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Total Number of Pages : 02

M.Tech  
P2ECCC05

2<sup>nd</sup> Semester Regular Examination 2018-19

**RADAR SYSTEM ENGINEERING**

**BRANCH : COMMUNICATION SYSTEMS**

Time : 3 Hours

Max Marks : 100

Q.CODE : F335

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

**Part- I**

**Q1 Only Short Answer Type Questions (Answer All-10) (2 x 10)**

- What is the pulse repetition frequency of radar to achieve a maximum unambiguous range of 85 nmi.
- What is the peak power of a radar whose average transmitted power is 200W, pulse width of  $1\mu\text{s}$  and pulse repetition frequency of 1000Hz.
- What are the operating frequency ranges of radar?
- How blind speed problem can be minimized in MTI radar.
- Differentiate between sequential lobing and conical scan.
- A 2.5 GHz MTI radar has unambiguous range of 160km. find the first two blind speeds.
- Mention the factors affecting the choice of the frequency of operation of radar.
- Explain major effects that limit the accuracy of the tracking radar.
- What factors influence phase shifting required for beam steering?
- How is the aperture efficiency different from the radiation efficiency of an antenna?

**Part- II**

**Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)**

- What do you mean by monopulse tracking? Explain it with neat diagram.
- What is CW radar principle. How can range ambiguities be overcome in CW radar?
- What is plan position indicator in a typical surveillance radar display? Explain various types of PP Indicators.
- Briefly explain the working of Bistatic CW radar with Limitations.
- What is beam squinting and which type of feed eliminates it?
- What is the highest frequency that a radar can be operated if it is required to have a maximum unambiguous range of 200nmi and no blind speeds less than 600kt.
- How amplitude-comparison monopulse radar works in single angle coordinate.
- What is the essential difference between a pulsed Doppler radar and MTI?
- Explain the basic principle of continuous angle tracking.
- Describe the working principle of cassegrain antenna using hyperbolic subreflector with clear diagram.
- Derive an expression for the half-power beam-width when a phased array scans an angle  $\theta_0$  from the broad side and explain how scan angle affects the antenna gain.
- What modifications are required to enable CW radar to measure the practical range and velocity of a moving target? Explain using neat sketch.

**Part-III**

**Q3 Only Long Answer Type Questions (Answer Any Two out of Four) (16)**

What is the Doppler effect? Derive the formula for Doppler shifts.  
A Satellite is orbiting the earth in a circular orbit at an altitude of 4500nmi has a speed of 3.5 nmi/s. What is the Doppler frequency shift for UHF radar (300MHz).

- Q4** Derive radar range equation and analyze the parameters that influence the range measurement. (16)  
A Ground based surveillance radar operates at a frequency of 1300MHz. Its maximum range is 200nmi with a radar cross section of one square meter. Its antenna is 12 m wide by 4 m high with aperture efficiency of 65%. The receiver minimum detectable signal is  $10^{-13}$  W. find the following :
- a) Antenna effective aperture (square meter) and antenna gain (dB)
  - b) Peak transmitted power
  - c) PRF to achieve max unambiguous range of 200 nmi.
  - d) Avg. transmitted power if pulse width is 2us
  - e) Duty cycle
  - f) Horizontal beam width (degree)
- Q5** What do you mean by reflector antennas? Discuss the different types of feed placements in parabolic reflector in detail with neat schematics using examples. (16)
- Q6** Write Shorts Notes on any TWO of the following : (8 x 2)
- a) Super heterodyne radar receiver
  - b) Pulse compression radar
  - c) Digital MTI processing