

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

**CLASS: MTECH
BRANCH: AEROSPACE ENGINEERING**

**SEMESTER: I
SESSION: MO/2025**

SUBJECT: SR503 SPACE ENGINEERING AND SPACE DYNAMICS

TIME: 3 Hours

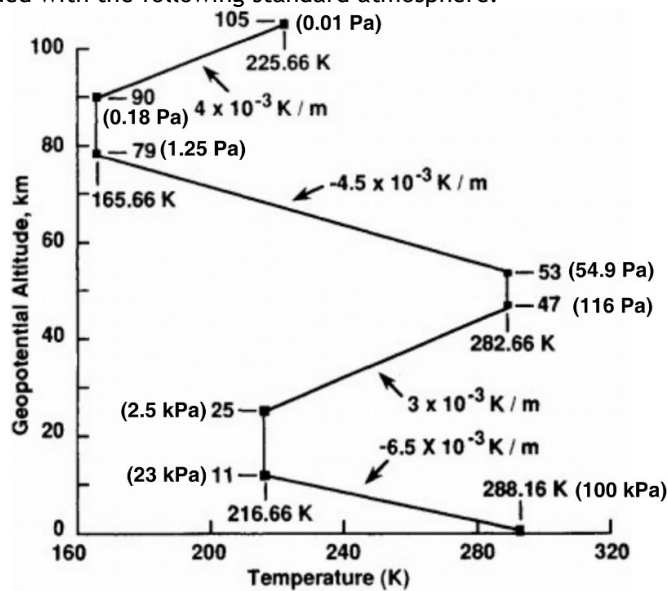
FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

CO BL

Q.1 You are provided with the following standard atmosphere.



- | | | | | |
|--|------|--|-----|---|
| Q.1(a) Obtain a mathematical model of atmospheric density. | [5] | | 4 | 4 |
| Q.1(b) If temperature fluctuates by ± 2 K, estimate probable density band at the edge of troposphere using the model of 1(a). | [5] | | 4 | 4 |
| | | | | |
| Q.2 Answer the following questions | | | | |
| Q.2(a) Derive the working equation of Goddard problem. | [5] | | 3 | 3 |
| Q.2(b) Provide an algorithm to obtain a mathematical model of rocket motion in straight-line inclined trajectory in free-space in appropriate reference frame. | [5] | | 2,3 | 4 |
| | | | | |
| Q.3 Answer the following questions | | | | |
| Q.3(a) Prove that Δv is given without displacement in ideal impulsive shot. ($v \equiv$ velocity) | [5] | | 1 | 4 |
| Q.3(b) Draw sketches showing how one heliocentric elliptic trajectory can support four interplanetary missions / probable launch dates. | [5] | | 3,4 | 3 |
| | | | | |
| Q.4 Assuming that a spacecraft sensor yields sinusoidal ($\theta - t$) signals, obtain a randomized sequence of instantaneous θ over a cycle of one randomized period. Use the signals to explain jitter and attitude error. ($\theta \equiv$ attitude; $t \equiv$ time) | [10] | | 3 | 3 |
| | | | | |
| Q.5 In a hurriedly organized space mission by Eureka-Dubb Aerospace, an ordinary UPS will be installed as a power backup for a LEO satellite of 8 hr long eclipse. As a specialist engineer, you are instructed to obtain a figure of merit for the performance of UPS using these specifications: battery capacity = 7 Ahr, battery voltage = 12 V, charging time = 8 hr, rated power = 0.4 kW, battery life = 3 years. The satellite needs 900 W during the eclipse. | [10] | | 4,5 | 2 |