John Wilson Education Society's

Wilson College (Autonomous)

Chowpatty, Mumbai-400007
RE-ACCREDITED 'A' grade by NAAC

Affiliated to the
UNIVERSITY OF MUMBAI

Syllabus for Second Year Bachelor of Science

Program: Bachelor of Science (B.Sc.)

Program Code: WSPHY (Physics)

National Education Policy 2020
Academic year 2024–2025

Discipline Specific Core Course 7

PROGRAM: S.Y.B.Sc.			SEMESTER:III		
Course: Mechanics I			Course Code: WSPHYMJ231		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
2	-	-	2	40	60

Learning Objectives:

1. To understand application of Newton's Laws for a multitude of systems.
2. To understand simple harmonic oscillator under various circumstances (free, damped, forced)

Course Outcomes: After completion of the course, learner will be able to

CO1: apply the concepts of classical mechanics in the real world.

CO2: identify approximations/assumptions for real life situations.

CO3: set up equations to solve problems.

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**Newton's Laws, its applications & Simple Harmonic Motion (Undamped and Damped)**	**15**
	1.1	1. (Translational and Rotational), Third Law (weak and strong form) 2. Concepts of Normal Reaction, Tension, Friction 3. Concept of Pseudo Force [Chapter 4, 5, 6 – Ref (2)] *(This part will be mostly problem based)*	
	1.2	Simple Harmonic Oscillator – (a) Theory. [Sec 9.1 – Ref (1)] (b) Examples – Simple Pendulum, Loaded Spring, Torsional Pendulum (angular vibrations), Compound Pendulum, Kater's Reversible Pendulum, Helmholtz Resonator – Longitudinal Vibrations in a Gas, L-C Circuit—Electrical Oscillations. [Sec 9.1.1 – Ref (1)]	

		(c) Energy [Sec 9.2 – Ref (1)]	
	1.3	Damped Harmonic Oscillator – (a) Solution [Sec 9.3 – Ref (1)] (b) Energy, Logarithmic Decrement, Relaxation Time, Quality factor [Sec 9.4 – Ref (1)] (c) Examples: Resistance Damping. Oscillatory Discharge of a Condenser Through a Circuit Containing Resistance and Inductance, Electromagnetic Damping in a Moving Coil Galvanometer. [Sec 9.5 – Ref (1)]	
II		**Work and Energy & Simple Harmonic Motion (Forced Damped)**	**15**
	2.1	Circular Motion [Chapter 7 – Ref (2)] *(This part will be mostly problem based)* (a) Kinematics and dynamics (b) Centrifugal and Centripetal Force	
	2.2	Work and Energy [Chapter 8 – Ref (2)] *(This part will be mostly problem based)* (a) Work Energy Theorem (b) Conservative and non-conservative forces, Potential Energy	
	2.3	Forced Damped Harmonic Oscillator – (a) Solution [Sec 9.6 – Ref (1)] (b) Resonance, Quality Factor [Sec 9.7 – Ref (1)] (c) Electrical [Sec 9.8 – Ref (1)] (d) Superposition Principle [Sec 9.9 – Ref (1)]	

References:

(1) Mechanics – Hans, S. P. Puri (Tata McGraw-Hill (2006))(2nd edition)
(2) Concepts of Physics – H.C. Verma (Bharati Bhuvan)

Additional Reference:

(1) Mechanics – Symon (3rd edition) (Addison-Wesley)(1971)
(2) David Halliday, Robert Resnick, Jearl Walker - Fundamentals of Physics_ Extended-Wiley (2018)
(3) An Introduction to Mechanics - Kleppner, Kolenkow (2nd edition)
(4) Physics For Mathematicians, Mechanics Spivak *(Advanced)*
(5) Classical Mechanics - Herbert Goldstein (3rd edition) *(Advanced)*

Discipline Specific Core Course 8

PROGRAM: S.Y.B.Sc.			**SEMESTER:III**		
Course: Thermodynamics II			**Course Code: WSPHYMJ232**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
2	**-**	**-**	**2**	**40**	**60**

Learning Objectives:

1. To understand the second law of thermodynamics and its implications.
2. To learn techniques required to apply thermodynamics in diverse conditions.

Course Outcomes: After completion of the course, learner will be able to

CO1: apply the second law of thermodynamics in explaining phenomena.

CO2: define entropy and use it in quantitative descriptions of a system.

CO3: employ thermodynamic potentials in order to study equilibrium conditions in a system.

CO4: analyse different systems using thermodynamic techniques.

DETAILED SYLLABUS

Unit	**Sub-Unit**	**Course/ Unit Title**	**Lectures**
I		**The Second Law**	**15**
	1.1	Basics – Reversibility and Ir-reversibility, Statements of the second law(GBG – 6.1 – 6.6)	
	1.2	Carnot Theory – Relation to the second Law, Thermodynamic Temperature scale, Clausius – Clapeyron Latent heat equation.(GBG – 6.7 – 6.8)	
	1.3	Entropy – Concept, Change of entropy during processes, Second law in terms of entropy, Unavailable energy, disorder.(GBG 7.1 – 7.9)	
	1.4	Combining first and second law,Physical implications of the second law ,Third Law of Thermodynamics(SS- 6.1-6.12)	
II		**Thermodynamic Relations**	**15**
	2.1	Free energy, Thermodynamic Potentials, Maxwell' s Relations.(SS-7.1-7.7)	

	2.2	Principles applicable to different systems, Conditions for equilibrium.(GBG- 9.1-9.6)	
	2.3	Study of Physical and Chemical ,Phenomena and Systems(SS- 8.1- 8.8, DK- 12.1-12,6)	
	2.4	Applications to other areas of science(SS – 8.9, DK 13.1-13.4)	

References:

1. Thermal Physics: with Kinetic Theory, Thermodynamics and Statistical Mechanics , 2nd Edition, by S.C. Garg , R.M. Bansal , C.K. Ghosh - McGraw Hill Education (GBG)
2. Thermodynamics Kinetic Theory and Statistical Thermodynamics,3rd edition by F.W. Sears, G.L. Salinger - Narosa Publishing House(SS)
3. Introduction to modern thermodynamics, by D. Kondepudi - Wiley(DK)

Additional Reference:

1. An introduction to Thermal Physics, by D.V. Shroeder - Addison-Wesley
2. Heat and Thermodynamics, by M.W. Zemansky and R.H. Dittman - McGraw Hill
3. Thermodynamics and Statistical Mechanics by W. Griener, L. Niece and H Stöcker - Springer

Discipline Specific Core Course 9

PROGRAM: S.Y.B.Sc.			SEMESTER:III		
Course: Waves and Oscillations			Course Code: WSPHYMN231		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
2	-	-	2	40	60

Learning Objectives:

1) To build mathematical model for oscillatory systems
2) To enlist and correlate various oscillatory systems
3) To solve differential equations of waves and oscillations
4) To study natural systems carrying waves with oscillatory motions of particles of media.

Course Outcomes: After completing the course, learner will be able to

CO1: set up differential equation for given oscillatory system

CO2: solve differential equations to get solution under various initial and boundary conditions

CO3: relate various oscillatory system to coupled harmonic oscillators and electrical analogs

CO4: set up differential equation for media carrying waves

CO5: examine overtones of various vibrating systems

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
1		**Oscillations**	**15**
	1.1	Simple Harmonic Oscillation using mass - spring system, Simple Harmonic oscillator Systems	3
	1.2	Damped Harmonic Oscillators: underdamped, overdamped and critically damped oscillations; critical damping applications, Analogy between mechanical and electrical systems	4
	1.3	Forced Harmonic oscillator, phase between driving and driven oscillations, resonance: displacement and velocity resonance, Q factor	3

	1.4	Two-coupled harmonic oscillators, normal modes of vibrations. Oscillations of diatomic and linear triatomic molecules, n-coupled harmonic oscillators, dispersion	5
2		**Waves**	**15**
	2.1	Fourier Series and analysis	4
	2.2	Wave equation in 1 dimension, phase of a wave, general solution Wave equation for motion of a stretched string, various initial conditions one dimensional medium as limiting case of n-coupled oscillator	4
	2.3	Wave equation for motion of sound wave in pipe: pipe open at one end, pipe open at both ends Harmonics and Overtones Speed of sound in air	3
	2.4	Wave equation in 2 and 3 dimensions, solution by separation of variables, motion of circular drum membrane, motion of square plate.	4

References:

Puri SP, Textbook of Vibrations and Waves; Macmillan India Ltd, 2004

Chapters 1, 2, 3, 4, 5, 6 all full

Additional Reference:

Halliday, D., Resnik R, Walker J; Fundamentals of Physics, 9th Edition

Morrin D., Introduction to Classical Mechanics, Cambridge, (2009) (Chapter 4)

Modality of Assessment

Theory Examination Pattern: (for Discipline Specific Core papers)

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	**Evaluation Type**	**Marks**
1	Assignment/ Case study/ field visit report/ presentation/ project	20
2	Assignment/ Case study/ field visit report/ presentation/ project	20
	Total	**40**

B. **External Examination- 60%- 60 Marks per course (for Discipline Specific Core courses)**

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:
   a) There shall be 3 questions each of 20 marks with different levels of difficulty.
   b) All questions shall be compulsory with at least 50% internal choice within the questions. (For example, 4 out of 6 sub-questions to be solved).
   c) All units will be given equal weightage.

Discipline Specific Core Course 10

PROGRAM: S.Y.B.Sc.			**SEMESTER:III**		
Course: Physics Practical Course 3			**Course Code: WSPHYMJ233**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
-	**4**	**-**	**2**	**40**	**60**

Learning Objectives:

1) To explore various oscillatory systems
2) To learn measurement techniques with timers
3) To verify various relations of elastic properties of materials
4) To study electrical analog of oscillatory systems

Course Outcomes: After completing the course, learner will be able to

CO1: setup the instruments as per instructions.

CO2: develop time measurement skill

CO3: record observations with uncertainty involved.

CO4: analyse the observations for scientific inference.

DETAILED SYLLABUS

Sr. No.	**Experiments**	**Credits/Hours (60 Hours)**
1	Flat spiral spring – as simple harmonic oscillator	
2	Torsional pendulum	
3	Bar pendulum as compound pendulum	
4	Young's modulus of material of flat spiral spring	
5	Modulus of rigidity of material of flat spiral spring	
6	Young's modulus by Vibration of cantilever	
7	Young's modulus by Konig's method	
8	Logarithmic decrement	

9	Resonance pendulum	
10	LCR series resonance	
11	LCR transients	
12	Thermal conductivity by Lee's method	
13	First law of thermodynamics	
14	Comparing irreversible process with reversible process	
15	Article (Equivalent to 2 experiments)	

References:
Lab manual will be prepared for the reference of students.

Modality of Assessment

Practical Examination Pattern: (for Discipline Specific Core Courses)

75% experiments must be completed for the journal certification. Without certified journal, learner will not be allowed to appear for the practical examination.

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	**Evaluation Type**	**Marks**
1	Viva	10
2	Journal	30
	Total	**40**

B. **External Examination- 60%- 60 Marks per course (for Discipline Specific Core courses)**

Sr. No.	**Evaluation Type**	**Marks**
1	Long Experiment (2 hours)	40
2	Short Experiment (1 hour)	20
	Total	**60**

Skill Enhancement Course 3

PROGRAM: S.Y.B.Sc.			**SEMESTER:III**		
Course: Computational Techniques using Python			**Course Code: WSPHYSE231**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
-	**4**	**-**	**2**	**-**	**60**

Learning Objectives:

1) To develop algorithms for coding
2) To learn Numerical techniques for solving problems in calculus
3) To develop Mathematical modelling for physics situation
4) To learn Python programming

Course Outcomes: After completing this course, learner will be able to

CO1: write an algorithm for performing mathematical operations.

CO2: write python code to do numerical operations.

CO3: display the calculated results in appropriate text, numerical or graphical format.

CO4: explore numpy and scipy libraries

CO5: interpret numerical results

CO6: construct a mathematical model of a physical situation

DETAILED SYLLABUS

Sr. No.	Experiments	hours (2 credits/ 60 hours)
1	Data types in Python 1 integer, float numbers, string, boolean Input and Output statements	
2	Data types in Python 2 List and tuples, List manipulations	
3	Conditional statements, branching and loop If-else-elif statements, for loop	
4	Introduction to numpy library	
5	Introduction to matplotlib.pyplot library trigonometric, exponential, logarithmic, polynomial functions	
6	formatting output and graphs	
7	Iterative methods and Newton Raphson method to solve transcendental and polynomial equations.	
8	Trapezoidal rule for numerical integration Example: Planck curve, gaussian curve	
9	Simpson's ⅓ method for numerical integration Example: Planck curve, gaussian curve	
10	Weddle's rule and Boole's rule for numerical integration	
11	Newton's forward difference method	
12	Numerical differentiation	
13	Linear regression, quadratic regression	
14	power regression and logarithmic regression	
15	Euler method for differential equation of 1st order Radioactivity, Beer-Lambert's law, Coupled equations	
16	RK 2 method	
17	RK 4 method	
18	Euler method for differential equation of 2nd order	

	Simple harmonic oscillator, Damped forced harmonic oscillator, resonance and phase - space representations	
19	Euler method: large amplitude pendulum, projectile motion with damping, two bodies under mutual gravity	
20	Introduction to scipy library	
21	matrix operations	
22	Fourier transform, FFT techniques	

References:

Lohar D; Computational Methods for Physics; Medtech (2019)

Dumka P., Dumka R. and Mishra D.; Numerical methods using Python (For scientists and engineers), Bluerose Publishers, 2022

Modality of Assessment

75% experiments must be completed for the journal certification. Without certified journal, learner will not be allowed to appear for the practical examination.

Practical Examination Pattern: (for Skill Enhancement Courses)
There will be three experiments each for 1 hour.

Sr. No.	**Evaluation Type**	**Marks**
1	**Experiment 1**	**20**
2	**Experiment 2**	**20**
3	**Experiment 3**	**20**
	Total	**60**

Value Education Course 3

PROGRAM: S.Y.B.Sc.			**SEMESTER: III**		
Course: Digital Communication Technologies			**Course Code: WSPHYVE231**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Assessment (CIA)**	**Semester End Examination (Marks- 60)**
2	**-**	**-**	**2**	**60**	**-**
Learning Objectives: To make learners aware of various communication technologies. To explain various technical specifications related to electronic communication.					
Course Outcomes: After completing the course, learner will be able to CO1: distinguish between various communication channels CO2: list technical specifications of various generations of communication CO3: choose the appropriate communication package for given applications CO4: relate between various applications and its data needs CO5: identify technology involved in the given communication system					

DETAILED SYLLABUS

Unit	**Sub-Unit**	**Course/ Unit Title**	**Lectures**
I		**Introduction to digital and wired communication technology.**	**15**
	1.1	Digital signals, modulation - demodulation, encryption- decryption, block diagram of digital communication, ADC	
	1.2	Internet, TCP/IP model, Browser, DNS, ISP	
	1.3	Cable internet and television. (co-axial & twisted pair cable)	
	1.4	fiber-optics, types, structure, uses.	
II		**Wireless communication technologies.**	**15**
	2.1	Cellular phone communication: 2G, 3G, 4G, 5G	

	2.2	Wifi: Router, Access point.	
	2.3	Satellite communication, GPS, DTH	
	2.4	Bluetooth, NFC, RFID, QR codes	
	2.5	Applications: UPI, RFID, IoT, Cloud computing	

References:

1) **Introduction to Digital Communications-Academic Press (2016) Elsivier - Ali Grami**
2) **Evolution of Wireless Communication Ecosystems (2023), Wiley Publication - Dr. Suat Seçgin**

Modality of Assessment

Theory Examination Pattern: (for Value Education Course)

Sr. No.	**Evaluation Type**	**Marks**
1	Assessment 1 Assignment/ Case study/ field visit report/ presentation/ project	30
2	Assessment 2 Assignment/ Case study/ field visit report/ presentation/ project	30
	Total	**60**

Open Elective 3

PROGRAM: S.Y.B.A.			**SEMESTER:III**		
Course: Light and Sound			**Course Code: WAPHYOE231**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Assessment**	**Semester End Examination**
2	**-**	**-**	**2**	**60**	**-**
Learning Objectives: 1. To understand light as a physical phenomena. 2. To understand sound as a physical phenomena.					
Course Outcomes: after completing the course, learner will be able to CO1: recognise various properties of light. CO2: relate optical phenomena to visual observations. CO3: recognise sound waves in various media. CO4: match observed sound effects to behaviour of sound waves.					

DETAILED SYLLABUS

Unit	**Sub-unit**	**Course/Unit Title**	**Lectures**
I		**Light**	**15**
	1.1	Nature of light, Sources of light, Properties of light, Light in different media, Light and Shadow	
	1.2	Reflection, refraction, absorption, dispersion, interference phenomena	
	1.3	The human eye, colour perception, optical illusions, optical instruments, generation of light	
II		**Sound**	**15**
	2.1	Oscillations, sound waves, properties of sound, sound in different media, addition of sound waves	
	2.2	Strings, pipes, membranes, musical instruments, musical scales	
	2.3	The human ear, perception of sound, acoustics, other sound phenomena	

References:

1. Physics in the Arts, by P.U.P.A. Gilbert and W. Haeberli - Academic Press(Elsevier)
2. Sears and Zemansky's University Physics, by R.A. Freedman and H.D. Young - Pearson
3. Sears and Zemansky's College Physics, by H.D. Young - Addison-Wesley
4. The Feyman lectures in Physics (Vol. I), by R.P. Feynman, R.B. Leighton, M. Sands - Addison-Wesley

Modality of Assessment

Theory Examination Pattern: (for Open Elective Course)

Sr. No.	Evaluation Type	Marks
1	Assessment 1 Assignment/ Case study/ field visit report/ presentation/ project	30
2	Assessment 2 Assignment/ Case study/ field visit report/ presentation/ project	30
	Total	**60**

Discipline Specific Core Course 11

PROGRAM: S.Y.B.Sc.			**SEMESTER:IV**		
Course: Quantum Mechanics			**Course Code: WSPHYMJ241**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
2	**-**	**-**	**2**	**40**	**60**

Learning Objectives:

1. To understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics.
2. To demonstrate quantitative problem solving skills in all the topics covered.

Course Outcomes: After completion of the course, learner will be able to

CO1: apply the postulates of quantum mechanics in explaining phenomena in Physics.

CO2: demonstrate problem solving skills in all the topics covered.

CO3: interpret the solutions of the Schrodinger Equation.

CO4: use Quantum Mechanics to solve real world problems.

DETAILED SYLLABUS

Unit	**Sub-Unit**	**Course/ Unit Title**	**Lectures**
I		**Schrodinger Equation, Wavefunction, Formalism, Applications**	**15**
	1.1	Wave Function, The Schrodinger Equation and its Statistical Interpretation. [Sec 1.1,1.2 - Ref(1)] Normalization of the wavefunction [Sec 1.4 - Ref(1)] Momentum [Sec 1.5 - Ref(1)]	
	1.2	Time independent Schrodinger Equation - Stationary States [Sec 2.1 - Ref(1)]	
	1.3	Formalizm: Hilbert Space [Sec 3.1 - Ref(1)], Observables [Sec 3.2 - Ref(1)], Eigenfunctions of a Hermitian operator [Sec 3.3 - Ref(1)], Generalized statistical interpretation [Sec 3.4 - Ref(1)], The Uncertainty Principle [Sec 1.6, 3.5 -	

		Ref(1)], Vectors and Operators [Sec 3.6 - Ref(1), Appendix - Linear Algebra - Ref(1)]	
	1.4	Free particle. [Sec 2.4 - Ref(1)]	
	1.5	Particle in infinitely deep potential well (one - dimension) [Sec 2.2 - Ref(1)]	
II		**Applications of Schrodinger steady state equation**	**15**
	2.1	Particle in finitely deep potential well (one - dimension). [Sec 2.6 - Ref(1)]	
	2.2	The Delta Function Potential [Sec 2.5 - Ref(1)]	
	2.3	Step potential. [Sec 8.2 - Ref(2)]	
	2.4	Potential Barrier - Finite height and width [Prob 2.33 (Ref(1), Sec 8.3 - Ref(2)]	
	2.5	Harmonic oscillator (one-dimension) [Sec 2.3 - Ref 1]	
	2.6	Particle in three dimension rigid box, degeneracy of energy state. [Sec 6.8 - Ref(2)]	

References:

1. Introduction to Quantum Mechanics – Griffiths, Schroeder (3rd edition)
2. Quantum Mechanics: Theory and Application – Ajoy Ghatak & S. Lokanathan

Additional Reference:

1. Quantum Mechanics - Leonard Schiff
2. Quantum Mechanics - Eugen Merzbacher
3. Quantum Mechanics - Claude Cohen Tannoudji, Bernard Diu, Frank Laloe
4. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles. - By R. Eisberg and R. Resnik.

Discipline Specific Core Course 12

PROGRAM: S.Y.B.Sc.			**SEMESTER:IV**		
Course: Physical Optics			**Course Code: WSPHYMJ242**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
2	**-**	**-**	**2**	**40**	**60**

Learning Objectives:

- To learn basic concepts of interference, diffraction and polarization.
- To learn explanations of various phenomena based on interference, diffraction and polarization.
- Applications of interference, diffraction and polarization in day to day life.

Course Outcomes:

CO1: The learner will be able to explain optical phenomena such as interference, diffraction and polarization

CO2: The learner will be able to realize the use of the above phenomena in day to day life.

CO3: The learner will be able to use optical instruments effectively.

DETAILED SYLLABUS

Unit	**Sub-Unit**	**Course/ Unit Title**	**Lectures**
I		**Interference**	**15**
	1.1	Interference of Two Beams of Light: Huygens' Principle, Young's Experiment, Interference Fringes from a Double Source, Intensity Distribution in the Fringe System, Fresnel's Biprism, Coherent Sources, Division of Amplitude; Michelson Interferometer, Circular Fringes, Localized Fringes, White-Light Fringes, Visibility of the Fringes, Interferometric Measurements of Length (JW: Chapter 13)	
	1.2	Interference Involving Multiple Reflections: Reflection from a Plane-Parallel Film, Fringes of Equal Inclination, Interference in the Transmitted Light, Fringes of Equal Thickness, Newton's Rings, Fabry-Perot Interferometer, Brewster's Fringes, Chromatic Resolving Power, Comparison of Wavelengths with the Interferometer, Study of Hyperfine Structure and of Line Shape, (JW: Chapter 14)	

II		**Diffraction**	**15**
	2.1	Fresnel's Diffraction: Fresnel's assumptions, Rectilinear propagation (Half period zones) of light, Diffraction pattern due to straight edge, Positions of maxima and minima in intensity, Intensity at a point inside the geometrical shadow(straightedge)(SB: Chapter 17)	
	2.2	Fraunhofer Diffraction: Introduction, Fraunhofer diffraction at a single slit, Intensity distribution in diffraction pattern due to a single slit, Fraunhofer diffraction at a double slit, Distinction between single slit and double slit, Effect of Increasing the Number of Slits, Intensity Distribution from an Ideal Grating, Principal Maxima, Minima and Secondary Maxima, Formation of Spectra by a Grating, Dispersion, Overlapping of Orders, Width of the Principal Maxima. (Brij lal and Subramaniyam:: Chapter 17) Chromatic Resolving Power of a Prism, Resolving Power of a Telescope, Resolving Power of a Microscope. (Brij lal and Subramaniyam: Chapter 18)	
	2.3	Types of polarization, Plane polarized light, Circularly polarized light, Elliptically polarized light, Partially polarized light, Production of Plane polarized light, Polarization by reflection from dielectric surface, Polarization by refraction - pile of plates, Polarization by scattering, Polarization by selective Absorption, Polarization by double refraction, Brij lal and Subramaniyam: Chapter 19)	
	2.4	Polarizer and Analyzer, Malus' Law, Anisotropic crystal, Calcite crystal, Optic Axis, Double refraction in calcite crystal, Huygens' explanation of double refraction. Applications of polarized light. (SB: Chapter 18)	

References:

1. **JW:** Fundamentals of Optics by Jenkins and White, McGraw Hill.
2. **SB**:A TextBook Of Optics By Dr. N. Subrahmanyam, Brijlal, Dr M.N. Avadhanulu, S.Chand,
3. Optics by Ajoy Ghatak, McGraw Hill.
4. Optics by Eugene Hecht, Addison Wesley.

Discipline Specific Core Course 13

PROGRAM: S.Y.B.Sc.			**SEMESTER:IV**		
Course: Intermediate Electricity & Magnetism			**Course Code: WSPHYMN241**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
2	**-**	**-**	**2**	**40**	**60**

Learning Objectives:

1. To understand properties of matter with charge and phenomena related to electricity.
2. To learn about magnetic forces and the effect of magnetic fields on charged particles.
3. To know about the behavior of matter in the presence of magnetic fields.
4. To study the relation between electricity and magnetism.

Course Outcomes: After completing the course, learner will be able to

CO1: compute electric fields due to various charge distributions.

CO2: analyse the motion of charge particles in the presence of an electric field.

CO3: explain the nature of a magnetic field due to various sources.

CO4: identify the behavior of different materials in the presence of a magnetic field

CO5: show the relation between changing magnetic and electric fields.

DETAILED SYLLABUS

Unit	**Sub-Unit**	**Course/ Unit Title**	**Lectures**
I		**Electricity**	**15**
	1.1	Electric Charge, Electric Fields and Gauss' Law(RH- Chap. 21,22,23;SZ - Chap. 21,22)	
	1.2	Dipoles, Electric Potential, Capacitance and Dielectrics (HR- Chap. 24,25;SZ- Chap. 23,24)	
	1.3	Energy, EMF and Electric Current(HR- Chap. 27;SZ- Chap. 25)	
II		**Magnetism**	**15**
	2.1	Magnetic Forces , Magnetic Fields .(HR- Chap. 28,29;SZ- Chap. 27,28,except 28.8)	
	2.2	Magnetic fields in matter, Magnetic Materials.(HR- Chap. 32, except 32.5 ;SZ- 28.8)	

	2.3	Electromagnetic Induction, Inductance and Maxwell's equations.(HR- Chap. 30,32.5;SZ- Chap. 29,30,32.1)	

References:

1. Sears and Zemansky's University Physics, by R.A. Freedman and H.D. Young - Pearson(SZ)
2. Halliday and Resnick Fundamentals of Physics by J. Walker - John Wiley & Sons(HR)

Additional References:

1. The Feyman lectures in Physics (Vol. I), by R.P. Feynman, R.B. Leighton, M. Sands - Addison-Wesley
2. Introduction to Electrodynamics by D.J.Griffiths - Pearson
3. Electricity and Magnetism by E.M.Purcell - McGraw Hill

Modality of Assessment

Theory Examination Pattern: (for Discipline Specific Core papers)

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	Evaluation Type	Marks
1	Assignment/ Case study/ field visit report/ presentation/ project	20
2	Assignment/ Case study/ field visit report/ presentation/ project	20
	Total	**40**

B. **External Examination- 60%- 60 Marks per course (for Discipline Specific Core courses)**

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:
   a) There shall be 3 questions each of 20 marks with different levels of difficulty.
   b) All questions shall be compulsory with at least 50% internal choice within the questions. (For example, 4 out of 6 sub-questions to be solved).
   c) All units will be given equal weightage.

Discipline Specific Core Course 14

PROGRAM: S.Y.B.Sc.			**SEMESTER:III**		
Course: Physics Practical Course 4			**Course Code: WSPHYMJ243**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
-	**4**	**-**	**2**	**40**	**60**

Learning Objectives:

1) To demonstrate various optical phenomena
2) To learn measurement techniques with optical instruments
3) To verify various relations in study of optical properties of materials

Course Outcomes: After completing the course, learner will be able to

CO1: align the instruments optically

CO2: adjust instruments precisely to get interference/diffraction patterns

CO3: record observations carefully with uncertainties

CO4: analyse the observations to get scientific inference

DETAILED SYLLABUS

Sub-Unit	**Experiments**	
1	Newton's rings	
2	Wedge shaped film	
3	Biprism	
4	Single slit diffraction using LASER	
5	Resolving power of telescope	
6	Resolving power of grating spectrometer	
7	Resolving power of prism spectrometer	
8	Double refraction	
9	Brewster's law	
10	Wavelength of monochromatic source using Single slit diffraction pattern	
11	Optical lever	

12	Rydberg's constant	
13	Visit to research lab / Industry and report writing (2 experiments)	
14	Article (2 experiment)	

References:

Hecht E, Ganesan A R; Optics; 4th Edition; Pearson Education (2014)

Ghatak Ajoy, Optics; McGraw Hill, 7thEdition, (2020)

Modality of Assessment

75% experiments must be completed for the journal certification. Without certified journal, learner will not be allowed to appear for the practical examination.

Practical Examination Pattern: (for Discipline Specific Core Courses)

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	**Evaluation Type**	**Marks**
1	**Viva**	**10**
2	**Journal**	**30**
	Total	**40**

B. **External Examination- 60%- 60 Marks per course (for Discipline Specific Core courses)**

Sr. No.	**Evaluation Type**	**Marks**
1	**Long Experiment (2 hours)**	**40**
2	**Short Experiment (1 hour)**	**20**
	Total	**60**

Vocational Skill Course 1

PROGRAM: S.Y.B.Sc.			**SEMESTER:IV**		
Course: Laboratory Technique for Instrumentation			**Course Code: WSPHYVS241**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
-	**4**	**-**	**2**	**-**	**60**

Learning Objectives:

1) To build foundations for electronic instrumentation
2) To understand various elements of instrumentation
3) To learn the process of calibration
4) To learn steps involved in circuit designing

Course Outcomes: After completing the course, learner will be able to

CO1: read electronic circuits

CO2: build electronic circuits from the design

CO3: troubleshoot electronic circuits

CO4: design electronic circuits

CO5: calibrate various instruments

CO6: assimilate different electronic units to construct larger project

DETAILED SYLLABUS

Sub-Unit	**Experiments**	
1	Use of Breadboard	
2	Soldering on PCB	
3	Regulated Variable Voltage Source using LM317	
4	Constant Voltage Dual source using 7805/7812/7815 and 7905/7912/7915	
5	Constant Current Source using Op-Amp	
6	Pulse generator using IC 555	
7	Binary Counter using IC 7493	
8	Decade Counter using IC 7490	
9	Seven-Segment (Common Anode) Display with Decoder 7446	

10	Seven-Segment (Common Cathode) Display with Encoder 7448	
11	Study of 3 ½ 7 Segment Display	
12	4-bit D-to-A converter using weighted resistors	
13	4-bit DAC using IC	
14	4-bit ADC using IC	
15	Calibration of Hall Probe	
16	Measurements of very small currents (1 nA to 100 nA) / Four probe method	
17	Visit to research lab (for exposure to modern instrumentation) (2 experiments): Nanocentre, UDP, IITB, TIFR	

References:

Nashelky L, Boylestad R; Electronic Devices and Circuit Theory, 11th Edition (2017), Pearson Education

Gayakwad R; Op-Amps and Linear Integrated Circuits; 4th Edition (2015 reprint), Pearson Education

Additional Reference:

Kalsi H S; Electronic Instrumentation and Measurements; 4th Edition, (2019), Mc Graw Hill

Mehta V, Mehta R; Principles of Electronics, 12th Edition, (2020), S. Chand

Modality of Assessment

75% experiments must be completed for the journal certification. Without certified journal, learner will not be allowed to appear for the practical examination.

Practical Examination Pattern: (for Vocational Skill Course)

There will be three experiments each for 1 hour.

Sr. No.	**Evaluation Type**	**Marks**
1	**Experiment 1**	**20**
2	**Experiment 2**	**20**
3	**Experiment 3**	**20**
	Total	**60**

Open Elective 4

PROGRAM: S.Y.B.A.			**SEMESTER:IV**		
Course: Physics in Science Fiction			**Course Code: WAPHYOE241**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Assessment**	**Semester End Examination**
2	**-**	**-**	**2**	**60**	**-**

Learning Objectives:

1) To appreciate scientific technologies in everyday situations
2) To understand science behind science fiction movies
3) To distinguish between science fiction and fantasy

Course Outcomes: After completing the course, learner will be able to

CO1: list various technologies shown in sci-fi that is close to real world technologies

CO2: explain physics of various technologies shown in sci-fi movies

CO3: distinguish between possible and impossible technologies from currently known theories

CO4: inspect situations from science-fictions for relevant technologies

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**Physics of weapons in Sci-Fi**	**10**
	1.1	Laser guns, Ray guns, microwave guns, sonic weapons: science of laser, maser, shock waves	
	1.2	Guided missiles, GPS: physics of motion on globe, maths of global positioning, telecommunication principles	
	1.3	Submarines, underwater weapons: fluid statics and dynamics results	
		Ideas from “Physics of the Impossible”: Ch. 3, 4	
II		**Time travel in Science Fiction**	**10**
	2.1	Space warps, Worm Holes: results from special and general relativity	
	2.2	Time tourism and various paradoxes	

	2.3	Multiverse: quantum uncertainty and multi-world interpretation	
		Ref: Ideas from Physics of the Impossible Ch 11, 12, 13	
III		**Materials in Science Fiction**	**10**
	3.1	Cybernetic organisms, humanoids: big data, omnipresent networking, cloud computing	
	3.2	Invisibility cloak: Radar and stealth technology, metamaterials and negative refractive index	
	3.3	Teleportation, telekinesis: scanning and 3-D printing technology, organ printing, cyborg experiments	
		Ref: Ideas from Physics of the impossible: Ch 2, 6, 7 Ideas from Visions: Ch 2, 4, 5, 13	

References:

Kaku, M.; Physics of the Impossible (2008), DoubleDay
Kaku, M.; Visions, (1997), Anchor Books

Modality of Assessment

Theory Examination Pattern: (for Open Elective Course)

Sr. No.	**Evaluation Type**	**Marks**
1	Assessment 1 Assignment/ Case study/ field visit report/ presentation/ project	30
2	Assessment 2 Assignment/ Case study/ field visit report/ presentation/ project	30
	Total	**60**

Open Elective 5

PROGRAM: S.Y.B.A.			**SEMESTER:IV**		
Course: Ideas in Science			**Course Code: WAPHYOE242**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Assessment**	**Semester End Examination**
2	**-**	**-**	**2**	**60**	**-**

Learning Objectives:

1. To understand important ideas in science.
2. To develop a scientific outlook.
3. To be able to relate scientific ideas to those in other fields.

Course Outcomes: After completing the course, learner will be able to

CO1: Describe various concepts in science.

CO2: Summarise popular writing in science.

CO3: Differentiate between scientific and non-scientific ideas.

CO4: Use scientific terminology in the right context.

DETAILED SYLLABUS

Unit	**Sub-Unit**	**Course/ Unit Title**	**Lectures 30**
		Introduction	**1**
I		**Mathematical Science**	**7**
	1.1	Numbers	1
	1.2	Logic	1
	1.3	Geometry	1
	1.4	Calculus	1
	1.5	Probability	1
	1.6	Symmetry	1
	1.7	Maps	1

II		**Physical Science**	**7**
	2.1	Motion	1
	2.2	Atoms	1
	2.3	Entropy	1
	2.4	Quanta	1
	2.5	Spacetime	1
	2.6	Beginning and End of the universe	1
	2.7	A Theory of Everything	1
III		**Biological Science**	**7**
	3.1	Origin of Life	1
	3.2	Molecular basis of Life	1
	3.3	Evolution	1
	3.4	Genetics	1
	3.5	The Mind	1
	3.6	Ecology	1
	3.7	Extraterrestrials	1
IV		**Engineering Science**	**7**
	4.1	Structures	1
	4.2	Materials	1
	4.3	Machines	1
	4.4	Automation	1

	4.5	Bio-engineering	1
	4.6	Artificial Intelligence	1
	4.7	Space Travel	1
		Conclusion	**1**

References: (Reading lists will be provided to the student before each lecture)

Modality of Assessment

Theory Examination Pattern: (for Open Elective Course)

Sr. No.	**Evaluation Type**	**Marks**
1	Assessment 1 Assignment/ Case study/ field visit report/ presentation/ project	30
2	Assessment 2 Assignment/ Case study/ field visit report/ presentation/ project	30
	Total	**60**