Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES
End Semester Examination, December 2024

Course: Microwave and Radar Engineering **Semester: 7**
Program: B.Tech Aerospace Engineering (Avionics) **Time : 03 hrs.**
Course Code: AVEG4012P **Max. Marks: 100**

Instructions:

1. Please read each question carefully and then proceed to answer it.
2. Answer all questions.
3. Use figures and diagrams wherever necessary.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	List 5 different types of RADAR systems and discuss an application for each type.	**4**	**CO1**
Q 2	What is the formula and unit of solid angle of a surveillance radar? Also, give an expression for the SNR relating range and search volume of a surveillance radar.	**4**	**CO2**
Q 3	A certain airborne pulsed radar has peak power of 10KW and uses two PRFs 10KHz and 30KHz. What are the required pulse widths for each PRF so that the average transmitted power is constant and is equal to 1500W? Compute the pulse energy in each case.	**4**	**CO1**
Q 4	Compare a Moving Target Indicator radar with a Continuous Wave radar with respect to its purpose and operation?	**4**	**CO3**
Q 5	Write an equation for the SNR of a receiver antenna and succinctly, explain each parameter of the equation. Also, draw a plot illustrating the relationship between SNR and range for 3 different values of RCS = 10 dBsm, -20 dBsm and 10 dBsm.	**4**	**CO1**

SECTION B (4Qx10M= 40 Marks)			
Q 6	a) List down and summarise any 5 factors that affects the operation of radar system in real time scenario? b) Derive an equation for the received power of a Bistatic Radar with necessary figure.	**5+5**	**CO4 & CO1**
Q 7	Two objects are present on the same line of sight, and the continuous wave (CW) radar installed on your vehicle is detecting four objects instead of two. Explain why the radar system is detecting four objects instead of two, and illustrate with suitable diagrams how one can overcome this false detection using the same CW radar.	**10**	**CO3**
Q 8	a) Discuss the purpose of a delay line canceller in a moving target indicator? b) An MTI radar operates at a PRF of 1.5KHz. Its operating wavelength is 3 cm. Determine the lowest blind speed.	**5+5**	**CO3**
Q 9	Compute the single pulse SNR for a high PRF radar with the following parameters: peak power Pt = 100KW, antenna gain is 20 dB, operating frequency is 6.6 GHz, losses = 8dB, noise figure = 4dB, dwell interval is 2.5 sec, duty factor is 0.25. The range of interest is 65 Km. Assume target RCS of 0.02 m^2. Boltzmann's constant = 1.38×10^{-23} Joule/degree kelvin; Absolute temperature = 290K. Hint: Use Logarithm method to solve the problem. Don't use the general substitution method. Or Derive an expression for range and radial velocity of a target using linear frequency modulated continuous wave radar, when the target is (a) stationary and (b) moving.	**10**	**CO2** **Or** **CO2**

SECTION-C (2Qx20M=40 Marks)			
Q 10	a) Compute the power aperture product for an X-band radar with the following parameters: signal-to-noise ratio = 15dB; losses = 8dB; search volume is 2 deg; scan time is 2.5 sec; noise figure is 5dB. Assume a -10 dBsm target cross section, and range is 250 Km. Also, compute the peak transmitted power corresponding to 30% duty factor, if the antenna gain is 45dB. Assume a circular aperture. Use wavelength as 0.03m; **Hint:** Use Logarithm method to solve the problem. Don't use the general substitution method b) Describe how doppler shift is estimated mathematically with help of suitable diagrams and waveforms? Please don't write an expression for frequency shift, rather try to explain how frequency shift is computed from the transmitted and received signals. c) Explain with appropriate diagrams the concept of range resolutions and range ambiguity? Also, give a formula for each, if any.	**10+5+5**	**CO2 & CO1**
Q 11	Discuss the purpose of a Kalman Filter in radar signal processing/navigation? Write down the different matrices involved in the filtering algorithm. Also, elucidate the three famous steps involved in the algorithm. Or a) The transmitted and received frequency of a monostatic radar is 200Hz and 220 Hz, respectively. At another instance, the transmitted and received frequency of the same monostatic radar is 220Hz and 200 Hz, respectively. The beat frequency in both cases is 20 Hz. Explain in detail how this problem is circumvented to estimate the velocity of a moving object. b) Derive an expression for Doppler frequency with suitable diagrams of the transmitted and received pulses with appropriate notations.	**20** **or** **10 + 10**	**CO4** **or** **CO4**