ROLL NO. _____

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

AMIETE – ET

Time: 3 Hours **JUNE 2013** **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. Differing colors on radar reflectivity refer to:

(A) Temperature differences **(B)** Power transmitted back to the radar
(C) Height of clouds **(D)** Speed that the clouds are moving

b. The resolution of radar data _____ with distance away from the radar site.

(A) Increases **(B)** Decreases
(C) Not changes **(D)** Either **(A)** or **(B)**

c. Radar emits energy at nearly the speed of light and the speed of light is:

(A) 345 meters per second **(B)** 14,480 meters per second
(C) 30,300 meters per second **(D)** 299,800,000 meters per second

d. Reflectivity from buildings and objects at the earth's surface that are picked up usually close to the radar site are referred to as:

(A) Ground Clutter **(B)** UFO
(C) Clear air returns **(D)** Doppler aliasing

e. As range increases from the radar site, the radar beam tends to climb to higher elevations due to:

(A) Earth's curvature **(B)** Elevation angle that beam is emitted
(C) Both **(A)** & **(B)** **(D)** None of these

f. The ability of radar to detect wind motions within thunderstorm clouds is due to _____ technology.

(A) Satellite **(B)** Reflectivity
(C) Cell phone **(D)** Doppler

g. An S-shaped radial velocity pattern indicates a _____ and indicates _____.

(A) Backing wind, warm air advection
(B) Backing wind, cold air advection
(C) Veering wind, warm air advection
(D) Veering wind, cold air advection

h. In modulated PRF pulse RADAR

(A) range resolution is poor **(B)** range accuracy is poor
(C) range resolution is better **(D)** altitude returns are not eliminated

i. Duplexer is called

(A) a switch **(B)** coupler
(C) TR switch **(D)** amplifier

j. Radar is

(A) a mechanical device **(B)** an electromagnetic device.
(C) a pneumatic device **(D)** an electrical device

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

Q.2 a. Derive all forms of radar-range equation and compare them. **(8)**

b. Discuss the major accomplishments of radar after world war II. **(8)**

Q.3 a. A radar has a bandwidth B = 50 kHz and an average time between false alarms of 10 minutes.
(i) What is the probability of false alarm?
(ii) If the pulse repetition frequency (prf) were 1000 Hz and if the first 15 nmi of range were gated out (receiver is turned off) because of the use of a long pulse, what would be the new probability of false alarm? (Assume the false-alarm time has to remain constant.)
(iii) Is the difference between (i) and (ii) significant?
(iv) What is the pulse width that results in a minimum range of 15 nmi? **(8)**

b. The unambiguous range of radar is 200Km. It has a bandwidth of 1MHz. Find the required

(i) pulse repetition interval (ii) pulse repetition frequency
(iii) range resolution (iv) pulse width **(2×4)**

Q.4 Write a short note on the following:

(i) N-pulse Delay Line Canceller
(ii) Doppler frequency shift
(iii) Blind speed in MTI radar
(iv) High-prf Pulse Doppler Radar **(4×4)**

Q.5 a. What is meant by automatic Detection and explain its four basic aspects. **(8)**

b. Define matched filter and give its frequency response function. **(8)**

Q.6 a. Derive the surface clutter radar equation. **(8)**

b. (i) Why does the image show rain and there is no rain in the area?
(ii) What are the limitations of Doppler Weather radars in rainfall measurements? **(4+4)**

Q.7 a. Explain the working of phased array antenna. **(8)**

b. Is it possible to discriminate details smaller than the angular resolution? If yes, how? **(8)**

Q.8 a. State the factors which influence the bandwidth of radar receiver. Write down the advantages of large bandwidth. **(8)**

b. What are Radar displays? Explain their principle of Operation with examples and sketches. **(8)**

Q.9 a. What are the various factors which determine the accuracy of tracking radar? **(8)**

b. What is an instrument landing system? Explain how elevation guidance is provided in this system. Give the configuration of localizer antenna also. **(8)**