Name: **Enrolment No:**	

UPES
End Semester Examination, May 2025

Course: Microwave and Radar Engineering **Semester: 6**
Program: B.Tech Aerospace Engineering (Avionics) **Time : 03 hrs.**
Course Code: AVEG3003P **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	Illustrate with suitable diagrams the application of auto-correlation in radar signal processing.	**4**	**CO1**
Q 2	Discuss how velocity and acceleration of a moving object are estimated with an example calculation.	**4**	**CO1**
Q 3	If a pulse radar operating with a peak power of 1.5MW has following parameters: pulse width is 1.6 μs and pulse repetition is 1ms. Find (a) Pulse repetition frequency, (b) average power, (c) duty cycle and (d) maximum unambiguous range.	**4**	**CO1**
Q 4	Derive 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 = 0 dBsm, -10 dBsm and -20 dBsm.	**4**	**CO2**
Q 5	Explain with appropriate diagrams the concept of range resolutions and range ambiguity? Also, give a formula for each, if any.	**4**	**CO1**

SECTION B (4Qx10M= 40 Marks)			
Q 6	a) How can one obtain a tangent wave? Write an equation for it and use the equation to plot the wave. b) Why there is a difference in the polarization direction of electromagnetic waves?	**5+5**	**CO3**
Q 7	a) Derive an equation for the received power of a monostatic radar with necessary figure. b) An MTI radar operates at a PRF of 2.5KHz. Its operating wavelength is 3 cm. Determine the lowest blind speed.	**5+5**	**CO2**
Q 8	a) A certain airborne pulsed radar has peak power of 12KW and uses two PRFs 12.5KHz and 28.9KHz. What are the required pulse widths for each PRF so that the average transmitted power is constant and is equal to 1900W? Compute the pulse energy in each case. b) 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.	**5+5**	**CO3**
Q 9	Imagine you have an audio signal that contains both low and high-frequency components, and you pass it through a low-pass filter to remove the high-frequency noise. (a) Explain in intuitive terms what the -3 dB point represents in this filter. (b) Derive the transfer function for a low-pass filter. Or Assume a certain C-band radar with the following parameters: Peak power is 1.5 MW, operating frequency is 5.6 GHz, antenna gain is 45dB, effective temperature is 290K, pulse width is 0.2 microsecond. The radar's minimum received signal threshold is 20dB. Assume target cross section of $0.1m^2$. Compute the maximum range in ***Km***. Use Logarithms method to solve the problem. Don't use the general substitution method.	**10**	**CO2**
SECTION-C **(2Qx20M=40 Marks)**			

Q 10	Consider a C-band radar system with the following specifications: Peak Power: 1.5 MW; Operating Frequency: 6.6 GHz; Antenna Gain: 45 dB; Effective Noise Temperature: 290 K; Pulse Width: 0.3 micro sec; maximum range: 86.2 km; noise figure: 3dB and Target Radar Cross-Section: 0.1 m^2. Using the appropriate radar equation, compute the $(SNR)_{out}$ in dB. Boltzmann's constant = 1.38×10^{-23} Joule/degree kelvin; Absolute temperature = 290K. Use Logarithm method to solve the problem.	**20**	**CO4**
Q 11	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. **Or** Derive an expression for Doppler frequency with suitable diagrams of the transmitted and received pulses with appropriate notations.	**20**	**CO4**