DEPARTMENT OF PHYSICS

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Course name: Modern Physics

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
	Modern Physics	**3**	**2**	**1**	**0**	**0**

PREREQUISITE
None

COURSE OBJECTIVE(s)
This course aims to familiarize and equip the students with fundamental knowledge of quantum mechanics, solid state physics and electrodynamics. The learned knowledge would enable the students to tackle the engineering problems.

COURSE OUTCOMES:

CO1	To impart fundamental Physics knowledge to engineering UG students, primarily in the areas of Quantum Mechanics, Solid state Physics and Electrodynamics.
CO2	Capability to use the fundamental knowledge in relevant applications.
CO3	To enable the students to independently solve engineering problems, by using the concepts of physics learned during the course.
CO4	To enable and encourage students to apply the learned concepts in interdisciplinary areas.

COURSE ASSESSMENT
The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Quantum Mechanics - Introduction to Quantum mechanics, Wave-Particle duality, Wave function and its properties, Energy and momentum operators, Schrodinger equation-both time dependent and time independent, solution of Schrodinger equation in simple cases such as 1-D potential well, 3D-box.

(No. of lectures- 6)

Solid State Physics - Basic crystal structures, Reciprocal lattice, Brillouin Zone, Bragg's law, X-ray diffraction and its applications, Free electron theory of metals, density of states, Origin of energy bands, Fermi energy, Bloch Theorem, Kronig-Penney Model, distinction between metals, semiconductors, and insulators, Intrinsic and extrinsic semiconductors and carrier concentration, Hall effect in metals and semiconductors.

(no. of lectures- 11)

Electrodynamics - Laws of electromagnetism, Continuity equation and Displacement current, Maxwell's equations (Differential and Integral forms) and their physical significance, Poynting theorem and power flow, Electromagnetic wave equation and its solution in free space, Transverse nature of EM waves, Energy and Momentum in Electromagnetic waves, The Potential Formulation: Scalar and Vector Potentials, Gauge Transformations: Coulomb Gauge and Lorenz Gauge.

(no. of lectures- 9)

TEXT BOOKS/ REFERENCE BOOKS: -

1. Introduction to Electrodynamics, David J. Griffiths, Prentice Hall
2. Quantum Mechanics, Nouredine Zettili, Wiley
3. Solid State Physics by S. O. Pillai, New Age Science
4. Solid State Physics, M. A. Wahab, Narosa
5. Engineering Physics, Hitendra K. Malik and A. K. Singh, McGraw Hill Education
6. Concepts of Modern Physics, Arthur Beiser, McGraw Hill Education
7. Quantum Mechanics, B. H. Bransden and C. J. Joachain, Pearson

Lecture Plan

Lecture No.	Topics to be covered
1.	Introduction to Quantum mechanics
2.	Wave-Particle duality, Wave function and its properties
3.	Energy and momentum operators
4.	Schrodinger equation (time dependent and time independent)
5.	Solution of Schrodinger equation for 1-D potential well, 3D-box
6.	Solution of Schrodinger equation for 3D-box
7.	Basic crystal structures, Reciprocal lattice
8.	Brillouin Zone, Bragg's law
9.	X-ray diffraction and its applications
10.	Free electron theory of metals
11.	Fermi energy, Density of states
12.	Bloch Theorem
13.	Kronig-Penney Model
14.	Origin of energy bands
15.	Distinction between metals, semiconductors, and insulators
16.	Intrinsic and extrinsic semiconductors and carrier concentration
17.	Hall effect in metals and semiconductors
18.	Laws of electromagnetism
19.	Continuity equation and Displacement current
20.	Maxwell's equations (Differential and Integral forms) and their physical significance
21.	Poynting theorem and power flow
22.	Electromagnetic wave equation and its solution in free space
23.	Transverse nature of EM waves
24.	Energy and Momentum in Electromagnetic waves
25.	The Potential Formulation: Scalar and Vector Potentials
26.	Gauge Transformations: Coulomb Gauge and Lorenz Gauge

Course name: Classical Physics

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
	Classical Physics	**3**	**2**	**1**	**0**	**0**

PREREQUISITE

None

COURSE OBJECTIVE(s)

This course aims to familiarize and equip the students with fundamental knowledge of coordinate systems, forces & moments, simple harmonic motion, moment of inertia etc. The learned knowledge would enable the students to tackle the engineering problems.

COURSE OUTCOMES:

CO1	To impart fundamental Physics knowledge to engineering UG students, primarily in the areas of mechanics (statics and dynamics).
CO2	Capability to use the fundamental knowledge in relevant applications.
CO3	To enable the students to independently solve engineering problems, by using the concepts of physics learned during the course.
CO4	To enable and encourage students to apply the learned concepts in interdisciplinary areas.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
d)	Internal assessment (based upon assignments, quizzes and attendance)	20%
e)	Mid-term examination	30%
f)	End Semester Examination	50%

COURSE CONTENTS

UNIT 1 - Coordinate systems, Forces and Moments, Equivalent force system, equations of equilibrium, free body diagram; Frame of reference, Newton's laws and applications (to

include friction and constraint equations); conservative forces, work energy theorem, conservation of linear momentum and collisions.

(No. of lectures- 8)

UNIT 2 - Simple Harmonic Motion, Compound Pendulum, Damped Harmonic Motion, Forced oscillations: Transient and steady states, Resonance: sharpness of resonance and quality factor.

(No. of lectures- 5)

UNIT 3 - Conservation of Angular Momentum, Rotation about a fixed axis, Moment of Inertia, Theorem of parallel and perpendicular axes, Principal moment of inertia, Polar moment of Inertia, Mass moment of inertia, Determination of moment of inertia of discrete and continuous objects [1-D, 2-D & 3-D (rectangular, cylindrical and spherical)], Gyroscope, Euler's equation; Elastic deformation: Hooke's Law, Stress, strain, Young's Modulus, Sheer Modulus, Bulk Modulus, Section Modulus.

(No. of lectures- 8)

UNIT 4 - Definition of Fluid, Fluid Dynamics, Pressure difference in accelerating fluid, Bernoulli's equation, viscosity, Surface tension, equation of continuity and Euler's equation, Navier-Stokes theorem.

(No. of lectures- 5)

TEXT BOOKS/ REFERENCE BOOKS: -

8. An Introduction to Mechanics by Kleppner and Kolenkow, McGraw Hill Education
9. Mechanics by D. S. Mathur, S. Chand
10. Engineering Mechanics: Statics and Dynamics by J. L. Meriam and L. G. Kraige, Wiley
11. Fluid Mechanics by Landau L.D. & Lifschitz E.M, Butterworth-Heinemann
12. Engineering Physics by D. R. Joshi, McGraw Hill Education
13. Vector Mechanics for Engineers: Statics and Dynamics by F. P. Beer and E. R. Johnston, McGraw Hill Education

Lecture Plan

Lecture No.	Topics to be covered
1.	Coordinate systems, Forces and Moments
2.	Equivalent force system
3.	Equations of equilibrium
4.	Free body diagram; Frame of reference
5.	Newton's laws and applications
6.	Friction and constraint equations
7.	Conservative forces, work energy theorem
8.	Conservation of linear momentum and collisions
9.	Simple Harmonic Motion
10.	Compound Pendulum
11.	Damped Harmonic Motion
12.	Forced oscillations: Transient and steady states
13.	Resonance: sharpness of resonance and quality factor
14.	Conservation of Angular Momentum, Rotation about a fixed axis
15.	Moment of Inertia, Theorem of parallel and perpendicular axes
16.	Principal moment of inertia, Polar moment of Inertia
17.	Mass moment of inertia
18.	Determination of moment of inertia of discrete and continuous objects (1-D (rectangular, cylindrical and spherical))
19.	Determination of moment of inertia of discrete and continuous (2-D & 3-D (rectangular, cylindrical and spherical))
20.	Gyroscope, Euler's equation
21.	Elastic deformation: Hooke's Law, Stress, strain, Young's Modulus, Sheer Modulus, Bulk Modulus, Section Modulus
22.	Definition of Fluid, Fluid Dynamics
23.	Pressure difference in accelerating fluid
24.	Bernoulli's equation, viscosity, Surface tension
25.	Equation of continuity and Euler's equation
26.	Navier-Stokes theorem