Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – Nov/Dec – 2016**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Semester :** | **2016-17 ODD** |
| **Code :** | **14AE2033** | **Duration :** | **3hrs** |
| **Sub. Name :** | **ADVANCED SPACE DYNAMICS** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q. No | Sub Div. | Questions | Course  Outcome | Marks |
| 1. | a. | If two point masses m1 and m2 are acted upon only by the mutual force of gravity between them, find the motion of the centre of mass. Prove that the motion of m2 around m1 is governed by a second-order differential equation. | CO1 | 15 |
| b. | Define central orbits. Prove that Kepler’s second law holds for central orbits. | CO1 | 5 |
| (OR) | | | | |
| 2. |  | Write equations of motion for planar restricted three body problem in synodic (rotating) coordinate system. Derive the two equations to find the locations of the five equilibrium points. Derive the fifth-degree algebraic equations to find the locations of any two of the three collinear Lagrangian points Li (i=1, 2, 3). | CO2 | 20 |
| 3. |  | Define Lambert’s problem. Derive Lambert theorem analytically. | CO1 | 20 |
| (OR) | | | | |
| 4. |  | To study the motion near the equilibrium points, expand the force function Ω around a Lagrangian point. Find the linearized variational equation of motion in two dimensions.Prove that two roots of the characteristic equationare real and other two are pure imaginary at the collinear points. | CO2 | 20 |
| 5. | a. | Construct the principal system of co-ordinates at the equilateral point L4 to show the angle α, which the major-axis of the elliptic orbit makes with the ξ-axis for mass ratio μ = 0.2 in the restricted three-body problem. Write the expression as function of μ to obtain the angle α and using the expression calculate α and compare it with α obtained from the figure. | CO2 | 6 |
|  | b. | Prove that the second-orderderivatives at the equilateral point L4 are  Ωxx= 3/4, Ωxy = 3.31/2 (μ - 1/2)/2, Ωyy = 9/4. | CO2 | 8 |
|  | c. | Using these values of partial derivatives, prove that the characteristic equation is  λ4 + λ2 + 27μ (1 - μ)/4 = 0. | CO2 | 6 |
| (OR) | | | | |
| 6. | a. | Find the second-order derivatives at the collinear points. Find the fourth-degree characteristic equation at these points. Find the coordinates of the equilateral points L4 and L5 analytically. | CO2 | 12 |
|  | b. | Find the value of the critical mass μ0  Prove that all the 4 roots are pure imaginary at the triangular points | CO2 | 8 |
| 7. | a. | Explain periodic and quasi-periodic orbits. | CO1 | 5 |
|  | b. | What is n-body problem? Derive the 10 integrals of n-body problem. Write the equations of motion of general three-body problem. | CO1 | 15 |
| (OR) | | | | |
| 8. | a. | Derive Hamilton’s equations of motion for two-body problem in spherical polar coordinates. | CO1 | 10 |
|  | b. | Define extended phase space. Consider a dynamical system with two degree  freedom with its Hamiltonian independent of time. Consider a canonical  transformation given by W3 = - [p1f1(Q1, Q2) + p2 f2(Q1, Q2).  Use it to find the old coordinates and new momenta. In the extended 6-dimensional phase space, write the equations of motion. | CO1 | 10 |
|  | | **Compulsory:** |  |  |
| 9. | a. | Prove that the following transformations are canonical.   1. Q = (q2 + p2)/2, P = - tan-1 (q/p);   (ii) Q = q tan p, P = log (sin p); | CO1 | 8 |
|  | b. | Prove that the Hamiltonian of a harmonic oscillator  H = (p12 + p22)/2 + ω2(x12 + x22)/2,  with the help of the generating function    reduces to the form | CO1 | 12 |

ALL THE BEST