Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2019

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) : 03
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	Discuss the antenna impedance of an antenna used for the transmission and reception.	**4**	**CO4**
Q 2	On what principle, the measurement of the velocity of target carried out. Discuss the principle in detail.	**4**	**CO2**
Q 3	What is the fundamental principle of Moving Target Indicator (MTI)?	**4**	**CO3**
Q 4	Explain the antenna gain and efficiency.	**4**	**CO4**
Q 5	Dictate the term Chaff, Clutter, Casssegrain feed and radar displays.	**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	If the power transmitted from a transmitter is 10kW and gains of transmitting and receiving antennas are 30dB and 20dB respectively then calculate the maximum power received at a distance of 10km over free space for 2GHz transmission frequency.	**10**	**CO2**
Q 8	a) A parabolic reflector has radiation characteristics whose half power beam width is 6^0. Find out its null-to-null beam width and power gain. b) A parabolic reflector is required to produce a beam width between the first nulls equal to 20 at an operating frequency of 4GHz. Find out the mouth diameter and power gain.	**5+5**	**CO4**

Q 9	Discuss 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. **OR** A CW radar is illuminating at 10 GHz frequency towards the automobiles and a car is found to move towards the radar with a speed of 200km/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**	**CO3**

SECTION-C

Q 10	The radar parameters for the bistatic radar system is as shown in Table 1. The range parameters are defined in Table 2. Calculate SNR for the RADAR receiver.	**20**	**CO1**

Table 1 – Radar Parameters

RADAR PARAMETER	VALUE
Peak Transmit Power @ Power Tube, P_T	1 Mw
Transmit Losses, L_t	2 dB
Pulse Width, τ_p	0.4 µs
Antenna Gain, G_T, G_R	38 dB
Operating Frequency, f_c	8 GHz
Receive Losses, L_R	3 dB
Noise Figure F_n	8 dB
Other Losses, L_{other}	2 dB

Table 2 – Radar Range Equation Parameters

RADAR RANGE EQUATION PARAMETER	VALUE (MKS)	VALUE (dB)
P_T	10^6 w	60 dBw
G_T	6309.6 w/w	38 dB
G_R	6309.6 w/w	38 dB
$\lambda = c/f_c$	0.0375 m	-14.26 dB(m)
σ	3.98 m^2	6 dBsm
R	60×10^3 m	47.78 dB(m)
kT_0	4×10^{-21} w-s	-204 dB(w-s)

$B = 1/\tau_p$	2.5×10^6 Hz	64 dB(Hz)
F_n	6.31 w/w	8 dB
$L = L_t L_r L_{other}$	5.01 w/w	7 dB

Q 11	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. **OR** Develop the range equation for the microwave operation of RADAR. Also, develop the relation for the range in terms of the noise figure implementation.	**20**	**CO2**