Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2018

Programme Name: M. Tech ASE+UAV **Semester : III**
Course Name : Guidance and Navigation **Time : 03 hrs**
Course Code : AVEG 8003 **Max. Marks : 100**
Nos. of page(s) :

Instructions: Make use of *sketches/plots* to elaborate your answer. Brief and to the point answers are expected.
The Question paper has three sections: Section A, B and C, Section B and C having internal choices.

SECTION A

S. No.	Questions	Marks	CO
Q 1	What is the operating frequency range for VHF Omni directional finder and draw the block diagram.	**4**	**CO1**
Q 2	Why is it necessary for the Gyroscope assembly of a directional gyro to be caged when setting is heading?	**4**	**CO2**
Q 3	Find the received power signal of a GPS receiver located at a distance of 2X10-7m. The satellite effective radiated power is 26.8 dBW.	**4**	**CO3**
Q 4	Explain about the Homing Guidance	**4**	**CO4**
Q 5	Write short note on modern proportional Guidance Laws	**4**	**CO5**

SECTION B

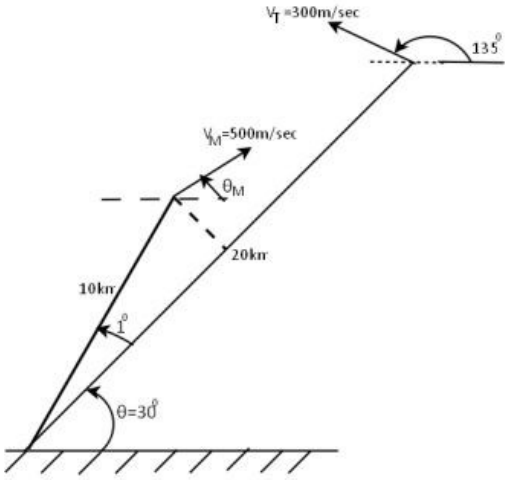
Q 6	Design the ILS? An aircraft is following the ILS glide path of 3° at an airfield where the outer marker is 4.2 nm from the ILS touchdown point. The aircraft approach speed is 130 kt. Find the height of the aircraft at the outer marker.	**4**	**CO3**
Q7 1.	Consider the direction cosine matrix, C = [Cij],, between two sets of right hand orthogonal unit vectors $\{a_1, a_2, a_3\}$ and $\{b_1, b_2, b_3\}$, defined as $\begin{bmatrix} \vec{b}_1 \\ \vec{b}_2 \\ \vec{b}_3 \end{bmatrix} = \begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{bmatrix} \begin{bmatrix} \vec{a}_1 \\ \vec{a}_2 \\ \vec{a}_3 \end{bmatrix}$ Show that the direction cosine matrix C is an orthonormal matrix The rotor of a turbojet engine has a mass 200 kg and a radius of gyration 25 cm. The engine rotates at a speed of 10,000 rpm in the clockwise direction if viewed from the	**10**	**CO2**

Q8	front of the aero plane. The plane, while flying at 1000 km/hr. turns with a radius of 2 km to the right. Compute the gyroscopic moment the rotor exerts on the plane structure. Also, determine whether the nose of the plane tends to rise or fall when the plane turns.	**10**	**CO1**

Magnetic Heading	Compass Deviation	Magnetic Heading	Compass Deviation
000^0	$+3^0$	270^0	2^0
050^0	$+4^0$	225^0	-2^0
080^0	$+2^0$	180^0	-1^0
040^0	$+3^0$	315^0	0^0

Q 9	A flight is made from VOR A (51^0 N, 01^0 W), local variation 8^0 W to VOR B (51^0 N, 06^0 W), local variations 9^0 W. same radial is maintained throughout the flight. If drift is 7 Starboard and aircraft flying great circle path, what is the heading (M) on departure? (Or) Design the following aircraft Interrogator and Transponder as per the details given below, a) Intermediate frequency b) Echo Signal c) Ranging circuit for DME	**(05+05 =10)**	**CO3**
	SECTION-C		
Q 10	a) Given the following information find the value of deviation coefficients A, B, C aircraft magnetism b) Why is it necessary for the Gyroscope assembly of a directional gyro to be caged when setting is heading?	**20**	**CO4**
	Consider the missile target engagement shown below. Answer the following questions:	**20**	**CO5**

Q 11



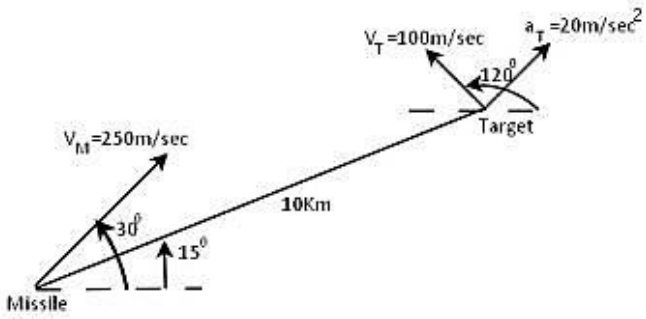
a) What should be the angle θ_M in order that the condition for LOS guidance is met?
b) Suppose the missile is guided by the pure pursuit guidance law then what should be θ_M in order to satisfy the condition of velocity pursuit and of attitude pursuit? The angle of attack is 2 degrees and the velocity vector lags the missile longitudinal axis.
c) Answer (b) when the missile is guided by a deviated pursuit guidance law with the angel of deviation=2.5 degrees.

(Or)

Consider the missile-target engagement geometry given below
At some instant in time t. Answer the following questions:

(a) What is the commanded latex if the missile uses (i) PN with N=4 (ii) APN with N=3 (iii) MGS with the current achieved latex same as the commanded latex in (ii) and the time delay t=0.1 sec?

(b) What is the estimated time-to-go? Is the actual time-to-go for the three guidance laws less, more or the same as the estimated value? Assume that the target employs a constant measure level, i.e., constant a_T throughout the engagement.



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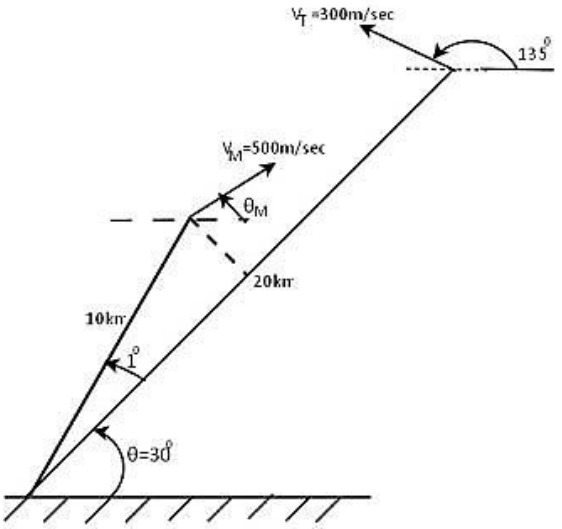
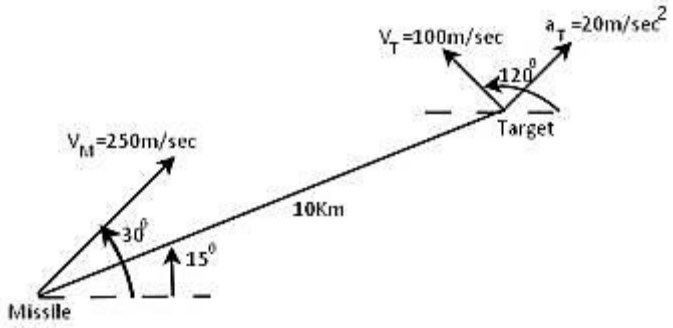
SECTION A

S. No.	Questions	Marks	CO
Q 1	What are the types of secondary radar system and list the elements of such a system.	**4**	**CO1**
Q 2	Define : Coriolis effects	**4**	**CO2**
Q 3	Find the free space loss factor on a GPS satellite L1 C/A code signal at a distance of 2X10-7m	**4**	**CO3**
Q 4	Discuss about the Pursuit Guidance Law	**4**	**CO4**
Q 5	Write some importance of Modern Guidance Maneuvering Targets	**4**	**CO5**

SECTION B

Q 6	An aircraft has to fly from A to D and C, details are as follows: Leg Distance W/C A to B 345 nm +35 B to C 320 nm +15 C to D 440 nm - 30 TAS 4 engines 350 kt TAS 3 engines 300 kt Fuel flow 4 engines 5,200 kg/hr Fuel flow 3 engines 4,300 kg/hr fuel on board at take off 30,000 kg fuel required in the event of return to 'A' 4,000 kg Find out the distance from 'A' to the critical point between A to D, assuming that an engine fails at the critical point	**10**	**CO4**

2. Q7	Consider the direction cosine matrix, C = [Cij],, between two sets of right hand orthogonal unit vectors $\{a_1, a_2, a_3\}$ and $\{b_1, b_2, b_3\}$, defined as $$\begin{bmatrix} \vec{b}_1 \\ \vec{b}_2 \\ \vec{b}_3 \end{bmatrix} = \begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{bmatrix} \begin{bmatrix} \vec{a}_1 \\ \vec{a}_2 \\ \vec{a}_3 \end{bmatrix}$$ Show that the direction cosine matrix C is an orthonormal matrix	**10**	**CO2**
Q8	Assuming an aircraft is flying in the southern hemisphere, What errors compass reading will be introduce when a) The Aircraft accelerates on an easterly heading b) The aircraft turns from southerly heading towards East c) Acceleration Error and northerly turning error	**10**	**CO1**
Q 9	A co-located VOR/DME is being used to track on airway inbound on the 160^0 radial, at 60 nm DME range, the VOR indicates 336^0 on the OBS and FROM/TO reads 'TO', Find the aircraft position. Design the Instrumentation parts of the VOR Receiver in details. a) Low pass Filter b) Discriminator c) Phase Shifting and adding Network d) Resolver e) Bridge phase Detector	**(05=05 =10)**	**CO3**
	SECTION-C		
Q 10	a) The operational details of an aircraft are, maximum takeoff weight 72,000 kg, maximum landing weight 63,000 kg and maximum zero fuel weight 60,000 kg, burn off fuel 6.5 tons, reserve fuel 3.5 tons, operational weight of aircraft 42,000 kg. Calculate the maximum payload that can be carried for this flight b) Describe the construction and operation of a fiber optic gyroscope processes under the influence of an applied torque.	**(10+10 =20)**	**CO3** **CO1**

Q 11	Consider the missile target engagement shown below. Answer the following questions:  a) What should be the angle θ_M in order that the condition for LOS guidance is met? b) Suppose the missile is guided by the pure pursuit guidance law then what should be θ_M in order to satisfy the condition of velocity pursuit and of attitude pursuit? The angle of attack is 2 degrees and the velocity vector lags the missile longitudinal axis. c) Answer (b) when the missile is guided by a deviated pursuit guidance law with the angel of deviation=2.5 degrees. (Or) Consider the missile-target engagement geometry given below at some instant in time t. Answer the following questions: (c) What is the commanded latex if the missile uses (i) PN with N=4 (ii) APN with N=3 (iii) MGS with the current achieved latex same as the commanded latex in (ii) and the time delay t=0.1 sec? (d) What is the estimated time-to-go? Is the actual time-to-go for the three guidance laws less, more or the same as the estimated value? Assume that the target employs a constant measure level, i.e., constant a_T throughout the engagement.  	**20**	**CO5**