Indian Institute of Science Education and Research, Mohali
Classical Mechanics (PHY301)
(September – December 2021)
Mid-Semester Exam (Part 2)

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1. We want to transport a spacecraft from the Earth to Mars. Consider a simplified situation here.

   (a) A small object of unit mass is in a circular orbit around the Sun. Mass of the Sun in 2×10^{30} kg and the radius of the orbit is 1.5×10^{11} m. Calculate the angular momentum and Energy of the object. [2]

   (b) The optimal transfer orbit is such that has perihelion at the Earth's orbit and aphelion at Mars' orbit. Assuming a circular orbit for Mars with a radius of 2.3×10^{11} m, calculate the eccentricity of the transfer orbit. [1]

   (c) What is the direction of change in velocity to put the object in the transfer orbit? Calculate the change in angular momentum, energy and the change in velocity required to put the object in the transfer orbit. [2]

   (d) On reaching aphelion, we would like to transfer to the same orbit as Mars. Calculate the change in velocity required to achieve this. Calculate the corresponding change in energy and angular momentum. [2]