INSTITUTE	**FACULTY OF TECHNOLOGY**
PROGRAM	**BACHELOR OF TECHNOLOGY (CIVIL ENGINEERING)**
SEMESTER	**1**
COURSE TITLE	**PHYSICS**
COURSE CODE	**01CI0102**
COURSE CREDITS	**4**

Objective:

1 To develop the fundamentals of vectors, force systems, equilibrium, and particle mechanics
2 To introduce centroid, moment of inertia, energy methods, and angular momentum in engineering analysis
3 To study oscillations, rotating frames, wave propagation, and rigid body motion.
4 To introduce basic concepts of quantum physics and their relevance to nanomaterials and sensing technologies.
5 To expose students to modern simulation tools such as FEA, BIM integration, and IoT-enabled monitoring in civil engineering

Course Outcomes: After completion of this course, student will be able to:

1 Apply vector algebra, force systems, and Newton's laws to analyze particle equilibrium and motion.
2 Determine centroid, area moment of inertia, and mass moment of inertia of engineering bodies
3 Analyze energy-based motion, central-force motion, oscillations, and wave propagation phenomena
4 Apply rigid body kinematics and dynamics in planar motion, and explain the basics of Euler's laws and 3D rigid body motion.
5 Explain the role of quantum concepts, smart materials, FEA, BIM, and IoT in modern civil engineering applications

Pre-requisite of course: Physics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

DR. KRISHNA ISHVARBHAI PATEL
Digitally signed by (Name of HOD)

DR. RAJENDRASINH BAHADURSINH JADEJA
Digitally signed by (Name of Dean/ Principal)

Contents : Unit	Topics	Contact Hours
1	**Introduction To Forces/Equilibrium of Rigid Body** Scalar and vector, system of forces, resultant force. Statics of a particle. Free-body diagram. , Equilibrium of a particle in two dimensions. The resultant of three or more concurrent forces is the resolution of a force into components. Rectangular components of a force. Resultant by rectangular components, Concurrent force system in space: Resolution of a force into rectangular components in space, Coplanar Non-Concurrent Force Systems, Moments about Point and Axis. Equilibrium of Non-coplanar Non-concurrent Forces, Equivalent Force Systems, Newton's laws; form invariance of Newton's second law; problems involving constraints and friction, Equations of Motion in Polar Coordinates; Introduction to Cylindrical and Spherical Coordinates	10
2	**Centroid and Moment of Inertia** Distributed forces: Centroid and centre of gravity. Determination of the centroid of lines and areas using the integral technique. Determination of the centroid of composite wires and areas. Centroid of volumes. , Theorems of Pappus - Guldinus and its applications. Second moment of areas. Definition of moment of inertia. Determination of moment of inertia by integration. Parallel axis theorem for Moment of Inertia. MI of composite area. Concept of Mass moment of inertia of a body	8
3	**Non-Inertial Frames, Oscillations and Wave Propagation** Non-inertial frames of reference, Rotating coordinate system; centripetal and Coriolis accelerations; applications such as weather systems and Foucault pendulum, Fundamentals of simple harmonic motion, Forced oscillations and resonance, Wave Propagation Technique: Introduction to wave motion, Longitudinal and Transverse waves, Wave parameters, Wave propagation in solids, standing waves, seismic wave propagation and civil engineering relevance	8
4	**Rigid Body Mechanics** Definition and motion of a rigid body in the plane, Rotation in the plane, Kinematics in a coordinate system rotating and translating in the plane, Angular momentum about a point of a rigid body in planar motion, Introduction to three-dimensional rigid body motion, Angular velocity vector, rate of change of angular velocity, and moment of inertia tensor, Example of apparently planar but actually three-dimensional motion, such as conical motion	8

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Digitally signed by (Name of HOD)

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Contents : Unit	Topics	Contact Hours
5	**Modern Physics and Simulation Applications for Civil Engineering** Basics of Quantum Physics and Applications: Introduction to Quantum Physics, Wave-Particle Duality, Photoelectric Effect, Matter waves, Uncertainty Principle, Quantization of energy, and Applications of Quantum Concepts in Nanomaterials, Smart Materials, and Sensing Technologies, Finite element analysis (FEA) in civil design, Multiphysics Simulations for Material Behavior, Building Information Modeling (BIM) and Simulation Integration, IoT-enabled Monitoring of Material Performance	8
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Practical 1** To determine the resultant of concurrent vectors by applying the law of the parallelogram	2
2	**Practical 2** To determine the resultant and equilibrium of a rigid body under coplanar and non-coplanar force systems	2
3	**Practical 3** To resolve a force into rectangular components in two-dimensional and three-dimensional force systems.	2
4	**Practical 4** To determine the centroid of various lines, plane areas, and composite sections using the integral technique	2
5	**Practical 5** To determine the moment of inertia of simple and composite sections by analytical and experimental/simulation method	2
6	**Practical 6** To study the motion of a particle in polar coordinates and solve simple engineering problems involving constraints and friction	2
7	**Practical 7** To study the concept of potential energy, conservative forces, and energy conservation using suitable numerical examples or simulations	2
8	**Practical 8** To analyze central force motion and conservation of angular momentum through orbit-based or satellite-motion examples/simulation	2
9	**Practical 9** To study the behavior of simple harmonic motion and determine the effect of system parameters on oscillatory response	2

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Digitally signed by (Name of HOD)

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Digitally signed by (Name of Dean/ Principal)

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
10	**Practical 10** To study wave propagation characteristics in solids, including longitudinal and transverse waves, using suitable demonstrations or simulations	2
11	**Practical 11** To study the effect of rotating and non-inertial frames and demonstrate centripetal and Coriolis acceleration using suitable models or simulation	2
12	**Practical 12** To study the properties of rigid body motion in the plane and compute angular momentum for a rotating body	2
13	**Practical 13** To apply AI, MI and IoT in applied physics for civil engineering problems	2
14	**Practical 14** To apply finite element analysis (FEA) to simulate material behavior in structures	2
Total Hours		**28**

Textbook :

1 Mechanics of Materials, Beer and Johnston, TMH, 1981

References:

1 Vector Mechanics for Engineers: Statics: , Vector Mechanics for Engineers: Statics: , Beer and Johnston, , TMH, 1981

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
0.00	15.00	35.00	35.00	15.00	0.00

Instructional Method:

1 Prerequisite of the course and its pattern shall be discussed on the commencement of the course.

2 Lectures shall be conducted in class room using various teaching aids.

3 Presence in all academic sessions is mandatory which shall carry 5% marks of the total internal evaluation.

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Digitally signed by (Name of HOD)

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Digitally signed by (Name of Dean/ Principal)

Instructional Method:

4 At the end of each unit/topic an assignment based on the course content shall be given to the students which shall carry 5% weightage for timely completion and submission of the assigned work.

5 The laboratory experiments are planned in such a way that it covers the practical aspects of the course contents. The performance of these experiments shall bring the clarity of the theoretical concepts which the students have studied during the academic sessions.

Supplementary Resources:

1 https://onlinecourses.nptel.ac.in/noc22_ce46/preview •

2 https://nptel.ac.in/courses/105105108

3 https://vlab.amrita.edu/?sub=1&brch=74&sim=571&cnt=1

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