic surface make a good reflector antenna? Explain feeds for paraboloids. **(6)**

c. List the functions of a radar antenna. **(4)**

Q.8 a. Show that when a receiver of noise figure f_r is attached to an antenna with antenna temperature T_a, the system noise figure is $f_s = \frac{T_a}{T_o} + f_r$

where T_o is standard temperature 290 K. **(8)**

b. Explain the types of mixer in a superheterodyne receiver. **(8)**

Q.9 a. What is amplitude- comparison monopulse tracking radar? Explain its operation with simple block diagram. **(8)**

b. Explain the operation and applications of LORAN. **(8)**