Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2018

Programme Name: B.Tech ASE+AVE | **Semester : VII**
Course Name : RADAR Technology | **Time : 03 hrs**
Course Code : ELEG 401 | **Max. Marks : 100**
Nos. 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

S. No.		Marks	CO
Q 1	List out the various major losses in the radar waves operation including system losses. Elaborate in detail with certain examples.	4	CO4
Q 2	If the noise figure of a receiver is 2.5dB, what reduction (in dBs) occurs in the signal-to-noise ratio output compare to the signal-to-noise ratio at the input?	4	CO2
Q 3	Explain Radar cross section for the target	4	CO3
Q 4	Define the term process gain used in the antenna signal transmission and reception	4	CO4
Q 5	Dictate the terms, PW, PRT, PRF and Doppler's shift	4	CO1

SECTION B

Q 6	a) For a parabolic reflector of diameter of 5m, illumination efficiency is 0.65. The frequency of operation is 9GHz. Find out its beam width, directivity and capture area. b) A parabolic reflector operates at 5GHz. Its mouth diameter is 5m. It is required to measure far-field pattern of the paraboloid. Find out the minimum distance required between two antennas.	5+5	CO4
Q 7	Noise is the random phenomena; hence, the detection of the signals in the presence of noise is also a random phenomenon and should be described in probabilistic terms. The scale of the probability is from 0 to 1. With consideration of this, elaborate all three different types of PDFs with the time response graph and deduce the mathematical modelling for the same. Also, explain the significance of PDF in radar clutter estimation in the rough SNR data signature.	10	CO2
Q 8	A radar peak transmitting power is 10MW with pulse repletion frequency of 1khz. The pulse width is 0.8microsec. Determine duty cycle, average power and maximum range of the radar.	10	CO1

Q 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 ***OR*** 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.	**10**	**CO3**
	SECTION-C		
Q 10	A radar at a frequency of 1.35GHz has an antenna of width 35ft, a maximum unambiguous range of 220nmi, and antenna scan time of 10s. a) What is the number of echo pulses/scan received by the radar from point target? Use antenna HPBW as $12\lambda/D$ b) What is the integration loss and the integration improvement factor when the PDF is 0.9 and PFA id 10^{-4}	**20**	**CO4**
Q 11	Pulse radar operates at an average power of 300 W with a pulse width of 2.0 µs. Its PRF is 1.5 kHz and radar cross-section of the target is 3 m^2 at an operating wavelength 0.2 m. The effective area of the radar antenna is 20, the minimum detectable signal is 2.0 PW. Find (a) operating frequency (b) Radar peak power (c) Maximum range of radar ***OR*** How the mono-static and bi-static radar systems can be differentiated? Derive the radar range equation for the both cases. Implement the SNR in each case of the range equation and derive the novel algorithm for the same with the implementation of Gaussian noise and factor of bandwidth for the suitable operation. How the minimum detectable signals (MDS) can be obtained? Define MDS in detail.	**20** **20**	**CO1**

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SECTION A

S. No.		Marks	CO
Q 1	List of the ten RADAR system losses along with the environmental losses.	**4**	**CO4**
Q 2	Define the principle of CW radar used for the target velocity measurement.	**4**	**CO2**
Q 3	Explain the principle of Doppler's effect with schematic diagram	**4**	**CO3**
Q 4	Why PDFs are important for the signal to clutter detection.	**4**	**CO4**
Q 5	Find the required PRF to have a maximum range of radar 500km.	**4**	**CO1**
	SECTION B		
Q 6	a) If a radar has a velocity of 300m/s towards an aircraft, which is moving towards the radar at a velocity of 200m/s, then find the Doppler frequency measured by the radar if the radar is operating at a frequency of 10GHz. b) A parabolic reflector is required to have a power gain of 500 at a frequency of 4GHz. Determine mouth diameter and beam width of the antenna.	**5+5**	**CO4**
Q 7	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**	**CO2**
Q 8	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 ***OR*** 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.	**10**	**CO3**

Q 9	A radar peak transmitting power is 10MW with pulse repletion frequency of 1khz. The pulse width is 0.8microsec. Determine duty cycle, average power and maximum range of the radar.	**10**	**CO1**
	SECTION-C		
Q 10	A radar at a frequency of 1.35GHz has an antenna of width 35ft, a maximum unambiguous range of 220nmi, and antenna scan time of 10s. a) What is the number of echo pulses/scan received by the radar from point target? Use antenna HPBW as $12\lambda/D$ b) What is the integration loss and the integration improvement factor when the PDF is 0.9 and PFA id 10^{-4}	**20**	**CO4**
Q 11	A search radar operates with the following parameters, Frequency=6GHz, PW=1.2microsec, DC=10^{-3}, RCS=2.0m^2, Power gain of the antenna=400, Maximum range=60km, MDS=5picowatt, Effective area=1.0m^2. Find (a) Operating wavelength, (b) PRT & PRF, (c) Peak power, (d) Average power, (e) Unambiguous range, (g) Range resolution. ***OR*** Pulse radar operates at an average power of 300 W with a pulse width of 2.0 μs. Its PRF is 1.5 kHz and radar cross-section of the target is 3 m^2 at an operating wavelength 0.2 m. The effective area of the radar antenna is 20, the minimum detectable signal is 2.0 PW. Find (a) operating frequency (b) Radar peak power (c) Maximum range of radar	**20** **20**	**CO1**