

29. Mathematics B-Course

B.A./B.Sc. Mathematics B-Course-I

Total Mark: 100

Appendix 'A'
(Outlines of Tests)

Vector and Mechanics : 100 Marks

Appendix 'B'
(Syllabi and Courses of Reading)

Vector and Mechanics **100 Marks**

Note: Attempt six questions by selecting one question from Section I, two questions from Section II, two questions from Section III and one question from Section IV.

Section-I (2/12)

Vectors:

- Introduction to vector algebra
- Scalar and vector product
- Scalar triple product and vector triple product
- Applications to geometry
- Vector equation of a line and plane
- Limit, continuity and differentiability of vector point functions
- Partial derivatives of vector point functions
- Scalar and vector fields
- The gradient, divergence and curl
- Expansion formulas.

Section-II (4/12)

Forces:

- Fundamental concepts and principles
- Inertial-non-inertial frames, Newton's laws
- Resultant of several concurrent forces
- The parallelogram law of forces
- Resolution of a forces, triangle of forces
- Lamy's theorem, polygon of forces
- Conditions of equilibrium for a particle
- External and internal forces, principle of transmissibility

- Resultant of like and unlike parallel forces
- Moment of forces about a point, Varignon's theorem
- Moment of a couple, equivalent couples, composition of couples
- Reduction of coplanar forces to a force or a couple

Friction:

- Dry friction and fluid friction
- Laws of dry friction, coefficients of friction, angle of friction
- Equilibrium of a particle on a rough inclined plane
- Particle on a rough inclined plane acted on by an external force
- Conditions for sliding or tipping

Virtual Work:

- Principle of virtual work
- Problems involving tensions and thrust

Centre of Mass and Gravity:

- Discrete and continuous systems, density of rigid and elastic bodies
- Centroid: Discrete and continuous systems, solid region, region bounded by planes
- Semi circular regions, sphere, hemisphere, cylinder and cone

Section-III (4/12)

Kinematics:

- Rectilinear motion of particles
- Uniform rectilinear motion, uniformly accelerated rectilinear motion
- Curvilinear motion of particle, rectangular components of velocity and acceleration
- Tangential and normal components
- Radial and transverse components

Projectile motion:

- Motion of a Projectile, Trajectory
- Range of projectile, Time of flight, height of projectile
- Vertical motion and motion on inclined plane

Kinetics:

- Work, power, kinetic energy, conservative force fields
- Conservation of energy, impulse, torque

- Conservation of linear and angular momentum
- Non-conservative forces

Simple Harmonic Motion

- The simple harmonic oscillator, amplitude, period, frequency,
- Resonance and energy
- The damped harmonic oscillator, over damped, critically damped and under damped
- Motion, forced vibrations

Section-IV (2/12)

Central Forces and Planetary Motion

- Central force fields, equations of motion, potential energy, orbits
- Kepler's laws of planetary motion
- Apical distance and apical angles for nearly circular orbits
- Motion in an inverse square field

Collisions of particles:

- Laboratory and centre of mass frames of reference
- Elastic and inelastic collisions
- impulse and momentum Motion in a circle and on other curves

Recommended Books:

1. Murray R. Spiegel, Vector Analysis, Schaum's Outline Series McGraw Hill Book Company, 2005.
2. Fowles, G.R, Cassiday, G.L. Analytical Mechanics, 7 Edition, Thomson Brook Cole, 2005.
3. Jafferson, B. Beadsword, T. Further Mechanics, Oxford University Press 280.
4. Murray R. Spiegel, Theoretical Mechanics, Schaum's Outline Series, McGraw Hill Book Company.
5. D.K. Anand and P.F. Cunniff, Statics and Dynamics, Allyn and Bacon, Inc. 1914.