53 (CE 810) RENS

2014

RADAR AND ELECTRONIC NAVIGATION SYSTEMS

Paper : EC 810

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Discuss the operations of Pulse-Doppler radar.

   (b) Show that for a CW Dopper radar, the output from the mixer / detector is given by

   $\frac{A}{2}\cos\left[\frac{4\pi}{\lambda}\frac{dR}{dt}\right]$; where the symbols have their usual meaning.

(c) Prove that the Doppler frequency for a target moving with a radial velocity (dR/dt) is given by $fd = \pm 2\frac{(dR/dt)}{\lambda}$;

where 'λ' is the operating wavelength of the radar. 8+6+6

2. (a) What is meant by unambiguous range in radar ? Show that the unambiguous range is given by $Ru = C\tau/2$; where 'τ' is the delay in pulse transmission.

(b) Show that two targets located at ranges 'R_1' and 'R_2' can be resolved exactly if the range resolution is given by $\Delta R/min = C/2B$; where 'B' is the radar bandwidth. 4+6+10

3. (a) Deduce the radar range equation given by

$$R_{max} = \left[\frac{P_T.G.\sigma.Ae}{(4\pi)^2.S\,min}\right]^{1/4}$$; where the symbols have their usual meaning.

(b) A certain radar has a bandwidth of 0·4*MHz* and the average time between false alarm is 30*min.* What is the probability of false alarm and the threshold-to-noise power ratio $\left(V_T^2 / \psi_0\right)$?

(c) Show that a single-delay line is equivalent to a high-pass filter. How the delay can be achieved in a radarbased system ? 8+4+8

4. (a) Describe the operation of a MTI-based radar.

(b) Deduce the frequency response of a single delay line canceler in connection with MTI radar. What is blind speed ?

(c) What methods are available for reducing the detrimental effects of blind speed ? 8+7+5

5. (a) What is Rayleigh criterion for a smooth surface ?

(b) Show that the effect of multipath propagation on radar range equation is to change the return power dependance on Range to R^{-8} rather than R^{-4} relationship found in free space. 4+16

6. *(a)* What is an analytic radar signal ? How does it differ from a real radar signal ?

(b) Find the response of an analytical network fed by an analytical input.

(c) Compute the maximum instantaneous SNR at the output of a linear filter whose inpulse response is matched to the signal $x(t) = e^{-t^2/2T}$. 5+10+5

7. Write short notes on ***any two*** of the following : 10+10

(i) Matched filter SNR

(ii) Single-pulse radar ambiguity function

(iii) Delay estimation using single envelope of a radar pulse.
