

Registration no:

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M.TECH
ETPE201

Second Semester Examination – 2013

RADAR SYSTEM ENGINEERING

Time: 3 Hours

Max marks: 70

Answer Question No.1 which is compulsory and any five from the rest.

The figures in the right hand margin indicate marks.



- Q1 Answer the following questions: (2 x 10)
- Why Radar frequencies are in microwave range?
 - What for a Duplexer unit is used in a Pulse-Radar system?
 - What is false alarm and how can it be controlled?
 - A 1 KW pulse radar uses pulses of $1\mu\text{s}$ duration. What is the p.r.f if the peak power transmitted is 2 MW?
 - What is the delay introduced in a delay line canceller of an MTI using a p.r.f 5000 Hz?
 - What are glint and echo amplitude fluctuations? What types of tracking are affected by these?
 - What should be the spacing between elements of an antenna array of isotropic radiators to avoid grating lobes?
 - What is the basic difference between an MTI and a Pulse-Doppler radar?
 - A 4-bit digital phase shifter is used for electronic beam switching. What are the lengths of the switched lines and what is the phase increment in steps?
 - What happens to the antenna gain as the beam of a phased array scans through an angle from the broad side?
- Q2 a) A 1 KW pulse-radar operating at 9 GHz has the following parameters : (7)
- | | | |
|-----------------------------|---|----------------|
| (i) Pulse width | = | $1\mu\text{s}$ |
| (ii) Duty cycle | = | 0.001 |
| (iii) Receiver Noise Figure | = | 10 dB |
| (iv) Antenna Gain | = | 30 dB |
- If the indicator minimum requirement is 6 dB SNR, find the maximum range of a target of minimum cross sectional area 10 m^2 .
- b) Find the maximum unambiguous range of the above Radar. (3)

- Q3 a) Why can't a CW radar measure range? What modification does a simple CW radar need to measure both range and velocity of targets? What is done to isolate the receiver from the high power transmitter? (5)
- b) How is the direction of the moving target (approaching or receding) could be ascertained in a CW radar? (5)
- Q4 a) What is an MTI? Give the block diagram of the same and explain its operation. Draw the time domain filter characteristics of the delay line canceller. (6)
- b) A 3 GHz MTI has a maximum unambiguous range of 150 Km. Find its first and second blind speeds. How can the blind speed range be extended? (4)
- Q5 a) What are the different types of tracking radars? Explain the basic principle of continuous angle tracking. What are the limitations to tracking (5)
- b) Explain the operation of a mono-pulse tracking radar with block diagram. What type of antenna is suitable for this radar? (5)
- Q6 a) How is the aperture illumination of a line source related to the Electric field intensity as a Fourier Transform pair? Find an expression for the Electric field intensity for a uniform aperture illumination extending from $-D/2$ to $+D/2$ in z-axis around the origin. What is the width of the main beam? (5)
- b) Explain the terms: (5)
- (i) Aperture Efficiency
 - (ii) Beam Area
 - (iii) Radiation efficiency
- in radar antennas.
- Q7 a) Find an expression for the received field intensity of an N -element (isotropic radiators) parallel feed linear array. What is the normalised radiation pattern if the elements are not isotropic but directive ones with gain G_e ? Can this help eliminate grating lobes? (6)
- b) How can beam steering be achieved through an angle θ_0 from the broadside? Discuss the relative merits and demerits of a parallel feed over a series feed steering of a linear array. (4)
- Q8 Write brief explanatory notes on any two of the followings: (5 x 2)
- a) Synthetic Aperture Radar
 - b) Cassegrain Antenna
 - c) Diode Phase Shifters
 - d) AMTI

