23AEOE411

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
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Model Question Paper

Seventh Semester BE Degree Examination

Fundamentals of Space Vehicle Systems

Time: 3 Hours(180 Minutes) **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

		Module -1	M	L	C
Q1	a.	Explain the concept of spacecraft environment and its importance in spacecraft design.	08	L2	CO1
	b.	Describe the characteristics of LEO, MEO and GEO.	06	L2	CO1
	c.	Explain the role of orbit selection in mission planning.	06	L2	CO1
		OR			
Q2	a.	Describe the differences between Earth-orbit missions and deep space missions.	08	L2	CO1
	b.	Explain the structure of Earth's atmosphere relevant to spacecraft flight.	06	L2	CO1
	c.	Describe the characteristics of the space environment beyond Earth's atmosphere.	06	L2	CO1
		Module- 2			
Q3	a.	Explain the basic principle of rocket propulsion with suitable sketch.	07	L2	CO2
	b.	Describe the different methods used for rocket engine cooling.	07	L2	CO2
	c.	A rocket engine ejects exhaust gases at a velocity of 2800 m/s with a propellant mass flow rate of 12 kg/s. The exit pressure is 90 kPa, the ambient pressure is 75 kPa, and the nozzle exit area is 0.5 m^2. Determine the total thrust produced by the rocket engine.	06	L3	CO3
		OR			
Q4	a.	Describe the main components of a rocket propulsion system with suitable sketch.	07	L2	CO2
	b.	Explain the purpose of nozzle expansion in rocket engines.	07	L2	CO2
	c.	A space agency is designing a launch vehicle for a small satellite mission. Two propulsion options are available: **Parameter** | **Solid Rocket Motor** | **Liquid Rocket Engine** Specific Impulse | 260 s | 320 s System Complexity | Low | High Thrust Control | Not possible | Possible Determine the effective exhaust velocity for both systems and recommend which propulsion system is more suitable for a satellite launch and justify your answer.	06	L3	CO3
		Module – 3			
Q5	a.	Describe the role of primary and secondary structures in spacecraft.	07	L2	CO2
	b.	Explain the thermal challenges faced by spacecraft in orbit.	07	L2	CO2
	c.	A spacecraft support strut experiences a maximum load of 12 kN. The material used has a yield strength of 300 MPa and the cross-sectional area is 40 mm^2. Determine the stress developed in the strut and also calculate the factor of safety.	06	L3	CO4

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<tr><td colspan="6">OR</td></tr>
<tr><td rowspan="3">Q6</td><td>a.</td><td>Describe the role of active thermal control systems in spacecraft temperature regulation.</td><td>07</td><td>L2</td><td>CO2</td></tr>
<tr><td>b.</td><td>Explain the three modes of heat transfer relevant to spacecraft.</td><td>07</td><td>L2</td><td>CO2</td></tr>
<tr><td>c.</td><td>Two materials are considered for a spacecraft panel:
<table>
<tr><th>Material</th><th>Yield Strength</th><th>Density</th></tr>
<tr><td>Aluminum Alloy</td><td>300 MPa</td><td>2700 kg/m³</td></tr>
<tr><td>Titanium Alloy</td><td>900 MPa</td><td>4500 kg/m³</td></tr>
</table>
Determine the strength-to-weight ratio for each material and also identify the more suitable material for lightweight spacecraft structures.</td><td>06</td><td>L3</td><td>CO4</td></tr>
<tr><td colspan="6">Module – 4</td></tr>
<tr><td rowspan="3">Q7</td><td>a.</td><td>Describe the importance of attitude determination for spacecraft missions.</td><td>08</td><td>L2</td><td>CO5</td></tr>
<tr><td>b.</td><td>Explain the factors influencing aerodynamic disturbance torque.</td><td>06</td><td>L2</td><td>CO5</td></tr>
<tr><td>c.</td><td>Describe the combined impact of various disturbance torques on spacecraft stability.</td><td>06</td><td>L2</td><td>CO5</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td rowspan="3">Q8</td><td>a.</td><td>Describe the causes of attitude jitter during spacecraft operation.</td><td>08</td><td>L2</td><td>CO5</td></tr>
<tr><td>b.</td><td>Explain the sources of magnetic disturbances in spacecraft.</td><td>06</td><td>L2</td><td>CO5</td></tr>
<tr><td>c.</td><td>Describe the reference frames used to define spacecraft attitude.</td><td>06</td><td>L2</td><td>CO5</td></tr>
<tr><td colspan="6">Module – 5</td></tr>
<tr><td rowspan="3">Q9</td><td>a.</td><td>Explain the working principle of momentum wheels in spacecraft attitude control.</td><td>07</td><td>L2</td><td>CO5</td></tr>
<tr><td>b.</td><td>Explain the concept of gravity-gradient stabilization.</td><td>07</td><td>L2</td><td>CO5</td></tr>
<tr><td>c.</td><td>Describe the advantages and limitations of passive attitude control systems.</td><td>06</td><td>L2</td><td>CO5</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td rowspan="3">Q10</td><td>a.</td><td>Explain the role of sensors in spacecraft attitude determination.</td><td>07</td><td>L2</td><td>CO5</td></tr>
<tr><td>b.</td><td>Describe how aerodynamic forces can be used for spacecraft stabilization.</td><td>07</td><td>L2</td><td>CO5</td></tr>
<tr><td>c.</td><td>Explain the principle of spin stabilization in spacecraft.</td><td>06</td><td>L2</td><td>CO5</td></tr>
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