MTMAP 10 (Credit: 6)
Analytical statics and particle dynamics
Full Marks: 100

Marks and Credit distribution:

Theory: 5 Credits, 85 Marks

End Semester exam: 50Marks, Continuous Assessment: 15 Marks, Midterm: 15 Marks, Attendance: 5 Marks

Tutorial: 1 Credit, 15 Marks

Course Outcome: In this course a student will learn about S. H. M., motion of a particle in a plane, tangent and normal accelerations, circular motion, motion of a particle in a plane under different laws of resistance, central forces and central orbits, planetary motion, friction, virtual work, different types of equilibrium and centre of gravity. This is the basic requirement for the advanced mechanics course.

Group – **(**20L, Marks assigned for End Semester: 20**):**

Analytical Statics

1. Friction**:** law of Friction, angle of friction, cone of friction, to find the positions of equilibrium of a particle lying on a (i) rough plane curve, (ii) rough surface under the action of any given forces.

2. Astatic equilibrium, astatic centre, positions of equilibrium of a particle lying on a smooth plane curve under action of given force.

3. Virtual work**:** principle of virtual work for a single particle, deduction of the conditions of equilibrium of a particle under coplanar forces from the principle of virtual work, the principle of virtual work for a rigid body, the principle of virtual work for any system of coplanar forces acting on a rigid body, converse of the principle of virtual work.

4. Stable and unstable equilibrium, coordinates of a body and of a system of bodies, field of forces, conservative field, potential energy of a system, the energy test of stability, condition of stability of equilibrium of a perfectly rough heavy body lying on fixed body.

5. Centre of gravity for different bodies.

References:

[1] Analytical Statics – M. C. Ghosh.

[2] Analytical Statics – S. L. Loney.

[3] Analytical Statics – Pradhan & Sinha.

[4] Principles of Mechanics – J. L. Synge, B. A. Griffith

[5] Engineering Mechanics: Statics and Dynamics – I.H. Shames and G. Krishna Mohan Rao

[6] Engineering Mechanics: Statics and Dynamics – R.C. Hibbeler and Ashok Gupta

Group – B (40L, Marks assigned for End Semester: 30**):**
Analytical Dynamics of a Particle

1. Motion in a straight line under variable acceleration, motion under inverse square law, motion under gravity with resistance proportional to some integral power of velocity, terminal velocity, motion of a particle tied to one end of an elastic string, disturbed simple harmonic motion, basic kinematic quantities**:** momentum, angular momentum and kinetic energy, principle of energy and momentum.

2. Expressions for velocity and acceleration of a particle moving on a plane in cartesian and polar co-ordinates, components of velocity and acceleration referred to a set of rotating rectangular axes, motion of a particle in a plane.

3. Tangential and normal component of velocity and acceleration, uniform circular motion, simple cases of a constrained motion of a particle.

4. Motion of a particle in a plane under different laws of resistance, motion of a projectile in a resisting medium in which the resistance varies as the velocity, trajectories in a resisting medium where resistance varies as some integral power of the velocity.

5. Central forces and central orbits, typical features of central orbits, areal velocity, apse on a central orbit, apsidal distance, apsidal angle, central orbit in a resisting medium, stability of nearly circular orbits.

6. Planetary motion and Kepler's laws, slightly disturbed orbits**:** effect of some tangential disturbing force, effect of an instantaneous change in μ.

References

[1] An Elementary Treatise on the Dynamics of a Particle & of Rigid bodies – S. L. Loney.

[2] Dynamics (Part – I & II) – A. S. Ramsey.

[3] Analytical Dynamics of a particle – Ganguly & Saha.

[4] Dynamics of a particle – Datta & Jana.

[5] A text book on Dynamics – M. Ray.

[6] Advanced analytical Dynamics – Chakraborty & Ghosh.

[7] Principles of Mechanics – J. L. Synge, B. A. Griffith

[8] Textbook of Dynamics – F. Chorlton

[9] Principle of Dynamics – D. T. Greenwood

[10] Engineering Mechanics: Statics and Dynamics – I.H. Shames and G. Krishna Mohan Rao

[11] Engineering Mechanics: Statics and Dynamics – R.C. Hibbeler and Ashok Gupta

Tutorial: (1 Credit, 15 Marks)

1. Evaluation for the tutorial will be conducted in the following forms (which will be informed to the students at the beginning of the semester):

i) Written test, ii) viva-voce, iii) home-assignment, iv) presentation

2. Tutorial for each core course will comprise of a total of minimum 15 marks and maximum 60 marks for tutorial evaluation which will be converted to 15 marks.

3. Date of written test/viva-voce /home assignment/presentation for tutorial will be informed to the students at least 4days in advance via departmental notice.

4. Evaluated written answer sheets / assignments will be returned back to the students.

5. If any student is absent in the tutorial examination, a re-test may be arranged by the permission of the principal.