ROLL NO. _____

Code: AE78/AE126 **Subject: RADAR AND NAVIGATIONAL AIDS**

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **JUNE 2016** **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 peak transmitted power in a radar system is increased by a factor of 16, the maximum range will be increased by a factor of

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

b. If the antenna diameter in a radar system is increased by a factor of 4, the maximum range will be increased by a factor of

(A) $\sqrt{2}$ **(B)** 2
(C) 4 **(D)** 8

c. If a radar receives an echo signal 2 milliseconds after the signal was transmitted, the distance of target is

(A) 100 km **(B)** 200 km
(C) 300 km **(D)** 450 km

d. A solution to the "blind speed" problem is to

(A) Change the Doppler frequency
(B) Vary the PRF
(C) Use monopulse
(D) Use MTI

e. A radar is to have a maximum range of 60km. The maximum allowable pulse repetition frequency for unambiguous reception will be

(A) 25 pps **(B)** 250 pps
(C) 500 pps **(D)** 2500 pps

f. The output tube for a pulsed radar system may be a

(A) magnetron **(B)** klystron
(C) travelling wave tube **(D)** any of these

g. The minimum range of detection by a pulse radar depends on
(A) pulse width
(B) average transmitter power
(C) beamwidth of the antenna
(D) None of these

h. The minimum receivable signal in a radar receiver having bandwidth of 1.5MHz and noise figure of 9 dB will be of the order of

(A) 4×10^{-4} W **(B)** 4×10^{-6} W
(C) 4×10^{-14} W **(D)** 4×10^{-28} W

i. In a Doppler radar, the transmitter signal frequency was 115 MHz and the frequency of echo was 15 MHz. It can be concluded that

(A) the target is also equipped with a radar
(B) the target is moving away from the radar
(C) the target is moving towards the radar
(D) the target is losing height

j. Radar nautical mile is a time interval of approximately

(A) 1.2367 μs **(B)** 12.367 μs
(C) 123.67 μs **(D)** 1.2367 ms

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

Q.2 a. (i) Explain an elementary form of RADAR with neat block diagram. **(6)**
(ii) Write any four frequencies used in RADAR. **(2)**

b. (i) Derive three different form of radar equations which describe range performance. **(6)**
(ii) Write any four applications of RADAR. **(2)**

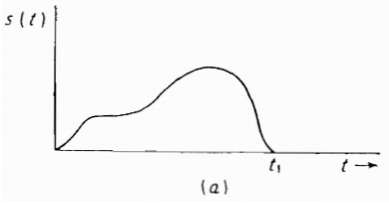
Q.3 a. Write short notes on receiver noise by describing thermal noise, noise bandwidth, noise figure and minimum detectable signal. **(8)**

b. Explain transmitter power and derive radar range equation as a function of average power. **(8)**

Q.4 a. Compare moving target indicator (MTI) and pulse doppler radar. **(8)**

b. Explain pulse radar with neat block diagram, necessary equations and waveforms. **(8)**

Q.5 a. (i) What is meant by matched filter? Give its impulse function. Draw the matched filter response for the received waveform s(t) given below. **(4)**
(ii) What is meant by automatic detection? What are the advantages? Name different types of automatic detectors. **(4)**



b. (i) Explain in brief about following types of detectors. **(4+2)**
Envelope detector
Logarithmic detector
(ii) Name different types of receivers based on detection criteria. **(2)**

Q.6 a. (i) What is clutter? What is the effect of clutter on radar? Explain in brief. **(5)**
(ii) Mention about surface clutter and volume clutter. Draw the geometry of radar clutter. **(3)**

b. (i) List out the applications which require information about the radar backscatter from the land. **(4)**
(ii) Write short note on radar signal scattering from snow. **(4)**

Q.7 a. Explain directive gain and power gain. Write necessary equations. Give the relationship between them. **(8)**

b. Explain about electronically steered phased array antenna in radar. **(8)**

Q.8 a. (i) What is the purpose of radar display? Mention about traditional display, synthetic video and blip. **(4)**
(ii) Compare deflection-modulated CRT with intensity-modulated CRT. **(4)**

b. Write about any eight different types of CRT displays which were used for surveillance and tracking radars from the list given below.

A-scope	*B-scope*	*C-scope*	*D-scope*
E-scope	*F-scope*	*G-scope*	*H-scope*
I-scope	*J-scope*	*K-scope*	*L-scope*
M-scope	*N-scope*	*O-scope*	*P-scope*
R-scope	*RHI*		

(8)

Q.9 a. Explain tracking with RADAR. **(8)**

b. Explain instrument landing systems such as Lorenz system and MIT-CAA microwave system. **(8)**