GOVERNMENT GENERAL DEGREE COLLEGE, KALNA-I

SYLLABUS
for

Semester-II

Four-Year (Honours)/Three-Year B.Sc. Programme

in

Major-Physics

Under Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) as per NEP, 2020
(With effect from the session 2023-2024)

Semester-II

Course Type	Title of the Course	Credit	Full Marks	Lecture Hour
Major Course **PHYS2011**	**Mechanics**	**4** (Theory-03, Practicals-01)	**75** (Theory-40, Practical–20, Internal Assessment–15)	**75** (Theory-45, Practical-30)
Minor Course **CHEM2021** **(for Four year Honours)**	**General Chemistry-II**	**4** (Theory-03, Practicals-01)	**75** (Theory-40, Practical–20, Internal Assessment–15)	**75** (Theory-45, Practical-30)
Minor Course **MATH2021** **(for Three Year)**	**Introductory Algebra and Number Theory**	**4** (Theory-04)	**75** (Theory-60, Internal Assessment–15)	**60** (Lecture -45, Tutorial – 15)
Multi/ Interdisciplinary **ENGL2031**	**Technical Writing**	**3** (Theory-03)	**50** (Theory-40, Internal Assessment–10)	**45**
AEC **(L2-1 MIL)** **ENGL2041**	**Functional English**	**2** (Theory-02)	**50** (Theory-40, Internal Assessment–10)	**30**
SEC **PHYS2051**	**Electrical Circuits and Network Skills**	**3** (Theory-03)	**50** (Theory-40, Internal Assessment–10)	**45**
Common Value-Added Course **CVA2061**	**Health & Wellness, Yoga Education, Sports and Fitness**	**4** (Theory-04)	**100**	**60**
		Total Credit = 20	**Total Marks = 400**	

MAJOR-PHYSICS COURSE

Semester II

MAJOR II: PHYS2011: MECHANICS (Credits: Theory - 03, Practical - 01)

F.M. = 75 (Theory- 40, Practical – 20, Internal Assessment –15)

COURSE OBJECTIVE: The objectives of this course is to provide an in-depth understanding of the principles of Newtonian mechanics and apply them to solve problems involving the dynamics of classical mechanical systems.

Theory: 45 Lectures

Fundamentals of Dynamics: Reference frames, Inertial frames, Review of Newton's Laws of Motion. Galilean transformations, Galilean invariance. Momentum of variable-mass system: Motion of a rocket, Motion of a projectile in Uniform gravitational field, Dynamics of a system of particles: Centre of Mass, Motion relative to the centre of mass, Principle of conservation of momentum, Impulse.

(6 Lectures)

Work and Energy: Work-Energy theorem, Conservative and non-conservative forces, Potential energy, Energy diagram, Stable and unstable equilibrium, Force as gradient of potential energy, Work and potential energy, Work done by non-conservative forces, Law of conservation of Energy.

(4 Lectures)

Collisions: Elastic and inelastic collisions between particles in Centre of mass and Laboratory frames.

(3 Lectures)

Rotational Dynamics: Angular momentum of a particle and a system of particles, Torque and the principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia, Calculation of moments of inertia for regular shaped bodies, Kinetic energy of rotation. Motion involving both translation and rotation.

(8 Lectures)

Elasticity: Elastic properties of matter, Hooke's Law, Relation between Elastic constants, Twisting torque on a cylinder or a wire, Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane and a concentrated load W is applied at the midpoint.

(4 Lectures)

Gravitation and Central Force Motion: Law of gravitation, Gravitational potential energy, Inertial and gravitational mass, Gravitational potential and the gravitational field due to a spherical shell and a solid sphere.

(4 Lectures)

Motion of a particle under a central force field: Two-body problem, its reduction to one-body problem and its solution, the energy equation and energy diagram. Kepler's Laws, Satellite in circular orbit and

applications. Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS).

(6 Lectures)

Oscillations: Simple Harmonic Oscillations: Differential equation of SHM and its solution, Kinetic energy, potential energy, Total energy and their time-averaged values. Damped oscillation, Forced oscillations: Transient and steady states, Resonance, Sharpness of resonance, Power dissipation and Quality Factor, Compound pendulum.

(6 Lectures)

Non-Inertial Systems: Non-inertial frames and fictitious forces: Uniformly rotating frame, Laws of Physics in rotating coordinate systems, Centrifugal force, Coriolis force and its applications. Components of velocity and acceleration in cylindrical and spherical coordinate

(4 Lectures)

COURSE OUTCOME: This course in Mechanics serves as the foundation for further progress towards the study of physics at graduate or post-graduate level. Upon completion of the course, the student will be able to apply Newton's laws of motion to different force fields for a single particle and for a system of particles.

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
6. An Introduction to Classical Mechanics, R G Takwale & P S Puranik, TMG Hill.
7. Mechanics, P K Srivastava, New Age International Pvt. Ltd.
8. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
9. Vibrations, Waves and Acoustics, D Chattopadhyay and P C Rakshit, Books and Allied Pvt. Ltd.
10. Advanced Acoustics, D P Roychaudhuri and P Banerjee, The New Book Stall, 2009

MAJOR-II: PHYS2011: MECHANICS

Practical: 30 Lectures

Practical:

1. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
2. To determine the Moment of Inertia of a Flywheel/regular shaped body.
3. To determine g and velocity for a freely falling body using Digital Timing Technique.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle/dynamical method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar pendulum/Kater's Pendulum.
8. To determine the value of Young's Modulus by Flexure method.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna,11thEdn,2011,KitabMahal.
3. Engineering Practical Physics, S.Panigrahi &B.Mallick,2015,CengageLearningIndiaPvt.Ltd.
4. Practical Physics,G.L.Squires,2015, 4thEdition,CambridgeUniversityPress.
5. Practical Physics, D Chattopadhyay, P C Rakshit and B Saha, Books and Allied Pvt. Ltd.
6. Advanced Practical Physics, B Ghosh and K G Mazumdar, Sreedhar Publishers.
7. B. Sc. Practical Physics, Harnam Singh and P S Heme, S Chand and Company Limited.
8. B. Sc. Practical Physics, C L Arora, S Chand and Company Limited.

SEC-PHYSICS

Semester-II

SEC-2: PHYS2051: ELECTRICAL CIRCUITS AND NETWORK SKILLS (Credits: 03)

F.M.= 50 (Theory - 40, Internal Assessment - 10)

COURSE OBJECTIVE*:* The aim of this course is to enable the students to understand the basics of electronic circuits. Practical design and trouble shoot of electronic instrument is also a major objective of this Couse.

Theory: 45 Lectures

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. (5 Lectures)

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

(8 Lectures)

Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. (5 Lectures)

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. (5 Lectures)

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. (5 Lectures)

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources (5 Lectures)

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device) (5 Lectures)

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit Cable trays. Splices: wire nuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. (7 Lectures)

COURSE OUTCOME: After the completion of the course the student will acquire necessary skills/ hands on experience /working knowledge on Multimeter, voltmeters, ammeters, electric circuit elements, dc power sources. With the knowledge of basic electronics a student can able to detect troubleshoot and repair some of the electronic instruments used in our daily life.

Reference Books:

1. A Text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A Text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn.

Chemistry MINOR

Paper code: CHEM202-I

Paper title: General Chemistry-II Credits 3+1

Theory Credits 3

1. Thermodynamics-II

Statement of the second law of thermodynamics, concept of heat reservoirs and heat engines, Carnot cycle, physical concept of entropy, Carnot engine, refrigerator and efficiency, entropy change of systems and surroundings for various processes and transformations, auxiliary state functions (G and A) and criteria for spontaneity and equilibrium

5 Hours

2. Ideal gas

Collision of gas molecules, collision diameter, collision number and mean free path, frequency of binary collisions (similar and different molecules), rate of effusion

Nature of distribution of velocities, Maxwell's distribution of speed and kinetic energy, average velocity, root mean square velocity and most probable velocity, equipartition principle and its application to calculate the classical limit of molar heat capacity of gases.

5 Hours

3. Chemical Kinetics-II

Collision theory, Lindemann theory of unimolecular reaction, outline of Transition State theory (classical treatment) *5 Hours*

4. Fundamentals of Organic Chemistry

Electronic displacement phenomena- inductive effect, resonance and hyperconjugation, cleavage of bonds- homolytic and heterolytic, structures of organic molecules on the basis of VBT, nucleophiles, electrophiles, reactive intermediates- carbocations, carbanions and free radicals.

6 Hours

5. Stereochemistry

Isomerism- geometrical and optical isomerism, concept of chirality and optical activity (up to two carbon atoms), asymmetric carbon atom, elements of symmetry (plane and centre), interconversion of Fischer and Newman representations, enantiomerism and diastereomerism, meso compounds, threo and erythro, D and L, cis- and trans- nomenclatures, CIP rules: R/S (upto 2 chiral carbon atoms) and E/Z nomenclatures.

6 Hours

6. Nucleophilic Substitution and Elimination Reactions

Nucleophilic substitutions- S_N1, S_N2 and $S_Ni$reactions, eliminations- E_1 and E_2 reactions (elementary mechanistic aspects), Saytzeff and Hofmann eliminations, elimination vs. substitution *6 Hours*

7. Chemical Bonding and Molecular Structure

Ionic Bonding: general characteristics, energy considerations, lattice energy and solvation energy and their importance for stability and solubility of ionic compounds, statement of Born-Landé equation for lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability, Fajans' rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character

Covalent bonding: Valence Bond (VB) theory approach, shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements Concept of resonance and resonating structures in various inorganic and organic compounds Molecular orbital (MO) theory approach -the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods. (including the idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+, comparison of VB and MO approaches *12 Hours*

Reference Books:

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.

2. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970.

4. Atkins, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India.

6. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.

7. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson, 2006.

8. Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998).

9. Burgess, J., Ions in solution: basic principles of chemical interactions. Ellis Horwood (1999).

10. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, Second edition, Oxford University Press, 2012.

11. Smith, J. G. Organic Chemistry, Tata McGraw-Hill Publishing Company Limited.

12. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

13. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd., (Pearson Education).

14. Morrison, R. T. Study guide to organic Chemistry, Pearson.

15. Pathak & Saha, Organic Chemistry (Volume-1), Books and Allied (P) Ltd.

16. Castellan, G. W. Physical Chemistry, Narosa Publishing House.

17. Engel, T. & Reid, P. Physical Chemistry, Pearson.

18. Maron, S. &Prutton, Principles of Physical Chemistry, Collier Macmillan Ltd.

19. Laidler, K. J. Chemical Kinetics, Pearson.

20. Glasstone, S. & Lewis, G.N. Elements of Physical Chemistry.

21. Rakshit, P.C., Physical Chemistry, Sarat Book House.

22. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas Publishing House.

23. Sharma, K. K. & Sharma, L. K., A Textbook of Physical Chemistry, Vikas Publishing House.

24. Bajpai, D. N., Advanced Physical Chemistry, S. Chand Publication.

25. Rajaram, J. Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson.

26. Nasipuri, D. Stereochemistry of Organic Compounds, New Age International (P) Ltd.

27. Sengupta,S.Basic Stereochemistry of Organic Molecules, Oxford University Press

28. Chatterjee Hrishikesh, Physical Chemistry (Volume-1), Platinum Publisher

29. Kapoor, K.L., Textbook of Physical Chemistry (Volume 1 and Volume-2), McGraw Hill Education

30. Ghoshal, A. Numerical problems & short questions on Physical Chemistry, Books and Allied (P) Ltd.

31. Atkins, P. W. & Paula, J. de Atkins' Physical Chemistry, Oxford University Press.

Practical Credit 1

1. Determination of pH of unknown strong alkali and acid by colour matching method
2. Study of kinetics of acid-catalyzed hydrolysis of methyl acetate
3. Estimation of Mohr's salt by titrating with $KMnO_4$/ $K_2Cr_2O_7$
4. Estimation of sodium carbonate and sodium hydrogen carbonate in a mixture *30 Hours*

Reference Books:

1. Bhattacharyya, R. C, A Manual of Practical Chemistry.

2. Nad, Mahapatra, Ghosal, An Advance course in Practical Chemistry, New Central Book Agency (P) Ltd.

3. K. S. Mukherjee, Textbook on Practical Chemistry, New Central Book Agency (P) Ltd.

4. Ghosh, Das Sharma, Majumdar, Manna, Chemistry in Laboratory, santra Publication (P) Ltd.

5. Poddar and Ghosh, Degree Practical Chemistry, Book Syndicate (P) Ltd.

MINOR COURSES

Course Code: MATH2021
Course Name: Introductory Algebra and Number Theory
(Credit: 4, Marks: 75)
Total Hours: Lecture -45, Tutorial – 15

Objectives

To present a systematic introduction to number theory and basic course on algebra.

Learning outcomes

On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about

i. number theory which has wide applicability in advanced mathematics and also in various practical field, e.g., cryptography, computer science and many competitive exams.
ii. complex number and its properties which are equally indispensable tools for advanced studies and different practical field.
iii. a basic introduction to modern algebra which has wide applicability in different branch of sciences.

Skills:

The students would be able to

i. access and also generate different tricky examples and counter examples involving integers during their advanced study of ring theory and field theory.
ii. simplify a mathematical problem in different field of science using complex number.
iii. motivate themselves for future research after getting the glimpse of gateway of modern algebra from classical algebra and number theory and relate use of group, ring and field in different field of science.

General competence: The students would gain

i. descriptive idea of various properties of complex number.
ii. knowledge of richness in number theory.
iii. understanding in basic concepts of group, ring and field.
iv. expertise in solving many tricky problems in number theory, complex numbers.

Contents:

Algebra

Complex Numbers: De Moivre's theorem for rational indices and its applications.

Theory of equations: Fundamental Theorem of Algebra (Statement), Relation between roots and coefficients, Transformation of equation, Descarte's rule of signs, Cubic and biquadratic equations, Reciprocal equation, separation of the roots of equations, Strum's theorem.

Inequality: The inequality involving AM≥GM≥HM, Cauchy-Schwartz inequality. [L-**10H & T-4H]**

Partial order, total order relations, partitions of a set and its connection with equivalence relation, greatest lower bound, least upper bound, maximal, minimal elements, lattice, bounded lattice, modular lattice, distributive lattice, complemented lattice, statement of Zorn's lemma.

[L-**5H & T-2H]**

Semigroups, Monoids, Groups – examples including permutation group, Matrix groups $(M_{n\times n}(\mathbb{R}), GL_n(\mathbb{R}), SL_n(\mathbb{R}))$, Z_n, elementary properties of groups, generators and relations, order of an element of a group, Subgroups and examples of subgroups, cosets, normal subgroup, center of a group, cyclic groups, Lagrange's theorem, Rings, subrings, Ideals (left, right and two sided), integral domain, field, subfield – examples and basic properties, characteristic of a ring and field.

[L-**10H & T-4H]**

Number Theory

Well ordering principle of set of natural numbers, pigeon-hole principle, division algorithm, greatest common divisor (gcd), Euclidean algorithm, least common multiple (lcm), Linear Diophantine equation, prime numbers, relatively prime numbers and related properties including Euclid's lemma, fundamental theorem of arithmetic and its applications, perfect square and square free integers, congruences, solution of congruences, Binary and decimal representation of integer, Chinese remainder theorem and its application. Fermat's little theorem, Wilson's theorem, sum of two squares, Arithmetic function-$\phi(n), d(n), \sigma(n)$. [L-**20H & T-5H]**

Reading References:

Text books:

1. Classical Algebra- S. K. Mapa,8th Edition, (Sarat Book House).
2. Topics in Abstract Algebra – M.K. Sen, S. Ghosh, P. Mukhopadhyay, S. K. Maity, 3rd Edition (University Press).
3. Higher Algebra- S. K. Mapa,8th Edition, (Sarat Book House).
4. An introduction to Theory of Numbers- Niven, Ivan, S. Zuckerman Herbert, L. Montogomery Hugh,5th Edition, (Willey).
5. Elementary Number Theory- D. M. Burton, (Mc Graw Hill Education).

Reference Books:

1. Topics in Algebra – I. N. Herstein,2nd Edition, (Wiley).
2. Contemporary Abstract Algebra - Gallian, A. Joseph, Standard Edition, (Cengage India Private Limited).
3. Higher Algebra - S. Barnards, J. M. Child, (Arihant).
4. Algebra - M. Artin, 2nd Edition, (Pearson Education, India).
5. A first course in Abstract Algebra - J. B. Fraleigh7th Edition, (Pearson Education, India).

INTERDISCIPLINARY COURSE

ENGL2031: Technical Writing
[3 Cr, Full Marks: 50 (Theory: 40 + IA: 10), LH: 45 hrs]

COURSE OBJECTIVE:

Technical writing is a necessary requirement in many professions, and this course is designed to make students aware ofthe various forms of such writing. The objective is to equip students to face the challenges of technical writing in professional life.

Introducing Technical Writing(LH: 15)
What is technical writing?
Difference between technical writing and other forms of writing
Roles and responsibilities of technical writers
Qualities and qualifications of technical writers

Forms and Styles of Technical Writing(LH: 30)
Styles in technical writing
Forms of discourse, audience analysis, persuasion
Grammar in technical writing, revising a written document
Clarity, precision, coherence and logic in technical writing
Collecting notes, writing summaries and drafts, writing minutes and resolutions of meeting
Designing and reviewing documents
Document formats, differences between hard and soft copy versions
Web content writing
Collaborative writing
Professional Ethics, plagiarism, and copyright

COURSE OUTCOME:

It is expected that students emerging from this course will be capable of handling the demands and challenges of technical writing in the course of their professional careers in government and private sectors as well as in transactions of business.

ABILITY ENHANCEMENT COURSE

ENGL2041: Functional English
[2 Cr, Full Marks: 50 (Theory: 40 + IA: 10), LH: 30 hrs]

COURSE OBJECTIVE:

The importance of functional English at the present moment cannot be over-emphasized. Recognizing this importance, the course seeks to acquaint students with the various uses of English in today's world, with particular focus on developing one's conversational and writing skills together with the ability to comprehend English speech and writing.

What is functional English? (LH: 1)
Aims and objectives of functional English (LH: 1)
Functional English and formal English/ literary English (LH: 1)
Types and modes of Communication (LH: 1)
Language of communication (LH: 1)
Conversational skills (LH: 1)
Verbal and Non-verbal communication(LH: 1)
Personal, social and business communication (LH: 1)
Understanding English language films, songs, documentaries, news bulletins, sports commentaries (LH: 4)
Comprehension skills (LH: 2)
Paraphrasing difficult passages (LH: 2)
Analysis and Interpretation (LH: 1)
Writing for classified advertisements (LH: 2)
Using idioms and phrases (LH: 2)
One-word substitution (LH: 1)
Figures of speech: simile, metaphor, irony, personification, hyperbole (LH: 3)
Reading online content (LH: 1)
George Bernard Shaw: "Spoken English and Broken English" (LH: 4)

COURSE OUTCOME:

Besides developing the student's ability to comprehend the English that one hears and reads, the course will also enhance the student's skills at using English in speech and in various forms of writing. Thus, the course shall fulfil to a large extent an intensely felt need in today's professional world.

Semester-II	Course Type with Code	Name of the Course	Credit	Lect.	Tuto.	Pract./ Viva-voce	Full Marks	Distribution of Marks		
								Theory	Pract./ Viva-	Internal Assessment
	Value Added (VA) Course Code:CVA2061	Health & Wellness, Yoga Education, Sports and Fitness	4	3	0	1	100	60	20	20

Value Added (VA) Course

Course Name: Health & Wellness, Yoga Education, Sports and Fitness

Course Code: CVA2061 **Total Lecture Hours (Theory) :** 45

Credit: 4 **Total Lecture Hours (Practical):** 30

Unit- 1: Concepts of Wellness and Illness (15 Lecture Hours)

Concept of health (Modern and Ancient View); Concept of Wellness and Illness (Modern and Ancient View); Concept of Body (Pancha Kosha according to Taittiriya Upanisada); Potential causes of illness according to Yoga Vasishta- Concept of Adhi and Vyadhi and their consequences on the body

Unit- 2: Yogic Concept on Holistic Health (15 Lecture Hours)

Total Human Development through Yogic practices for Pancha Kosha (Annamaya Khosha, Pranamaya Kosha, Manomaya Kosha, Vijnanamaya Kosha and Ananda Maya Kosha) and its integration with Ashtanga Yoga of Patanjali.

Unit- 3: Yoga as Preventive Health Care (15 Lecture Hours)

Concept of stress according to modern science and yoga; Stress as the cause for illness; Role of Yoga in Stress Management: Holistic approach of catering to moderation in eating (yogic Diet), Sleeping (rhythm of the nature), Working (the sense of duty as per BG), Entertainment (moderation), Change in life style;

Unit-4 (Practical) : Asana (30 Lecture Hours)

Pranayama: Anulome-Vilome, Suryabhidana, Chancrabhedana, Ujjai, Sitali

Meditation: A-U-M Meditation, Yog Nidra

Reference Books:

1. Ajith 'Yoga Pravesh' Rastrotana Paruhad Bangalore.
2. Bachelor of Sports Management Syllabus (Revised) 2008.
3. B. C. Rai Health Education and Hygiene, Published by Prakashana Kendra, Lucknow.
4. B.K.S. Iyenger 'Yoga The Path of Holistic Health', Dorling Kindersley, Delhi 2001.
5. Dixit Suresh (2006) Swasthya Shiksha Sports Publication, Delhi.
6. Puri, K. Chandra, S.S (2005) Health and Physical Education, New Delhi, Surjeet Publication.
7. A Text Book on Physical Education & Health Education Fitness, Wellness and Nutrition, Dr. A. K. Uppal, Dr. P. P. Ranganathan.
8. Warner W. K. Oeger & Sharon A. Hoeger, Fitness & Wellness, Morton Publishing Co., 1990
9. Robert Malt. 90 day Fitness Plan, D. K. Publishing, Inc. 95, Madison Avenue, New York 2001.

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Department of Physics
Government General Degree College at Kalna -I

Lesson Plan
for
B.Sc. Semester-II
Subject: Physics
Paper Name: Mechanics
Paper Code: Major: PHYS2011

Credits: Theory-03, Practicals-01
F.M.=75 (Theory-40, Practical–20, Internal Assessment–15)

COURSE OBJECTIVE: The objectives of this course is to provide an in-depth understanding of the principles of Newtonian mechanics and apply them to solve problems involving the dynamics of classical mechanical systems.

Module-I **Fundamentals of Dynamics** (6 lectures)
Contents Reference frames; Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable- mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.
Module Objectives: In this module, Newtonian mechanics is developed from Galilean transformation. Three laws of motion and their implications are discussed. Finally, Newtonian framework is being used to solve different problems.

Lecture Serial	Topics of Discussion
Lecture-1	Review of basic ideas of Classical mechanics: Applicability, Limitation, Historical ideas
Lecture-2	Newton's laws of motion 1: Three laws with their importance. How 1st law is not a byproduct of 2nd law? Inertial frame as a fundamental idea of classical dynamics. Galilean transformation
Lecture-3	Newton's laws of motion 2: Problem solving using Newton's laws: Free body diagram
Lecture-4	Newton's laws of motion 3: Third law of motion and conservation of linear momentum
Lecture-5	Motion of a projectile in Uniform gravitational field and rocket motion.
Lecture-6	Dynamics of system of particles: Center of mass and its usefulness

Module-II **Work and Energy** (4 lectures)
Contents Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work Potential energy. Work done by non-conservative forces.Law of conservation of Energy.
Module Objectives: Force and Energy in Mechanics. Conservative and non-conservative forces and their implication. Energy diagram as a qualitative tool to analyze motion.

Lecture Serial	Topics of Discussion
Lecture-1	Work-Kinetic Energy Theorem as general consequence of Newton's laws of motion.

Lecture-2	Conservative and non- conservative forces. Examples of both. Path independence of work done under conservative force field.
Lecture-3	Idea of potential energy in context of conservative forces and conservation of mechanical energy for conservative forces.
Lecture-4	Energy diagram as a tool of analyzing particles in conservative force field.

Module-III **Collisions** (3 lectures)
Contents Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.
Module Objectives: Theories Elastic and inelastic collision are discussed in this module.

Lecture Serial	Topics of Discussion
Lecture-1	Theory of collision and its significance in terms of modern aspects of Physics.
Lecture-2	Elastic, inelastic and partially elastic collisions. Co-efficient of restitution in this aspect.
Lecture-3	Laboratory frame and COM frame for analysis of collision.

Tutorial Assignment—I

Module-IV **Rotational Dynamics** (8 lectures)
Contents Angular momentum of a particle and system of particles. Torque.Principle of conservation of angular momentum. Rotation about a fixed axis.Moment of Inertia.Calculation of moment of inertia for rectangular, cylindrical and spherical bodies.Kinetic energy of rotation. Motion involving both translation and rotation.
Module Objectives: Angular momentum being a key physical quantity is discussed in this module and its conservation principle is highlighted. Also, moment of inertia and its tensorial form is discussed in some detail which leads to concepts like principal axes of inertia and ellipsoid of inertia.

Lecture Serial	Topics of Discussion
Lecture-1	Rotational dynamics and key ideas about them.
Lecture-2	Angular momentum and Torque as key concepts in rotational dynamics.
Lecture-3	Angular momentum of a particle and system of particles and its conservation.
Lecture-4	Orbital and Spin angular momentum and their connection to orbital and Spin components of torque.
Lecture-5	Rotation about a fixed axis.Moment of Inertia tensor.
Lecture-6	Calculation of moment of inertia. Parallel axis and Perpendicular axis theorem
Lecture-7	Calculation of moment of inertia for rectangular, cylindrical and spherical bodies
Lecture-8	Kinetic energy of rotation. Ellipsoid of inertia. Motion involving both translation and rotation.

Module-V **Elasticity** (4 lectures)
Contents Elastic properties of matter, Hooke's Law, Relation between Elastic constants, Twisting torque on a cylinder or a wire, Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane and a concentrated load W is applied at the midpoint.

Module Objectives:
1. This module gives knowledge about different elastic constants and relation between them 2. one can get knowledge about twisting torque on a cylindrical wire and Torsional pendulum

Lecture Serial	Topics of Discussion
Lecture-1	Elastic constants: Hooke's law, stress-strain diagram, Youngs modulus, Bulk modulus, Rigidity modulus Poisson's ratio and relation between them
Lecture-2	Torsion of a wire: Work done in deforming a wire, Torsional Pendulum, Twisting torque on a Cylindrical Wire.
Lecture-3	Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane
Lecture-4	Bending of Beams: A concentrated load W is applied at the midpoint.

Tutorial Assignment—II

Module-VI **Gravitation and Central Force Motion** (4 lectures)
Contents Law of gravitation, Gravitational potential energy, Inertial and gravitational mass, Gravitational potential and the gravitational field due to a spherical shell and a solid sphere
Module Objectives: This unit gives idea about Gravitational potential energy and one can gain idea how to find Potential and field due to spherical shell and solid sphere inside and outside of it.

Lecture Serial	Topics of Discussion
Lecture-1	Basic theory of Gravitation: Law of gravitation.
Lecture-2	Gravitational potential energy. Inertial and gravitational mass.
Lecture-3	Potential and field due to spherical shell and solid sphere
Lecture-4	Potential and field inside and outside of a spherical shell and solid sphere and their graphical variation with distance

Module-VII **Motion of a particle under a central force field** (6 lectures)
Contents Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws.Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).
Module Objectives: 1. This unit delivers idea about the motion of a particle under central force field and the energy equation and energy diagram. 2. One can get idea about equation and types of orbits of a particle depending upon its energy. 3. One can also get knowledge about Kepler's Laws. 4. Basic idea about communication satellite can also be obtained.

Lecture Serial	Topics of Discussion
Lecture-1	Two-body problem and its reduction to one-body problem and its solution
Lecture-2	Central force: Definition and general properties, Form of equation of motion.
Lecture-3	The energy equation and energy diagram: Effective potential, Motion of a particle in inverse square field, Equation of orbit.
Lecture-4	Kepler's Laws: Kepler's Laws and their proofs

Lecture-5	Satellite in circular orbit and applications: Communication Satellites
Lecture-6	Geosynchronous orbits. Weightlessness, Basic idea of global positioning system (GPS).

Tutorial Assignment—III

Module-VIII **Oscillations** (6 lectures)
Contents Simple Harmonic Oscillations: Differential equation of SHM and its solution, Kinetic energy, potential energy, Total energy and their time-averaged values. Damped oscillation, Forced oscillations: Transient and steady states, Resonance, Sharpness of resonance, Power dissipation and Quality Factor, Compound pendulum.
Module Objectives: In this module, students will learn the motion of a simple harmonic oscillator and analyze the same in different domains.

Lecture Serial	Topics of Discussion
Lecture-1	Simple Harmonic Oscillations: definition, different examples
Lecture-2	Differential equation of SHM and its solution: $x(t) = A \sin(\omega t+\phi)$ significance of A and ϕ
Lecture-3	Energy of Simple harmonic oscillator: Kinetic energy, potential energy, total energy and their time-average values
Lecture-4	Damped oscillation: Solutions for (i) over, (ii) critical and (iii) under damping and its interpretation
Lecture-5	Forced oscillations: Transient and steady states
Lecture-6	Resonances: Amplitude resonance, velocity resonance. Power dissipation and Quality Factor

Module-IX **Non-Inertial Systems** (4 lectures)
Contents Non-inertial frames and fictitious forces. Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force.Coriolis force and its applications.Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.
Module Objectives: In this module, non-inertial frames will be discussed and physics in the same will be highlighted via Galilean transformations

Lecture Serial	Topics of Discussion
Lecture-1	Non-inertial frames and fictitious forces as their by-product.
Lecture-2	Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force.
Lecture-3	Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.
Lecture-4	Apply the ideas of non-inertial frames to explain Foucault's pendulum and hence understand the rotation of earth.

Tutorial Assignment—IV

COURSE OUTCOME: This course in Mechanics serves as the foundation for further progress towards the study of physics at graduate or post-graduate level. Upon completion of the course, the student will be able to apply Newton's laws of motion to different force fields for a single particle and for a system of particles.

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.

3. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
6. An Introduction to Classical Mechanics, R G Takwale & P S Puranik, TMG Hill.
7. Mechanics, P K Srivastava, New Age International Pvt. Ltd.
8. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
9. Vibrations, Waves and Acoustics, D Chattopadhyay and P C Rakshit, Books and Allied Pvt. Ltd.
10. Advanced Acoustics, D P Roychaudhuri and P Banerjee, The New Book Stall, 2009

Practical

Course Object:
1.To gain practical knowledge by applying the experimental methods to correlate with the theory of classical mechanics.
2. To apply the analytical techniques and graphical analysis to the experimental data.

Contents
1. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
2. To determine the Moment of Inertia of a Flywheel/regular shaped body.
3. To determine g and velocity for a freely falling body using Digital Timing Technique.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle/dynamical method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar pendulum/Kater's Pendulum.
8. To determine the value of Young's Modulus by Flexure method.

Lab:
1. . To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
2. To determine the Moment of Inertia of a Flywheel/regular shaped body.
3. To determine g and velocity for a freely falling body using Digital Timing Technique.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle/dynamical method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar pendulum/Kater's Pendulum.
8. To determine the value of Young's Modulus by Flexure method.

Reference Books:
1. Advanced Practical Physics for students, B. L. Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna,11thEdn,2011, KitabMahal.
3. Engineering Practical Physics, S.Panigrahi &B.Mallick,2015,CengageLearningIndiaPvt.Ltd.
4. Practical Physics,G.L.Squires,2015, 4thEdition,CambridgeUniversityPress.
5. Practical Physics, D Chattopadhyay, P C Rakshit and B Saha, Books and Allied Pvt. Ltd.
6. Advanced Practical Physics, B Ghosh and K G Mazumdar, Sreedhar Publishers.
7. B. Sc. Practical Physics, Harnam Singh and P S Heme, S Chand and Company Limited.
8. B. Sc. Practical Physics, C L Arora, S Chand and Company Limited.

Department of Physics

Government General Degree College at Kalna -I

Lesson Plan

for

B.Sc. Semester-I I

Subject: Physics

Paper Name: Electrical Circuits and Network Skills

Paper Code: SEC-2:PHYS2015

Credits: Theory-03

F.M.=50 (Theory-40, Internal Assessment-10)

COURSE OBJECTIVE: The aim of this course is to enable the students to understand the basics of electronic circuits. Practical design and trouble shoot of electronic instrument is also a major objective of this Couse.

Module-I

Basic Electricity Principles, Understanding Electrical Circuits, Electrical Drawing and Symbols

Contents

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. (5 Lectures)

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money. (8 Lectures)

Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. (5 Lectures)

Module Objectives:

1. Grasp fundamental electrical concepts
2. Analyze circuit components and Apply circuit analysis techniques
3. Creating Clear and Effective Diagrams

Lecture Serial	Topics of Discussion
Lecture-1.	Basic idea on Voltage, Current, Resistance, and Power.
Lecture-2.	Ohm's law. Series, parallel, and series-parallel combinations of resistance
Lecture-3.	Basic idea on AC Electricity and DC Electricity
Lecture-4.	Idea about Volmeter and ammeter
Lecture-5.	Measurment current and voltage with multimeter
Lecture-6.	Undersanding about Main electric circuit elements and their combination
Lecture-7.	Analyze DC sourced electrical circuits

Lecture-8.	Discuss on Current drop across the DC circuit elements.
Lecture-9.	Discuss on Voltage drop across the DC circuit elements.
Lecture-10.	Analyze Single-phase and three-phase alternating current sources.
Lecture-11.	Rules to analyze AC sourced electrical circuits
Lecture-12.	Real, imaginary and complex power components of AC source.
Lecture-13.	Power factor. Saving energy and money.
Lecture-14.	Mastering Electrical Symbols
Lecture-15.	Understanding Drawing Standards
Lecture-16	Ladder diagrams. Electrical Schematics. Power circuits. Control circuits.
Lecture-17	Tracking the connections of elements and identify current flow
Lecture-18	Tracking the connections of elements and identify voltage drop.

Tutorial Assignment—I

Module-II

Generators and Transformers, Electric Motors, Solid-State Devices, Electrical Protection, Electrical Wiring

Contents

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. (5 Lectures)
Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. (5 Lectures)
Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources (5 Lectures)
Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device) (5 Lectures)
Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit Cable trays. Splices: wire nuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. (7 Lectures)

Module Objectives:

1. Understanding Generator Operation and Analyzing Transformer Operation
2. Applying Motor Control Techniques
3. Analyzing Semiconductor Diodes
4. Understanding Fault Types and Studying Protective Devices
5. Executing Proper Wiring Techniques

Lecture Serial	**Topics of Discussion**
Lecture-1.	Understanding of DC Power sources
Lecture-2.	Working principal of AC/DC generators.
Lecture-3.	Connection of Inductance, capacitance

Lecture-4.	Calculation of impedence and admitance
Lecture-5.	Operation of transformers
Lecture-6.	Idea of Single-phase, three-phase & DC motors
Lecture-7.	Basci connection of Single-phase, three-phase & DC motors
Lecture-8.	Interfacing DC sources to control heaters & motors.
Lecture-9.	Interfacing AC sources to control heaters & motors.
Lecture-10.	Calculation of Speed & power of ac motor.
Lecture-11.	Solid-State Devices: Resistors, inductors and capacitors.
Lecture-12.	Basic idea on Diode and rectifiers.
Lecture-13.	Components in Series or in shunt
Lecture-14.	Response of inductors and capacitors with DC sources
Lecture-15.	Response of inductors and capacitors with AC sources
Lecture-16	Working principal of Relays. Fuses and disconnect switches.
Lecture-17	Circuit protection: Circuit breakers Overload devices. Ground-fault protection.
Lecture-18	Circuit protection: Grounding and isolating. Phase reversal. Surge protection.
Lecture-19	Interfacing DC sources to control elements
Lecture-20	Interfacing AC sources to control elements
Lecture-21	Different types of conductors and cables. Basics of wiring-Star and delta connection
Lecture-22	Calculation of Voltage drop and losses across cables and conductors.
Lecture-23	Instruments to measure current, voltage, power in DC circuits.
Lecture-24	Instruments to measure current, voltage, power in AC circuits.
Lecture-25	Solid and stranded cable. Conduit Cable trays.
Lecture-26	Splices: wire nuts, crimps, terminal blocks, split bolts, and solder.
Lecture-27	Preparation of extension board.

Tutorial Assignment—II

COURSE OUTCOME: After the completion of the course the student will acquire necessary skills/ hands on experience /working knowledge on Multimeter, voltmeters, ammeters, electric circuit elements, dc power sources. With the knowledge of basic electronics a student can able to detect troubleshoot and repair some of the electronic instruments used in our daily life.

Reference Books:

1. A Text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A Text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn.

Department of Physics
Government General Degree College at Kalna -I

Lesson Plan
for
B.Sc. Semester-II
Subject: Physics
Paper Name: Mechanics
Paper Code: Minor: PHYS2021

Credits: Theory-03, Practicals-01
F.M.=75 (Theory-40, Practical–20, Internal Assessment–15)

COURSE OBJECTIVE: The objectives of this course is to provide an in-depth understanding of the principles of Newtonian mechanics and apply them to solve problems involving the dynamics of classical mechanical systems.

Module-I **Fundamentals of Dynamics** (6 lectures)
Contents Reference frames; Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable- mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.
Module Objectives: In this module, Newtonian mechanics is developed from Galilean transformation. Three laws of motion and their implications are discussed. Finally, Newtonian framework is being used to solve different problems.

Lecture Serial	Topics of Discussion
Lecture-1	Review of basic ideas of Classical mechanics: Applicability, Limitation, Historical ideas
Lecture-2	Newton's laws of motion 1: Three laws with their importance. How 1st law is not a byproduct of 2nd law? Inertial frame as a fundamental idea of classical dynamics. Galilean transformation
Lecture-3	Newton's laws of motion 2: Problem solving using Newton's laws: Free body diagram
Lecture-4	Newton's laws of motion 3: Third law of motion and conservation of linear momentum
Lecture-5	Motion of a projectile in Uniform gravitational field and rocket motion.
Lecture-6	Dynamics of system of particles: Center of mass and its usefulness

Module-II **Work and Energy** (4 lectures)
Contents Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work Potential energy. Work done by non-conservative forces.Law of conservation of Energy.
Module Objectives: Force and Energy in Mechanics. Conservative and non-conservative forces and their implication. Energy diagram as a qualitative tool to analyze motion.

Lecture Serial	Topics of Discussion
Lecture-1	Work-Kinetic Energy Theorem as general consequence of Newton's laws of motion.

Lecture-2	Conservative and non- conservative forces. Examples of both. Path independence of work done under conservative force field.
Lecture-3	Idea of potential energy in context of conservative forces and conservation of mechanical energy for conservative forces.
Lecture-4	Energy diagram as a tool of analyzing particles in conservative force field.

Module-III **Collisions** (3 lectures)
Contents Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.
Module Objectives: Theories Elastic and inelastic collision are discussed in this module.

Lecture Serial	Topics of Discussion
Lecture-1	Theory of collision and its significance in terms of modern aspects of Physics.
Lecture-2	Elastic, inelastic and partially elastic collisions. Co-efficient of restitution in this aspect.
Lecture-3	Laboratory frame and COM frame for analysis of collision.

Tutorial Assignment—I

Module-IV **Rotational Dynamics** (8 lectures)
Contents Angular momentum of a particle and system of particles. Torque.Principle of conservation of angular momentum. Rotation about a fixed axis.Moment of Inertia.Calculation of moment of inertia for rectangular, cylindrical and spherical bodies.Kinetic energy of rotation. Motion involving both translation and rotation.
Module Objectives: Angular momentum being a key physical quantity is discussed in this module and its conservation principle is highlighted. Also, moment of inertia and its tensorial form is discussed in some detail which leads to concepts like principal axes of inertia and ellipsoid of inertia.

Lecture Serial	Topics of Discussion
Lecture-1	Rotational dynamics and key ideas about them.
Lecture-2	Angular momentum and Torque as key concepts in rotational dynamics.
Lecture-3	Angular momentum of a particle and system of particles and its conservation.
Lecture-4	Orbital and Spin angular momentum and their connection to orbital and Spin components of torque.
Lecture-5	Rotation about a fixed axis.Moment of Inertia tensor.
Lecture-6	Calculation of moment of inertia. Parallel axis and Perpendicular axis theorem
Lecture-7	Calculation of moment of inertia for rectangular, cylindrical and spherical bodies
Lecture-8	Kinetic energy of rotation. Ellipsoid of inertia. Motion involving both translation and rotation.

Module-V **Elasticity** (4 lectures)
Contents Elastic properties of matter, Hooke's Law, Relation between Elastic constants, Twisting torque on a cylinder or a wire, Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane and a concentrated load W is applied at the midpoint.

Module Objectives:
1. This module gives knowledge about different elastic constants and relation between them 2. one can get knowledge about twisting torque on a cylindrical wire and Torsional pendulum

Lecture Serial	Topics of Discussion
Lecture-1	Elastic constants: Hooke's law, stress-strain diagram, Youngs modulus, Bulk modulus, Rigidity modulus Poisson's ratio and relation between them
Lecture-2	Torsion of a wire: Work done in deforming a wire, Torsional Pendulum, Twisting torque on a Cylindrical Wire.
Lecture-3	Bending of Beams: Cantilever, Beam supported near the ends on two knife edges held in the same horizontal plane
Lecture-4	Bending of Beams: A concentrated load W is applied at the midpoint.

Tutorial Assignment—II

Module-VI **Gravitation and Central Force Motion** (4 lectures)
Contents Law of gravitation, Gravitational potential energy, Inertial and gravitational mass, Gravitational potential and the gravitational field due to a spherical shell and a solid sphere
Module Objectives: This unit gives idea about Gravitational potential energy and one can gain idea how to find Potential and field due to spherical shell and solid sphere inside and outside of it.

Lecture Serial	Topics of Discussion
Lecture-1	Basic theory of Gravitation: Law of gravitation.
Lecture-2	Gravitational potential energy. Inertial and gravitational mass.
Lecture-3	Potential and field due to spherical shell and solid sphere
Lecture-4	Potential and field inside and outside of a spherical shell and solid sphere and their graphical variation with distance

Module-VII **Motion of a particle under a central force field** (6 lectures)
Contents Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws.Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).
Module Objectives: 1. This unit delivers idea about the motion of a particle under central force field and the energy equation and energy diagram. 2. One can get idea about equation and types of orbits of a particle depending upon its energy. 3. One can also get knowledge about Kepler's Laws. 4. Basic idea about communication satellite can also be obtained.

Lecture Serial	Topics of Discussion
Lecture-1	Two-body problem and its reduction to one-body problem and its solution
Lecture-2	Central force: Definition and general properties, Form of equation of motion.
Lecture-3	The energy equation and energy diagram: Effective potential, Motion of a particle in inverse square field, Equation of orbit.
Lecture-4	Kepler's Laws: Kepler's Laws and their proofs

Lecture-5	Satellite in circular orbit and applications: Communication Satellites
Lecture-6	Geosynchronous orbits. Weightlessness, Basic idea of global positioning system (GPS).

Tutorial Assignment—III

Module-VIII **Oscillations** (6 lectures)
Contents Simple Harmonic Oscillations: Differential equation of SHM and its solution, Kinetic energy, potential energy, Total energy and their time-averaged values. Damped oscillation, Forced oscillations: Transient and steady states, Resonance, Sharpness of resonance, Power dissipation and Quality Factor, Compound pendulum.
Module Objectives: In this module, students will learn the motion of a simple harmonic oscillator and analyze the same in different domains.

Lecture Serial	Topics of Discussion
Lecture-1	Simple Harmonic Oscillations: definition, different examples
Lecture-2	Differential equation of SHM and its solution: $x(t) = A \sin(\omega t+\phi)$ significance of A and ϕ
Lecture-3	Energy of Simple harmonic oscillator: Kinetic energy, potential energy, total energy and their time-average values
Lecture-4	Damped oscillation: Solutions for (i) over, (ii) critical and (iii) under damping and its interpretation
Lecture-5	Forced oscillations: Transient and steady states
Lecture-6	Resonances: Amplitude resonance, velocity resonance. Power dissipation and Quality Factor

Module-IX **Non-Inertial Systems** (4 lectures)
Contents Non-inertial frames and fictitious forces. Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force.Coriolis force and its applications.Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.
Module Objectives: In this module, non-inertial frames will be discussed and physics in the same will be highlighted via Galilean transformations

Lecture Serial	Topics of Discussion
Lecture-1	Non-inertial frames and fictitious forces as their by-product.
Lecture-2	Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force.
Lecture-3	Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.
Lecture-4	Apply the ideas of non-inertial frames to explain Foucault's pendulum and hence understand the rotation of earth.

Tutorial Assignment—IV

COURSE OUTCOME: This course in Mechanics serves as the foundation for further progress towards the study of physics at graduate or post-graduate level. Upon completion of the course, the student will be able to apply Newton's laws of motion to different force fields for a single particle and for a system of particles.

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
6. An Introduction to Classical Mechanics, R G Takwale & P S Puranik, TMG Hill.
7. Mechanics, P K Srivastava, New Age International Pvt. Ltd.
8. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
9. Vibrations, Waves and Acoustics, D Chattopadhyay and P C Rakshit, Books and Allied Pvt. Ltd.
10. Advanced Acoustics, D P Roychaudhuri and P Banerjee, The New Book Stall, 2009

Practical

Course Object:

1.To gain practical knowledge by applying the experimental methods to correlate with the theory of classical mechanics.

2. To apply the analytical techniques and graphical analysis to the experimental data.

Contents
1. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
2. To determine the Moment of Inertia of a Flywheel/regular shaped body.
3. To determine g and velocity for a freely falling body using Digital Timing Technique.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle/dynamical method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar pendulum/Kater's Pendulum.
8. To determine the value of Young's Modulus by Flexure method.

Lab:
1. . To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
2. To determine the Moment of Inertia of a Flywheel/regular shaped body.
3. To determine g and velocity for a freely falling body using Digital Timing Technique.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle/dynamical method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar pendulum/Kater's Pendulum.
8. To determine the value of Young's Modulus by Flexure method.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna,11thEdn,2011, KitabMahal.
3. Engineering Practical Physics, S.Panigrahi &B.Mallick,2015,CengageLearningIndiaPvt.Ltd.
4. Practical Physics,G.L.Squires,2015, 4thEdition,CambridgeUniversityPress.
5. Practical Physics, D Chattopadhyay, P C Rakshit and B Saha, Books and Allied Pvt. Ltd.
6. Advanced Practical Physics, B Ghosh and K G Mazumdar, Sreedhar Publishers.
7. B. Sc. Practical Physics, Harnam Singh and P S Heme, S Chand and Company Limited.
8. B. Sc. Practical Physics, C L Arora, S Chand and Company Limited.