ROLL NO. _____

Code: AE78/AE126 Subject: RADAR AND NAVIGATIONAL AIDS

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **December - 2017** **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 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

b. Range of target if the time taken by the radar signal to travel to and fro is 100μsec.
(A) 15 km **(B)** 51 km
(C) 15 m **(D)** 51 m

c. A circular loop with diameter of 2m and 10 turns is at a height of 1m. Then the operating frequency is
(A) 18.84GHz **(B)** 84.81GHz
(C) 48.81GHz **(D)** None of these

d. Blind speed is
(A) PRF(nλ/2) **(B)** PRF(λ/2)
(C) PW(nλ/2) **(D)** PRT(nλ/2)

e. 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

f. 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

g. STALO stands for_____
(A) Standard local oscillator **(B)** Stable L-band output
(C) Stabilized local oscillator **(D)** Saturated and linear oscillator

h. The minimum receivable signal in a RADAR receiver whose IF bandwidth is 1.5 MHz and which has a noise figure 9 dB will be _____
(A) 4.16×10^{-10} Watt **(B)** 4.16×10^{-12} Watt
(C) 4.16×10^{-13} Watt **(D)** 4.16×10^{-14} Watt

i. 'LORAN C' operates in the following frequency range
(A) 50 – 70 kHz **(B)** 90 – 110 kHz
(C) 80 – 120 kHz **(D)** 140 kHz – 160 kHz

j. The radar system losses depend upon:
(A) Antenna losses **(B)** Plumbing losses
(C) Signal processing losses **(D)** All of these

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

Q.2 a. Draw the block diagram of radar and explain the working of its each block. **(10)**

b. Calculate the maximum range of a radar system which operates with a peak pulse power of 600 kW 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. Describe, how threshold level for detection is decided in the presence of receiver noise for a specified probability of occurrence of false alarms by applying statistical noise theory? **(6)**

b. The unambiguous range of radar is 200 km. It has a bandwidth of 1MHz. Find the required
(i) pulse repetition interval (ii) pulse repetition frequency
(iii) range resolution (iv) pulse width **(2.5×4)**

Q.4 a. A pulse Doppler radar has a carrier frequency of 9 GHz and PRF of 400 GHz. Find its blind Doppler frequencies and the radial velocity of target which would be undetected by the radar. **(8)**

b. Describe the method of staggering pulse repetition frequency to reduce the effect of blind speeds in an MTI system **(8)**

Q.5 a. Derive the expression for frequency response of the matched filter with non-white noise. **(8)**

b. Write a note on Neyman-Pearson observer in detection criteria. **(8)**

Q.6 a. What do you understand by the term clutter? Enlist the different types of clutter (names only) and explain detection of target in sea clutter? **(8)**

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

Q.7 a. Why does a parabolic surface make a good reflector antenna? Explain feeds for paraboloids. **(6)**

b. What is electronically steered phased array antenna system? Explain its radiation pattern with the help of a neat diagram. **(4+6)**

Q.8 a. Draw and explain TR Duplexer. **(12)**

b. Explain the working of Plan Position Indicator. **(4)**

Q.9 a. Explain the block diagram of the AGC portion of tracking radar receiver. **(8)**

b. Write a short note on LORAN-A and LORAN-C. **(8)**