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

CLASS: M.TECH **SEMESTER : I**
BRANCH: SER **SESSION : MO/18**

SUBJECT: SR503 SPACE ENGINEERING AND SPACE DYNAMICS

TIME: 3 HRS. **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.

Q.1(a) Discuss in brief about the space and upper atmosphere environment. [5]

Q.1(b) Write in detail about the advanced mission concepts. [5]

Q.2(a) Describe briefly about the factors causing dispersion of rockets in ground launch. [5]

Q.2(b) A two-stage planetary exploration vehicle is launched from a high-orbit satellite into a gravity-free vacuum trajectory. The following data are given: [5]

Flight and velocity increment in gravity-free vacuum	6200 m/s
Effective exhaust velocity, c (all stages)	3050 m/s
Initial launch vehicle mass	4500 kg
Propellant mass fraction (each stage)	0.88
Structural mass fraction (each stage)	0.12

Determine the payload for cases: (i) when the two stage masses are equal, and (ii) when the mass ratios of the two stages are equal.

Q.3(a) A satellite is launched into an elliptical orbit of Earth with an initial perigee altitude of 490 km and an apogee altitude of 1790 km. What are the velocities at these points? Given values for $K=GM=3.99\times10^{14}$ m^3/s^2, Earth's mean radius, $R_0=6.371\times10^6$ m. [5]

Q.3(b) Derive and analyze the condition for impulsive shot. [5]

Q.4(a) What is the basic purpose behind the analysis of spacecraft re-entry? Define a coordinate system for analyzing the entry of a spacecraft into the Earth's atmosphere and obtain the balance equations. [5]

Q.4(b) With the help of simplifying assumptions, obtain their dimensionless forms. [5]

Q.5(a) Identify design drivers for a spacecraft intended for exploration of outer planets. Present a conceptual design based on the identified design drivers. [10]

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