**Name:**

**Enrolment No:**

**UPES**
**End Semester Examination, December 2024**

**Course: Navigation, Guidance and Control**
**Semester: VII**
**Program: B.Tech Mechatronics** **Time : 03 hrs.**
**Course Code: MECH4041** **Max. Marks: 100**
**Instructions: Provide relevant diagrams if applicable.**

**SECTION A**
**(5Qx4M=20Marks)**

| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | List the challenges in Mobile Robot localization | **4** | **CO1** |
| Q 2 | Explain importance of Schuler principle in IMU Navigation | **4** | **CO2** |
| Q 3 | Why is the gimbal lock phenomenon important? | **4** | **CO2** |
| Q 4 | List different types of missiles with examples. | **4** | **CO1** |
| Q 5 | What are different categories of Homing guidance Schemes? | **4** | **CO1** |
| | **SECTION B**<br>**(4Qx10M= 40 Marks)** | | |
| Q 6 | Differentiate between localization based navigation versus programmed solutions based Navigation for Robots. | **10** | **CO1** |
| Q 8 | Differentiate between GPS and GLONASS Satellite navigation Systems. How many Satellites and Orbits are used in each of them. | **10** | **CO2** |
| Q 9 | Derive Proportional Navigation Missile Guidance laws giving latex acceleration along with neat sketch for each case.<br>Or<br>What is the significance of *Delta guidance* scheme for Boosted launch Vehicles. Derive the relevant guidance *equation* for *Delta guidance* scheme along with the help of neat sketch. | **10** | **CO3** |

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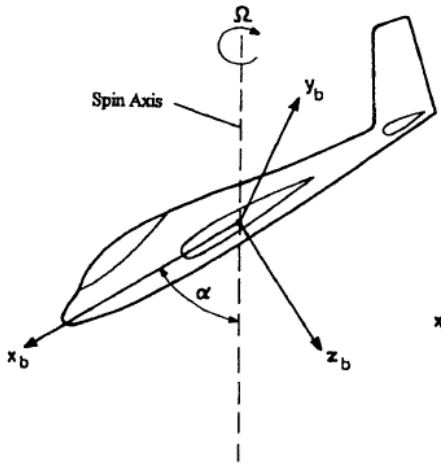
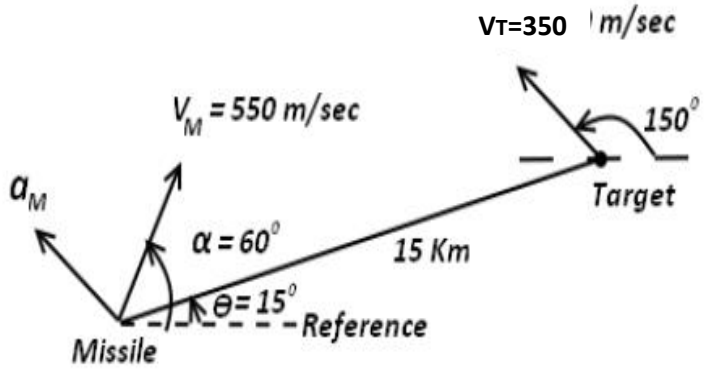
|---|---|---|---|
| Q10 | Find and compare the component of angular velocity along x-,y-,z- body-fixed axis as shown in below figure with 1) $\alpha$=30 deg, 2) $\alpha$=45 deg, and $\alpha$=60 deg. Assume that the angular velocity $\Omega$ about the velocity vector in each case is 25 deg/s.<br>  <br> | **10** | **CO4** |
| **SECTION-C<br>(2Qx20M=40 Marks)** | | | |
| Q 11 | A) What do you mean by *Velocity-to-be-gained* (Vg) term in *Q-guidance* scheme.<br>B) Derive following equation which provides a scheme for *Q guidance* algorithm<br>$V_g = Q \mathrm{x} V_g = -a_T$ | **20** | **CO3** |
| Q 12 | What is the object of Delta Guidance. Derive the relations for Delta Guidance equations for required velocity components. If the Launch Vehicle normal burnout parameters are assumed to be<br>$X_b$=25,000 m $V_b$=40000 m $t_b$=60 sec<br>$X_T$=25,000 m $V_T$=40000 m $t_T$=300 sec<br>$V_{Rx0}$=1000 m/s<br>$V_{ry0}$-1300 m/s<br>Estimate the Delta guidance equations for the required velocity in this particular case to engages target<br>OR<br>B) Consider the missile-target engagement geometry shown below. Find the following<br>*a)* Closing velocity, *b)* $\dot{R}$, *c)* LOS rate, *d)* estimated time-to-go,<br>*e)* turn rate and radius of turn of the missile if a latex ($n_c$) of 28 m/sec is applied by the missile in a direction normal to the missile velocity,<br>*f)* a angle $\alpha$ so that the missile is on a collision course with the target. (Note: missile is on a collision course with the target if the LOS rate is zero), | **20** | **CO4** |

| | | | |
|---|---|---|---|
| | *g)* the heading error (Note: Heading error is the difference between the actual missile angle (w.r.t reference frame) and the missile angle required for collision course.)<br>  <br> | | |