UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination – December, 2017

Program/course: M.Tech/ASE+UAV   Semester – III
Subject: Guidance and Navigation   Max. Marks : 100
Code   :MAEG-821   Duration   : 3 Hrs
No. of page/s: 02

INSTRUCTIONS:
1. No students will be allowed to leave the examination hall before 1hr.
2. Assume any missing data with suitable explanation.

SECTION-A [05x04=20]

1. A radar receiver has a bandwidth of 1.2 MHz and a noise figure of 5 dB. Determine the minimum receivable signal.   **04**
2. The noise figure of a radar receiver is 9 dB and if bandwidth is 2 MHz. Find its minimum receivable signal.   **04**
3. The radar peak transmitting power is 10 MW with pulse repetition frequency of 1000 Hz. The pulse width is 0.8 µs. Determine duty cycle, average power and maximum range of the radar.   **04**
4. A pulse radar transmits pulses whose pulse width is 1.2 µs. The reception rate of pulse is 0.8 kHz. Determine the minimum and maximum ranges of the radar.   **04**
5. Explain Radar Cross Section for the aircraft used in defence technologies   **04**

SECTION-B [10x4=40]

6. Explain the basic fundamental principle of Navigational RADAR. Draw its basic block diagram. Explain each sub-component. Derive the relationship for the range obtained at a particular frequency of operation. Also, modify the equation with the implementation of SNR and Noise figure in to the range equation. How could you conclude the equation for the obtained result?   **10**
7. Navigation radar operates at 2500 MHz with a peak pulse power of 500 kW. Its antenna has a diameter of 64 m and a noise figure of 20. Determine the maximum tracking range of the radar and the diameter of the antenna beacon, if radar bandwidth is 5 kHz. The beacon transmits a peak power of 50 W. Also fins the range of beacon if the noise figure of beacon is 1.1.   **10**
8. A radar system operates at f=10 GHz with a peak pulse power of 500 kW. Its minimum receivable signal power is 1 pW, the capture power of this antenna is 5 m^2 and radar cross-section of the target is 16 m^2. Find the maximum range of radar system.   **10**

9. A CW radar is illuminating at 8 GHz frequency towards the automobiles and a car is found to move towards the radar with a speed of 100km/hr. Find the Doppler shift and the frequency of received echo signal. Also find the frequency of the echo signal if the car moves away from the radar with the same speed. Describe what principle its operates, Also derive the system equation for target velocity measurement. **10**

SECTION-C [20X2=40]

10. Search radar operates with the following parameters. **20**
Frequency = 6 GHz, pulse width = 1.2 μs, Duty cycle = 10^{-3}, Radar cross-section = 2 m^2, Power gain of antenna = 400, maximum range = 60 km, Minimum detectable signal = 5 pW, Effective area = 1 m^2. Find a) Operating wavelength, b) Pulse repetition time, c) Pulse repetition frequency, d) Peak power, e) Average power, f) Unambiguous range, g) Range resolution.

11. Define the basic principle of Doppler's effect. Write down the various cases for the Electromagnetic/speech signal transmissions from the source to observer. Derive the relative velocity for the moving target under radial manner. Develop the algorithms for the same under the various categories. **20**
    OR
11. Write the short notes on **20**
    i)   LORAN
    ii)   DECCA
    iii)   OMEGA
    iv)   DGPS
    v)   TACAN

Roll No: ---------------------------

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SECTION-A [05x04=20]

1. Define the basic principle of RADAR and its operation based on its block diagram.   **04**
2. The PRF of pulse radar is 1 kHz and the echo reaches back to the radar receiver in 0.2ms after the pulse is transmitted. Find the target range and the maximum unambiguous of the radar.   **04**
3. The radar peak transmitting power is 10 MW with pulse repetition frequency of 1000 Hz. The pulse width is 0.8 μs. Determine duty cycle, average power and maximum range of the radar.   **04**
4. The noise figure of a radar receiver is 9 dB and if bandwidth is 2 MHz. find its minimum receivable signal.   **04**
5. A radar receiver has a bandwidth of 1.2 MHz and a noise figure of 5 dB. Determine the minimum receivable signal.   **04**

SECTION-B [10x04=40]

6. Deep space navigational radar operates at 3 GH with a peak pulse power of 20 MW. The diameter of the radar antenna is 50 m and radar cross-section is 1 m^2 .The receiver noise figure is 2.0. The bandwidth of receiver is 5 kHz. Find the maximum range of radar. **10**

7. Explain the basic fundamental principle of Navigational RADAR. Draw its basic block diagram. Explain each sub-component. Derive the relationship for the range obtained at a particular frequency of operation. Also, modify the equation with the implementation of SNR and Noise figure in to the range equation. How could you conclude the equation for the obtained result?   **10**
8. For a parabolic reflector of diameter of 5m, illumination efficiency, b=0.65. The frequency of operation is 9GHz. Find out its beam width, directivity and capture area. **10**

9. A parabolic reflector is operating at 6GHz has a radiation pattern with null-to-null beam width of 5^0. Find out the mouth diameter of paraboloid, HPBW and power gain. **10**

SECTION-C [20X2=40]

10. A pulse guided radar system has peak power of 5kW and uses two PRFs given by PRF1=10kHz and PRF2=20kHz. Find the required (a) duty cycle, (b) pea repetition intervals, (c) pulse width of each PRF to make constant average transmitted power of 1kW and (d) pulse energy. **20**

11. Define the basic principle of Doppler's effect. Write down the various cases for the Electromagnetic/speech signal transmissions from the source to observer. Derive the relative velocity for the moving target under radial manner. Develop the algorithms for the same under the various categories. **20**
    OR

11. Write short notes on the following **20**

    i)   DGPS
    ii)   FMS
    iii)   DME
    iv)   MDS
    v)   TACAN