ROLL NO. _____

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

## AMIETE – ET (Current & New Scheme)

**Time: 3 Hours** **DECEMBER 2018** **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.**

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**Q.1 Choose the correct or the best alternative in the following: (2×10)**

a. When the target is moving with a speed equal to the lowest blind speed, the Doppler shift equals

**(A)** Twice the pulse repetition frequency
**(B)** One half the pulse repetition frequency
**(C)** Pulse repetition frequency
**(D)** Thrice the pulse repetition frequency

b. A pulse radar with a transmitted pulse width of 10 μs would have a range resolution of

**(A)** 150 m **(B)** 1.5 km
**(C)** 15 m **(D)** None of the these

c. The maximum PRF that can be used for a maximum unambiguous range is given by

**(A)** fr = c/2. Rmax **(B)** 2.c/Rmax
**(C)** c/Rmax **(D)** Rmax/2.c

d. _____ radar has both a higher range resolution and higher detection capability.

**(A)** Pulse compression radar **(B)** MTI
**(C)** Pulse Doppler radar **(D)** Tracking radar

e. If the target cross section is rapidly changing , the best choice for accurate tracking is

**(A)** Monopulse tracking **(B)** Conical scan tracking
**(C)** Lobe switching **(D)** Sequential lobing.

f. The radiation pattern for an antenna array depends on

**(A)** Pattern and spacing of the antennas, and the magnitudes and phase relations of the signals feeding the antennas.
**(B)** Patterns of the antennas, and independent of magnitudes and phase relations of the signals feeding the antennas.
**(C)** Spacing of the antennas, and independent of magnitudes and phase relations of the signals feeding the antennas.
**(D)** Magnitudes and phase relations of the signals feeding the antennas and independent of Pattern and spacing of the antennas

g. The distance ___, at which far and near fields are equal, is termed as ___.

**(A)** $\lambda/2\pi$, Radian sphere **(B)** $\lambda/2\pi$, Radian distance

**(C)** $\lambda/2$, Equi-distance **(D)** $\lambda/2$, Radian distance

h._____ is not a type of Radar display.

**(A)** A scope **(B)** F scope

**(C)** PPI **(D)** None of the these

i. "SYLEDIS" in Navigation systems is suitable for _____ Range.

**(A)** VHF **(B)** UHF

**(C)** SHF **(D)** Microwave frequency

j. A system of long-range navigation in which pulsed signals sent out by two pairs of radio stations are used to determine the location of a ship or airplane is _____.

**(A)** ILS **(B)** MLS

**(C)** LORAN **(D)** RDF

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

**Q. 2** a. Explain the advantages and potential applications of Radar. **(5)**

b. Derive simple radar range equation. Explain its limitations. **(5)**

c. Explain the difference between pulsed radar and CW radar. **(6)**

**Q. 3** a. If a pulse width of 0.01sec of a radar signal is transmitted, what are the blind speeds of the target, at which the radar cannot easily see the target? **(5)**

b. A receiver at 1 GHz with 1 MW radar requires at least 0.001 W to detect a valid target properly. Compute RCS of the target when the target is to be at 100 km range. Assume antenna gain as 40 dB. **(5)**

c. Define and explain Doppler shift. Derive the Doppler frequency. What is the Doppler shift when tracking a car moving away from two radars at speed of 100 km/hr if the two radars operate at 1 GHz and 10 GHz? **(6)**

**Q. 4** a. Explain the principle of operation of ADT with a neat diagram. **(5)**

b. Explain the principle of integration of radar pulses in detail with diagrams. **(5)**

c. Differentiate MTI radar from PDR. Explain the differences. **(6)**

**Q. 5** a. Determine the matched frequency response function H(7) for a perfectly rectangular pulse of sine wave of duration $\tau$ , amplitude A and frequency $f_o$. **(6)**

b. Discuss the different detectors for radar signals with diagrams. **(6)**

c. Derive the radar equation for detection of targets in rains. **(4)**

**Q. 6** a. Define and explain all the parameters of an antenna. **(6)**

b. A feed with a gain function $14\cos^6 \theta$ is to be used with a paraboloidal reflector in an optimum design .The required gain is 50 dB at 12 GHz. Find the required diameter & focal length of the Reflector. **(6)**

c. Derive an expression for receiver noise figure. Explain its significance. **(4)**

**Q. 7** a. Differentiate duplexer and diplexer. **(6)**

b. Explain the principle of operation of Monopulse tracking radar with a neat block diagram. **(6)**

c. Explain the concept of phased array with a diagram. Derive an expression for its steering angle. **(4)**

**Q.8** a. Explain the principle of operation of Conical scan tracking radar with a neat block diagram. **(5)**

b. Define and explain the parameters of a radar receiver. The receiver of a radar has a noise figure of 5dB. If the IF bandwidth B of the receiver be 2.5 MHz, calculate the minimum detectable power. **(5)**

c. Compare and contrast the features of all the trackers. Explain the comparison. **(6)**

**Q. 9** a. Explain the principle of operation of Adcock direction finder with a neat diagram. **(6)**

b. Compare and contrast Loran A and Loran C systems. **(6)**

c. Write a technical note on "The omega system ". **(4)**