

Subject: RADAR AND NAVIGATIONAL AIDS

Time: 3 Hours

DECEMBER 2010

Max. Marks: 100

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 half an hour 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 81, the maximum range increases by a factor of

- (A) 3
- (B) 6
- (C) 9
- (D) 81

b. In a radar system, clutter is

- (A) Identification of objects moving at high speed
- (B) Identification of objects at low heights
- (C) Echoes corresponding to stationary targets
- (D) Jamming of radar

c. For stationary targets Doppler frequency shift f_d is:

- (A) infinite
- (B) zero
- (C) one
- (D) twice the prf

d. One of the possible solutions for blind speed is

- (A) use a high prf
- (B) use a low prf
- (C) use MTI radar system
- (D) vary prf

e. The range resolution of pulse radar can be improved by

- (A) increasing pulse width
- (B) decreasing the pulse width
- (C) increasing the pulse amplitude
- (D) decreasing the pulse amplitude

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- f. In mono pulse tracking radar , number of pulses required to generate all the angular error are
- (A) one (B) two
(C) three (D) four
- g. The main functions of a radar receiver are
- (A) To amplify the received signal and optimize the probability of detection
(B) To gain maximum signal to interference ratio
(C) To remove the carrier and restore signal to base band frequencies
(D) All the above
- h. An Instrument landing system (ILS) consist of :
- (A) localizer transmitter (B) glide path transmitter
(C) Both A and B (D) Neither A nor B
- i. In a single antenna radar, where same antenna is used as receiving and transmitting antenna
- (A) The TR duplexer is the only one that can be used
(B) The circular duplexer is the only one that can be used
(C) No duplexer is required for the system
(D) None of the above
- j. PPI (Plan Position Indicator) gives the following information
- (A) range of target (B) azimuth of targets
(C) neither A nor B (D) both A and B

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

- Q.2** a. With the help of a diagram, explain the working of a radar. (8)
- b. Calculate the distance of a target if the time taken by radar signal to the target and back is 100 micro seconds. (8)
- Q.3** a. Derive an expression of radar range equation in simplest form. (8)
- b. A radar is operating at 10 GHz with peak power of 500 KW. The power gain of antenna is 5000 and the minimum power required by receiver is 10^{-14} W. Calculate maximum range of the radar if effective area of the antenna is 10m^2 and radar cross section is 4m^2 . (8)

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- Q.4** a. With the help of a suitable diagram explain the function of Moving target indicator. **(10)**
- b. An MTI radar is used by traffic police to measure the speed of vehicles. The doppler frequency shift measured from the moving vehicle is 1.5 KHz, Calculate the speed of vehicle if the radar is operating at 1 GHz with a PRF of 1000 Hz. **(6)**
- Q.5** a. What is detector? Briefly discuss the various types of detectors used in radars. **(10)**
- b. Describe Matched filter receiver in brief. **(6)**
- Q.6** a. Define grazing, incidence and depression angles. **(6)**
- b. What is clutter? Discuss variation of surface clutter with grazing angle. **(10)**
- Q.7** a. What are various functions of a radar antenna? **(7)**
- b. Discuss three important parameters of radar antenna. **(9)**
- Q.8** a. Explain the function of a TR duplexer. **(8)**
- b. Explain the working of Plan Position Indicator. **(8)**
- Q.9** a. Explain the principle of conical scanning. **(8)**
- b. Explain the working of Instrumental Landing System. **(8)**