UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

Course: RADAR SYSTEMS **Semester: VIII**
Program: B.Tech EE
Time: 03 hrs. **Max. Marks: 100**

Instructions: All Sections are compulsory. Attempt all questions from each section.

SECTION A

S. No.		Marks	CO
Q1	What is the difference between MTI & Pulse Doppler radar?	**4**	**CO3**
Q2	What is a Second-time-around echo? Derive the expression for maximum unambiguous range.	**4**	**CO1**
Q3	Determine the peak power and duty cycle of a radar whose average transmitter power is 100 W, pulse width of 0.5μs and pulse repetition frequency of 2000 Hz.	**4**	**CO2**
Q4	Calculate the average power when the peak power is 200kW, pulse width is 2 second and the rest time is 2000 seconds.	**4**	**CO1**
Q5	If the noise figure of a receiver is 2.5dB, what reduction occurs in the S/N at the output compared to the S/N at the input?	**4**	**CO2**

SECTION B

Q6	Find the pulse repetition frequency of a radar in order to achieve a maximum unambiguous range of 50 nmi and if the radar has a peak power of 600 kW, what is its average power with a pulse width of 1.8 μs.	**10**	**CO1**
Q7	Explain the need of integration of pulses in radar system? Derive the radar Range equation in terms of integration of pulses?	**10**	**CO2**
Q8	Explain in detail how FMCW radar is used for measurement of range. Explain the various measurement errors in FMCW radar. A CW radar (MTI) ia operating at a PRF of 1 KHz. Find the lowest blind speed, if it is operating at 2 cm wavelength.	**10**	**CO3**
Q9	How the target can track with phase comparision Method? Explain?	**10**	**CO4**

SECTION-C

Q 10	A monopulse radar is found to be tracking a target with angular accuracy of 0.5 mil at a particular range. (a) What is the accuracy in degrees? (b) Assuming the accuracy is solely determined by the receiver noise, what would be the angle accuracy at this range of a similar conical scan tracker (the same frequency, prf, beamwidth, power, noise figure, number of pulse processed and antenna effective area)? (c) If on the other hand the accuracy is at short range so that angle accuracy is solely determined by glint, what would be the accuracy of the conical scan tracker relative to the monopulse tracker?	**20**	**CO5**

Q11	A typical L band 2D air surveillance radar usually has its maximum elevation coverage extending to about 20-40 degree, depending upon the particular radar. If it is required to extend coverage of the radar to higher elevation angles, there are reasons why it might be better to employ a separate antenna at a different frequency to fill the hole above the radar.(a) What are some reasons why aa separate radar might be used rather than attempt to increase the elevation coverage of 2D antenna? (b) If the elevation hole extends from 30 degree elevation angle to the zenith at 90 degree, what type of scanning pattern might be used? (c) What frequency band might be used for this hole filler (and explain the reason for your selection)? (d) What type of antenna might be used for the hole filler radar?	**20**	**CO5**

Name: **Enrolment No:**	UPES

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SECTION A

S. No.		Marks	CO
Q1	Define radar wave forms, maximum unambiguous range and resolution?	**4**	**CO1**
Q2	How far apart in range (meters) must two equal-size targets be separated in order to be certain they are completely resolved by a pulse width of 1.5μs?	**4**	**CO1**
Q3	Explain the need of modulation in CW Radar for detecting Moving targets?	**4**	**CO2**
Q4	What does one have to do to obtain an electronically steered phased array with a large instantaneous signal bandwidth?	**4**	**CO5**
Q5	When the beam of a phased array antenna is electronically steered to an angle θ_0 from broadside, show that its beamwidth varies inversely as $\cos(\theta_0)$?	**4**	**CO2**

SECTION B

Q6	The moon as a radar target may be described as follows: average distance to the moon is 3.844x108m and radar cross section is 6.64x1011 m 2 and its radius is 1.738x106m. i) What is the round-trip time (seconds) of a radar pulse to the moon and back? ii) What should the PRF be in order to have no range ambiguities?	**10**	**CO1**
Q7	Explain in detail how FMCW radar is used for measurement of range. Explain the various measurement errors in FMCW radar.	**10**	**CO3**
Q8	Explain about Sequential Lobing technique with a neat diagram and describe its advantages and disadvantages. Explain the fluctuation effects on tracking system	**10**	**CO4**
Q9	What is the need of AGC circuit in tracking radar systems? Explain the working principle of AGC circuit?	**10**	**CO4**

SECTION-C

Q 10	A frequency scan array has an element spacing d=5cm, aperture dimension d=3m and a feed system with wrap up factor =16. As the beam is frequency scanned past the target , the echo will be frequency modulated with a bandwidth δfb. (a) If frequency f = 1.05f_0 points the beam to 30 degree, what is the spectral width of the	**20**	**CO5**

	echo signal due to the linear FM modulation induced on the echo? (b) If pulse compression processing is used on receiver to take advantage of the frequency modulation of the echo signal, what will be the compressed pulse width?		
Q11	(a) Why radars seldom operates at a frequency of 22GHZ or near 60GHz? (b) What is two way attenuation of a radar signal (in dB) in the clear atmosphere at a frequency of 5GHz when propagating 200nmi and back at an elevation of 0 degree? (c) What is the two way attenuation is increased to 5 degree? (d) Why are aircraft targets not likely to be detected at a long range at 0 degree elevation angle?	**20**	**CO5**