Sanjay Ghodawat University, Kolhapur

2020-21

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EXM/P/09/00

Year and Program: Final Year B.Tech.	**School of Technology**	**Department: Aeronatics**
Course Code: AET405	**Course Title: Space Flight Dynamics**	**Semester : VII**
Day : Saturday **Date: 19.12.2020**	**End Semester Examination**	**Time:2 Hrs.** **Max Marks:50**

Instructions: 1) All questions are compulsory.
2) Assume appropriate values wherever necessary

Q.1	**Answer the following (any two)**–	**Marks**	**Bloom's Level**	**CO**
a)	Examine your location on the Earth and sketch the celestial sphere based on these conditions and mark NCP, SCP, celestial equator, zenith, and horizon if from your location: i. Polaris is at the horizon ii. South celestial pole is at the nadir iii. Zenith is at 66.5^0 measured clockwise from the north pole.	8	L_4	CO1
b) i.	An earth satellite is observed to have a height of perigee of 0.03 DU and height of apogee of 0.174 DU. Find the period of the orbit.	4	L_3	CO2
ii.	For a certain satellite, the observed semi-major axis is 1.43 DU. The orbit eccentricity is 0.2. Calculate: i. Perigee and apogee distances from center of Earth ii. Specific mechanical energy iii. semi-latus rectum iv. Time period of orbit	4	L_3	CO2
c)	Analyze using conic section equations each of the trajectories as either circular, elliptical, hyperbolic, or parabolic: i. r = 3 DU, v = 1.5 DU/TU ii. Specific mechanical energy = -1/3 DU^2/TU^2, p = 1.5 DU iii. $r_{perigee}$ = 1.5 DU, p = 3 DU iv. r = (J + 0.2K) DU, v = (0.9I + 0.123K) DU	8	L_4	CO2

Q.2 Answer the following (any two) –

a)	You are an astronaut in a spaceship which is in circular earth orbit travelling at a velocity of 2 DU/TU. There is a service module in another circular orbit with a velocity of 0.3 DU/TU. Perform the analysis to determine minimum ΔV (in km/s)needed to transfer your spacecraft from its current orbitto the service module's orbit.	8	L_5	CO3
b)	Determine how much propellant weight would be required for the Space Shuttle to make a 3-degreechange under following conditions: i. Space shuttle altitude = 275 km, space shuttle weight = 99750 kg, I_{sp} = 320 s ii. Space shuttle altitude = 500 km, space shuttle weight = 150,000 kg, I_{sp} = 400 s	8	L_3	CO3
c)	You are a part of ground control engineering team who needs to plan a rocket launch to send payload to the International Space Station. To do that you need to investigate various orbital deviations that must be considered to successfully carry out this mission. Explain the deviations that you need to consider. Which one will have the most significant effect on the rocket in space and why?	8	L_5	CO4

Q.3 Answer the following (any two) –

a)	A lunar probe is sent to the moon on a trajectory with r_O = 2 DU, v_O = 1.628 DU/TU, $\lambda_1 = 37^0$ and ϕ = 0 deg. Calculate: i. Specific mechanical energy and specific angular momentum ii. v_1 if R_S = 67,000 km and D = 384,400 km iii. p, a, e iv. E_1 and E_O. Does this trajectory work?	9	L_3	CO5
b)	Interplanetary missions have always been mankind's dream. To fulfill this dream, space engineers and scientists need to consider and overcome many challenges. i. Discuss these challenges in detail. ii. What could be done to overcome them according to your expertise. iii. What specific challenges will we face in interplanetary mission to Jupiter?	9	L_4	CO5

c)	ISRO is planning an unmanned mission from Earth to a newly discover planet named "Graha-1" following a Hohmann transfer trajectory. Its distance from Sun is 0.7233 AU. You are assigned the project to perform orbital mechanics calculations and compute: i. Heliocentric departure speed ii. Time of flight of return. Assume the spacecraft starts immediately back to Earth at the of Hohmann transfer at Venus in days. iii. Burnout velocity if burnout altitude is 1 DUand 2 DU near Earth.What is the trend between burnout altitude and burnout velocity? iv. Delta-v if this was a non-coplanar trajectory and requiredorbital angle change of 30^0 at 26 km/s and 45^0 at 45 km/s. Give answer in DU/TU.	9	L_4	CO5

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