

B.ETCE 4th year 2nd Semester Examination 2025

Radar and Navigation

Time : Three Hours

Full Marks : 100

Q.1 is compulsory and Answer any three questions from Q. 2-Q. 6

Q.1 A. Answer All Multiple Choice Questions.

10x 2= 20

1. The radar in which both transmission and reception is done using the same antenna are called
 - a. monostatic
 - b. monopulse
 - c. bistatic
 - d. MTI
2. For a perfect electric conductor (a sphere) immersed in EM wave can have
 - a. electric dipole component
 - b. magnetic dipole component
 - c. both of them
 - d. creeping wave
3. Zero reflection observed in bi static RADAR cross section of sphere depends on
 - a. cancelation of fields
 - b. on the basis of angle of observations
 - c. frequency of operation
 - d. all of the above
4. RADAR PRF of 1250 pulse per second. Maximum range that targets can have if they are to be in first range zone is
 - a. 64.8nmi
 - b. 66.4nmi
 - c. 60.4 nmi
 - d. 56.5nmi
5. If a RADAR operates at a PRF of 1250 pps and has an illumination frequency of 3GHz, what is the maximum target radial velocity giving an unambiguous Doppler shift
 - a. 24.12 m/s
 - b. 31.25m/s
 - c. 12.93 m/s
 - d. 42.11 m/s
6. If the bandwidth of IF amplifier is 1MHz and the average time between false alarm is 15 min. Probability of false alarm is
 - a. 1.03×10^{-8}
 - b. 1.21×10^{-9}
 - c. 1.11×10^{-9}
 - d. 1.03×10^{-9}
7. A gated CW waveform has a center frequency of 1.250GHz, a pulse width of 0.5 microsecond and a PRF 400 pps. what is the matched bandwidth?

[Turn over

7. A gated CW waveform has a center frequency of 1.250GHz, a pulse width of 0.5 microsecond and a PRF 400 pps. what is the matched bandwidth?

- a. 500 KHz b. 330 KHz c. 100 MHz d. 200 KHz

8. An FMCW radar has a theoretical maximum detectable distance dependent on

- a. PRF b. pulse shape c. chirp duration d. modulation index

9. Double delay line canceller is better than single delay line canceller because

- a. better resolution b. better efficiency c. better clutter rejection d. static component minimization

10. Clutter at low grazing angles is often deals with

- a. non coherent reflection b. coherent reflection c. both of them d. surface roughness

Q.1 B. Design question; Answer with your thought

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In a pulse radar system, the Pulse Repetition Frequency (PRF) plays a crucial role in determining both the maximum unambiguous range and Doppler resolution. Explain the concept of range ambiguity with respect to PRF. If a radar designer wants to detect both long-range and high-speed targets, what challenge does the choice of PRF give?

Q.2

- a. What are the difference with conical scan and sequential lobbing? **10**
- b. Describe the operation of three channel monopulse RADAR for boresight detection. **10**
- c. A monopulse radar has a half-power beamwidth (HPBW) of 2° . What is the minimum angular resolution the system can achieve in radians? **5**

Q.3

- a. What is probability of false alarm and threshold detection? Define Radar range equation in terms of receiver noise and transmitter power separately **6+ 6+6= 18**
- b. A radar operates at a frequency of 10 GHz and has a peak transmitted power of 1 MW. If the radar antenna has a gain of 30 dB and the target has an RCS (Radar Cross Section) of 10 m^2 , what is the received power at a target range of 50 km. **4**
- c. The average time between false alarm is 30 min and the receiver bandwidth is 0.4MHz. What is the threshold to noise ratio? **3**

Q.4

a. Deduce Ambiguity diagram expression. Describe the ambiguity diagram of general case. What happen in ambiguity diagram if the ideal spectrum component has several harmonics?

6+ 4+6= 16

b. Explain the operation of sweep to sweep subtraction method for MTI RADAR with block diagram of single delay line canceller

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Q. 5

a. What is delay line canceller and explain the frequency response of the same.

3+7=10

b. What is blind speed? What is the highest frequency of the RADAR can be operated if it is required to have a maximum unambiguous range of 200nmi and no blind speed less than 600kt.

4+5= 9

c. Show that the product of the maximum unambiguous range and the first blind speed v_1 is equal to $c\lambda/4$ where c is the velocity of propagation and λ is the radar wavelength

6

Q. 6

a. Describe the matched filter frequency response.

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b.If the clutter power in a radar system is 100 times the signal power, what is the clutter-to-signal ratio (CSR) in dB.

5

c. Explain the radar losses?

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d. A synthetic aperture radar (SAR) operates at 3 GHz with an aperture length of 5 m. What is the cross-range resolution?

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