Board of Studies in Physics

FACULTY OF SCIENCE AND TECHNOLOGY

GONDWANA UNIVERSITY, GADCHIROLI

Syllabus of

B. Sc. Semester I & Semester II

SUBJECT – PHYSICS

AS PER NEP 2020

Session 2024-2025

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Gondwana University, Gadchiroli

NEP 2020 U.G. PROGRAMME SESSION 2024-25

Faculty of Science and Technology

Programme Name - B. Sc. Sem-I (Level – 4.5)

Programme Code:GUGSTUGPHY Revised Examination Scheme & Basket

Sr. No.	Course Category	Subject name		Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Mark
								Theory					Practical				
					Th	Pra	Total Hrs.	UA	CA	Tot Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Tot Mark	Min Passing	
1	Core Subject -I	Select any Two core group subject from annexure -I	i)Subject-I Mechanics Course CodeSTUG01PHY001	02	02	--	02	40	10	50	20	02					50
			ii)Subject-II Major Subject From Science	02	02	--	02	40	10	50	20	02					50
			iii) Practical Based on Mechanics	02	--	04	04	--	--	--	--	--	30	20	50	25	50
			iv) Practical Based on Subject-II	02	--	04	04	--	--	--	--	--	30	20	50	25	50
2	OE	Group-A (Any one from Annexure-II) 1. Physics in Every Day Life : Measurements and Applications 2. Physics and Society 3. Introduction to Astronomy 4. Physics and Music Course Code:STUG01PHY002		02	02	--	02	40	10	50	20	02	--	--	--	--	50
3	VSC	Mechanical Measurement Techniques OR Advanced Instrumentation and Measurement Techniques (Annexure- III) Course Code:STUG01PHY003		02	--	04	04	--	--	--	--	--	30	20	50	25	50
4	SEC	Physics Workshop Skills OR Laboratory Techniques (Any one from Annexure- IV) Course Code:STUG01PHY004		02	02	--	02	40	10	50	20	02	--	--	-	-	50
5	VEC	Audit Course (Any one from Annexure-V)		02	02	--	02	--	50	50	20	--	--	--	--	--	50
6	AEC	English/Marathi/Hindi/Bengali/Pali/ Supplementary English, Annexure-VI		02	02	--	02	40	10	50	20	02	--	--	--	--	50
7	IKS	Generic IKS		02	02	--	02	40	10	50	20	02	--	--	--	--	50
8	CC	NCC/NSS/Yoga/Sports(Any one)		02	--	04	04	--	--	--	--	--	--	50	50	25	50
Total				22	14	16	30	240	110	350	140	12	90	110	200	100	550

Note(s): 1) As per open elective (OE) is concerned, students shall opt any one subject from Group-A to be Chosen Compulsory from Faculty other than that of the core subject. 2) Generic IKS will be common for all Faculties in the first Semester as per Government letter No. क्रमांक एन.ई. पी . २०२२ / प्र. क्र. ०९/विशी -३ (शिकना) दिनांक २५ जानेवारी, २०२४.

Gondwana University, Gadchiroli

NEP 2020 U.G. PROGRAMME SESSION 2024-25

Faculty of Science and Technology

Programme Name - B.Sc.Sem-II (Level – 4.5)

Programme code :GUGSTUGPHY

Revised Examination Scheme & Basket

Sr. No.	Course Category	Subject Name		Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Mark
								Theory					Practical				
					Th	Pr	Tot Hrs	UA	CA	Tot Mark	Min Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min Passing	
1	Core Subject	Select any Two core group subject from annexure -I	i)Magnetostatics and Electromagnetic Waves Course Code: STUG02PHY001	02	02	--	02	40	10	50	20	02					50
			ii)Subject -II Major Subject From Science	02	02	--	02	40	10	50	20	02					50
			iii) Practical Based on Magnetostatics and Electromagnetic Waves	02	--	04	04	--	--	--	--	--	30	20	50	25	50
			iv)Practical Based on Subject -II	02	--	04	04	--	--	--	--	--	30	20	50	25	50
2	OE	Group-A (Any one from Annexure-VII) 1. Environmental Physics 2. Introduction to Geophysics Course Code STUG02PHY002.1		02	02	--	02	40	10	50	20	02	--	--	--	--	50
		Group-B (Any one from Annexure-VII) 1. Energy Sources 2. Energy Audit Course Code: STUG02PHY002.2		02	02	--	02	40	10	50	20	02	--	--	--	--	50
3	VSC	Basic Electronic Instrumentation and Measurement Skills OR Advanced Electromagnetism and Circuit Design (Annexure- VIII) Course Code STUG02PHY003		02	--	04	04	--	--	--	--	--	30	20	50	25	50
4	SEC	Electrical Circuits and Network Skills OR Applied Measurement and Instrumentation Skills (Any one from Annexure-IX) Course Code STUG02PHY004		02	02	--	02	40	10	50	20	02	--	--	-	-	50
5	VEC	Audit course (Any one from Annexure-X)		02	02	--	02	--	50	50	20	--	--	--	--	--	50
6	AEC	English/Marathi/Hindi/Bengali/Pali/ Supplementary English, (Annexure-XI)		02	02	--	02	40	10	50	20	02	--	--	--	--	50
7	CC	NCC/NSS/Yoga/Sports(Any one)		02	--	04	04	--	--	--	--	--	--	50	50	25	50
Total				22	14	16	30	240	110	350	140	12	90	110	200	100	550

Note(s): 1) As per open elective (OE) is concerned, students shall opt any one subject from Group-A to be Chosen Compulsory from Faculty other than that of the core subject.

Abbreviations: OE: Generic/ Open Electives, SEC: Skill Enhancement Courses, VSC: Vocational Skill Courses, SEC: Skill Enhancement Courses, AEC: Ability Enhancement Courses, IKS: Indian Knowledge System, VEC: Value Education Courses

Instructions of Examination Scheme for B. Sc. Semester I and II:

1. The marks on internal assessment (CA) of the theory of the student shall be compounded with the theory paper (UA). The passing marks will be 40 % marks and the marks on internal assessment (CA) of the practical of the student shall be compounded with the practical (UA). The passing marks will be 50 % marks.
2. The theory internal assessment (CA) of Core subject, OE and SEC for B. Sc. Sem I and Sem II :

Sr. No.	Work Assigned	Marks Distribution for Core, OE and SEC
1.	Assignment	02
2.	Class Test	05
3.	Active Participation Seminar/Routine Activity etc.	03
	Total	**10**

3. A student will have to perform at least ten experiments per semester for core subject and seven experiments for VSC. At the time of Practical examination, every student has to perform two experiments of Core and VSC, each of six hours duration.
4. The practical University Assessment (UA) of Core subject and VSC for B. Sc. Semester I and II:

Sr. No.	Work Assigned	Marks Distribution
1.	Record Book	06
2.	Experiment 1 & 2	9+9
3.	Viva-voce	06
	Total	**30**

5. The practical College Assessment (CA) of Core subject and VSC for B. Sc. Semester I and II:

Sr. No.	Work Assigned	Marks Distribution
1.	Seminar on any one practical	10
2.	Viva-voce	05
3.	Report Submission	05
	Total	**20**

6. The internal assessment (CA) of theory and practical shall be done by respective college and the marks shall be sent to the university at the appropriate time.
7. The theory question paper shall be of 2 hours duration and comprise of 5 questions with internal choice and with equal weightage to all units. The pattern of question paper shall be as follows.

Pattern of Question Paper for Core subject, OE and SEC

B. Sc. Sem. I and Sem. II

Subject: Physics

Time: 2 Hours | Maximum Marks :40

Question No.			Marks Allotted
Qu. 1	**EITHER**		
A	(From Unit – I)		
	(Two or Three bits i, ii, iii)		08
	OR		
B	(From Unit – I)		
	[Four bits (a),(b), (c), (d)]		2 x 4
Qu. 2	**EITHER**		
A	(From Unit – II)		
	(Two or Three bits i, ii, iii)		08
	OR		
B	(From Unit – II)		
	[Four bits (a),(b), (c), (d)]		2 x 4
Qu. 3	**EITHER**		
A	(From Unit – III)		
	(Two or Three bits i, ii, iii)		08
	OR		
B	(From Unit – III)		
	[Four bits (a),(b), (c), (d)]		2 x 4
Qu. 4	**EITHER**		
A	(From Unit – IV)		
	(Two or Three bits i, ii, iii)		08
	OR		
B	(From Unit – IV)		
	[Four bits (a),(b), (c), (d)]		2 x 4

Qu. 5 Attempt any *eight* questions from the followings.

a) From Unit I	1
b) From Unit I	1
c) From Unit I	1
d) From Unit II	1
e) From Unit II	1
f) From Unit II	1
g) From Unit III	1
h) From Unit III	1
i) From Unit III	1
j) From Unit IV	1
k) From Unit IV	1
l) From Unit IV	1

Programme Name – GUGSTUGPHY Sem I

Core Subject-I (STUG01PHY001) Mechanics

Credit: 02 Theory Hrs: 30

Course Objectives:

- Introduce the basic concepts of Elasticity and elastic moduli.
- Understand the physical meaning and mathematical representation of elasticity and Develop the mathematical framework for describing elastic behaviour in materials.
- Introduce the basic concepts of simple harmonic motion (SHM) and the mathematical formulation of oscillatory systems.
- Understand and apply energy methods in analyzing oscillatory motion.
- Understand elastic and inelastic collisions,
- Understand the principles and applications of rotational motion and gravitational forces.
- Understand the Historical context of relativity and fundamental concept of special theory of relativity and its applications.

Course Outcomes:

Upon completion of the course successfully, students would be able to

- Understand the basic concepts of elasticity, elastic moduli, their relations and its applications.
- Differentiate free, forced and damped oscillations with examples.
- Understand different types of collision.
- Understand the analogy between translation and rotational dynamics.
- Learn Newton's law of gravitation, gravitational field and its applications
- Demonstrate knowledge and broad understanding of Special Relativity.

Unit I **7 Hrs**

Elasticity: Elastic moduli, Relation between elastic constants, Poisson's ratio, Expression for Poisson's ratio in terms of elastic constants, Work done in stretching and in twisting a wire, Twisting couple on a cylinder, Torsional Pendulum, Determination of rigidity modulus by static and dynamic method.

Numericals

Unit II **8 Hrs**

Oscillations: Simple Harmonic Motion (SHM), Differential equation of SHM and its solution, Kinetic and Potential Energy of SHM, Total energy and their time average, Free, Damped and Forced harmonic oscillations.

Collision: Perfectly elastic and inelastic collision in one dimension, Velocities of particles in elastic collision, Applications of elastic collision.

Numericals

Unit III **7 Hrs**

Rotational Dynamics: Dynamics of a system of particles, Centre of mass, Linear momentum about centre of mass, Principle of Conservation of linear momentum, Moment of inertia, Angular momentum of particle, Torque, Kinetic Energy of translation and rotation.

Gravitation: Newton's law of gravitation, Motion of particle in Central Force Field (Motion in a plane, angular momentum is conserved, areal velocity is constant in central force) Gravitational field and gravitational potential, Gravitational potential due to spherical shell, Gravitational Self-energy of a body.

Numericals

Unit IV **8 Hrs**

Relativity: Frame of Reference, Inertial and Non-Inertial frame of reference, Newtonian principle of relativity, Galilean Transformations, shortcoming of Galilean transformation.

Special Theory of Relativity: Lorentz transformation, Constancy of speed of light, Postulates of Special Theory of Relativity, Length Contraction, Time Dilation, Variation of mass with velocity, Mass Energy Equivalence.

Numericals

Text Books and Reference Books:

1. D. Kleppner, R. J. Kolenkow, "An Introduction to Mechanics", Mc Graw-Hill 1973.
2. C. Kittel, W. Knight et. al, "Mechanics Berkeley Physics", Vol. 1 Tata Mc Graw-Hill 2007.
3. Halliday and Resnick, "Fundamentals of Physics", (6^{th} edition).
4. R. Resnick, "Introduction to Special Relativity", John Wiley & Sons 2005
5. Ronald Lane Reese, "University Physics", Thomson Brooks/Cole
6. H.C. Verma, "Concepts of Physics Vol. I and II", Bharti Bhavan
7. Brijlal, "Properties of Matter", Eurasia Publishing House
8. Chaudhari R.N., "Waves and Oscillations", New Age International Publisher
9. C.L. Arora, Dr P.S. Hemne, "Physics for Degree Students B.Sc. First Year", S. Chand and Co.
10. D.S. Mathur , Dr. P.S. Hemne, "Mechanics", S. Chand and Co.
11. Brijlal & Subrahmanyam, "Properties of Matter", S. Chand & Co.
12. J. C. Upadhaya, "Mechanics", S. Chand

Practical based on Subject-I (Mechanics)

Credit: 02 Practical Hrs: 60

List of Experiments (Perform any 10 experiments)

1. To determine height of building using Sextant
2. To determine the Moment of inertia of flywheel.
3. To study of conservation of momenta in two dimensional collisions.

4. To determine the acceleration due to gravity 'g' by Compound Pendulum.
5. To determine the acceleration due to gravity 'g' by Kater's Pendulum.
6. To study the Motion of a Spring and calculate spring Constant & Value of g.
7. To study of oscillations of mass under different combinations of spring.
8. To determine acceleration due to gravity 'g' for a freely falling body using Digital Timing Technique.
9. To calculate the percentage error of diameter of orifice of capillary.
10. To determine Young's modulus by Cantilever.
11. To determine Modulus of rigidity by statistical method.
12. To determine Coefficient of Viscosity by Poiseuille's flow method.
13. To determine the Modulus of rigidity by Tortional Pendulum.
14. To determine the Young's modulus by bending of beam.
15. To determine the Young's modulus by Vibration method.
16. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

Note: Teacher can introduce new and relevant experiments which are not in the above list.

Text Books and Reference Books:

1. Harnam Singh, P. S. Hemne, " B. Sc. Practical Physics", S. Chand & Co.
2. B. Saraf, "Physics through experiments", Vikas Publications.
3. D.P. Khandelwal : A laboratory manual of Physics for undergraduate classes, 1st Edition, Vikas Publications.
4. C. L Arora, P. S. Hemne, "B.Sc. Practical Physics (Revised Edition)", S. Chand & Co.
5. D. Chatopadhyay, P.C.Rakshit, B. Saha, "An Advanced Course in Practical Physics", New Central Book Agency Pvt Ltd.
6. Samir Kumar Ghosh, "A text book of Practical Physics", New Central Book Agency Pvt Ltd.

OE : Group-A (Any one) (STUG01PHY002)

Credit: 02 Theory Hrs: 30

1. Physics in Every Day Life: Measurements and Applications

Course Objectives:

- To provide foundational knowledge of time and motion, weight and pressure, electrical energy, and thermodynamics
- To create the ability to do the measurement of time and motion, weight and pressure, electrical energy and temperature.

Course Outcomes:

Upon completing this course, students will be able to:

- Understand the concepts and units of time and the principles of motion.
- Measure and differentiate between weight, mass, and pressure.
- Apply electrical principles to measure voltage, current, and resistance, and calculate power and energy consumption.
- Understand temperature scales, heat transfer modes, and thermodynamic law.

Unit I **7 Hrs**

Time and Motion: Introduction to Time Measurement: Concepts of time and its measurement, Units of time: seconds, minutes, hours.

Principles of Motion: Definition of motion and its types, Kinematics: displacement, velocity, acceleration.

Speed and Velocity: Definition of speed and velocity, Calculating speed and velocity.

Unit II **8 Hrs**

Weight, Mass and Pressure: Introduction to Weight and Mass: Definitions of weight and mass, Units of measurement: kilograms, Newtons.

Measurement of Weight and Mass: Principles of weighing scales and balances.

Introduction to Pressure: Definition of pressure and its units, Pressure in fluids: hydrostatic pressure, Atmospheric pressure.

Unit III **7 Hrs**

Electrical Energy and Power Measurement: Fundamentals of Electricity: Basics of electric charge and current, Voltage, resistance, and Ohm's law.

Measurement of Voltage, Current, and Resistance: Principles of voltage and current measurement.

Power and Energy in Electrical Systems: Definition of power and energy, Calculating electrical power and energy consumption.

Unit IV **8 Hrs**

Temperature and Thermodynamics: Introduction to Temperature Measurement: Concepts of temperature and its scales. Principles of thermometers and temperature sensors.

Heat Transfer: Modes of heat transfer: conduction, convection, radiation.

Thermodynamics: Laws of thermodynamics, Impact of temperature on materials and processes.

Text Books and Reference Books:

1. Mehta, Neeraj, "Physics for Engineers", Pearson Education 2010.
2. Avadhanulu, M.N., and Kshirsagar, P.G., "A Textbook of Engineering Physics", S. Chand & Company Ltd. 2016.
3. Palanisamy, P.K., "Engineering Physics", Scitech Publications 2018.
4. Murugeshan, R., and Sivaprasath, Kiruthiga, "Engineering Physics", McGraw-Hill Education 2012.
5. Mahanta, Chitralekha, "Applied Physics", PHI Learning Private Limited 2014.

6. Aruldhas, B., "Engineering Physics", Prentice-Hall of India, 2009.
7. Gaur, R.K., Gupta, S.L., and Jain, Ashish., "Engineering Physics", Dhanpat Rai Publications, 2020.
8. Prakash, Satya, "Engineering Physics", Khanna 2017.
9. Mehta, V.K., and Mehta, Rohit, "Principles of Physics", S. Chand & Company Ltd. 2013.

2. Physics and Society

Course Objectives:

- To provide an understanding of how fundamental physics principles underpin critical areas such as energy, the environment, technology, and healthcare.
- To explore the application of these principles to current global challenges, enhancing their ability to analyze and develop solutions for energy efficiency, environmental monitoring, technological innovation, and healthcare advancements.

Course Outcomes:

Upon completing this course, students will be able to:

- Understand and analyze various energy sources (fossil fuels, renewable energy, nuclear energy) and trends in global energy consumption.
- Apply physics principles to energy-efficient technologies and conservation strategies.
- Identify and explain environmental issues like climate change, air pollution, and deforestation, and their physics-based causes.
- Utilize physics principles in environmental monitoring techniques, such as remote sensing and GIS, for effective environmental modeling.
- Explain the role of physics in technological innovations across information technology, telecommunications, and materials science.
- Discuss the impact of digital technologies (computers, smartphones, internet) on society using underlying physics concepts.
- Describe the physics principles behind medical imaging techniques (X-rays, MRI, ultrasound) and their applications in healthcare.
- Explore physics-based innovations in biomedical engineering, including medical devices and prosthetics, and their impact on patient care.

Unit I **7 Hrs**

Physics and Energy: Energy Sources and Consumption: Overview of energy sources, including fossil fuels, renewable energy, nuclear energy and global energy consumption trends.

Energy Efficiency and Conservation: Physics principles underlying energy-efficient technologies and strategies for energy conservation.

Unit II **8 Hrs**

Physics and Environment: Environmental Challenges: Overview of environmental issues including climate change, air pollution, water pollution, and deforestation and their physics-based drivers.

Environmental Monitoring and Modeling: Physics principles underlying environmental monitoring techniques, such as remote sensing, GIS, and computer modeling.

Unit III **8 Hrs**

Physics and Technology:Technological Innovations: Role of physics in driving technological innovations in fields such as information technology, telecommunications, and materials science.

Digital Revolution: Physics principles underlying digital technologies, such as computers, smartphones, and the internet, and their societal impacts.

Unit IV **7 Hrs**

Physics and Healthcare: Medical Imaging and Diagnostics: Physics principles underlying medical imaging techniques, such as X-rays, MRI, and ultrasound, and their applications in diagnosis and treatment. Biomedical Engineering: Physics-based innovations in medical devices, prosthetics, and healthcare technologies, improving patient care and quality of life.

Text Books and Reference Books:

1. S.P. Sukhatme, "Physics and Energy: Principles and Applications", Universities Press 2018.
2. G.D. Rai, "Physics and Sustainable Energy: Concepts and Innovations", PHI Learning Private Limited. 2016.
3. A.K. Nayak, "Physics and Energy Policy: Socioeconomic Perspectives", New Age International 2019.
4. R.K. Lohani, "Physics and Environment: Understanding Challenges and Solutions", Tata McGraw-Hill Education 2017.
5. K. Subramanian, "Physics and Environmental Monitoring: Techniques and Applications", CRC Press 2015.
6. R. N. Das, "Physics and Sustainable Development: Towards a Greener Future", Cambridge University Press India. 2020.
7. S. Meenakshi Sundaram, "Physics and Environmental Justice: Bridging the Gap", Pearson Education India 2013.
8. A.K. Singh, "Physics and Technology: Innovations and Governance", Oxford University Press India 2014.
9. M. N. Vahia, "Physics and Emerging Technologies: Trends and Implications", Wiley India 2018.
10. V.K. Ahluwalia, "Physics and Healthcare: Advancements and Equity", Elsevier India 2016.

3. Introduction to Astronomy

Course Objectives:

- To provide a comprehensive overview of the universe, exploring celestial bodies and astronomical phenomena.
- To introduce the fundamental concepts in observational astronomy and cosmology, examining the structure and evolution of the universe, stars, and planetary systems.

Course Outcomes:

Upon completing this course, students will be able to:

- Understand the different aspects of astronomy, from historical perspectives to current research frontiers.
- Understand the formation of Star, Steller System and Universe.

Unit I **7 Hrs**

Overview of the Universe: Introduction to Astronomy: Historical perspectives, the significance of astronomy in human culture, and the scientific method in astronomy. The Solar System: Structure, formation, and dynamics of the Sun, planets, moons, asteroids, comets, and dwarf planets. Observational Techniques: Telescopes, observatories, space missions, and astronomical imaging techniques. Planetary Astronomy: Comparative planetary geology, atmospheres, and potential for life beyond Earth.

Unit II **8 Hrs**

Stars and Stellar Systems: Properties of Stars: Stellar classification, luminosity, temperature, size, and life cycle of stars. Stellar Evolution: Star formation, nuclear fusion processes, main sequence evolution, and stellar remnants (white dwarfs, neutron stars, and black holes). Binary and Multiple Star Systems: Types of binary stars, interactions between stars, and the role of binaries in astronomy. Star Clusters and Galaxies: Open and globular star clusters, types of galaxies (spiral, elliptical, and irregular), and galaxy formation and evolution.

Unit III **7 Hrs**

Cosmology and the Universe: The Big Bang Theory: Evidence for the Big Bang, expansion of the universe, and the cosmic microwave background radiation. The Structure of the Universe: Large-scale structure, cosmic web, superclusters, and voids.

Dark Matter and Dark Energy: Observational evidence for dark matter and dark energy, their roles in the universe, and ongoing research efforts. The Fate of the Universe: Theories of the ultimate fate of the universe, including the Big Crunch, Big Freeze, and Big Rip scenarios.

Unit IV **8 Hrs**

Observational Astronomy and Current Research: Observing the Night Sky: Constellations, celestial coordinate systems, and observing techniques for amateur astronomers. Recent Discoveries in Astronomy: Exoplanets, gravitational waves, transient astronomical events, and multi-messenger astronomy. Astronomical Frontiers: Current research topics in astronomy, including black hole mergers, galaxy formation, and the search for extraterrestrial intelligence. Ethical and Societal Implications: The role of astronomy in shaping our

understanding of the cosmos, the cultural significance of astronomical discoveries, and ethical considerations in space exploration.

Text Books and Reference Books:

1. A.K. Choudhury and Asis Kumar De, "Introduction to Astronomy and Astrophysics"
2. H.K. Sen, "An Introduction to Astronomy".
3. Biman Basu, "Astronomy: From Stonehenge to Quasars".
4. Arnab Rai Choudhuri and Roy Dibyendu, "Introduction to Astronomy and Astrophysics".
5. M.N. Vahia, Tushar P. Prabhu and Aniket Sule, "Astrophysics: Stars".
6. Sumner Starrfield, Ann Wehrle and Richard Truran, "Understanding Stellar Evolution".
7. K.S. de Boer and J.S. Vink, "Star Clusters: Basic Galactic Building Blocks throughout Time and Space".
8. Malcolm S. Longair, "Galaxy Formation".
9. J.V. Narlikar , "Modern Cosmology and Philosophy".
10. Jayant V. Narlikar, "An Introduction to Cosmology".

4. Physics and Music

Course Objectives:

- To explore the fundamental principles of wave mechanics and sound, focusing on their applications in musical instruments, room acoustics, and audio technology.
- To understand and optimize sound quality in music performance and production.

Course Outcomes:

Upon completing this course, students will be able to:

- Understand wave properties and sound wave production.
- Analyze the acoustics of string and wind instruments.
- Apply room acoustics principles to optimize sound in enclosed spaces.
- Utilize audio technology for sound recording and amplification.
- Implement digital signal processing techniques in music production**.**

Unit I **7 Hrs**

Introduction to Wave Mechanics and Sound: Basics of Wave Mechanics: Wave properties, amplitude, frequency, wavelength, and phase.

Sound Waves: Production of sound waves, propagation, intensity and speed of sound.

Unit II **8 Hrs**

Acoustics of Musical Instruments: String Instruments: Physics of vibrating strings, harmonic series, and resonance in string instruments (e.g., sitar, veena).

Wind Instruments: Generation of sound in wind instruments, resonance chambers, and acoustic properties of flutes, clarinets, and brass instruments.

Unit III **7 Hrs**

Room Acoustics and Sound Reproduction: Room Acoustics: Reflection, absorption and diffusion of sound in enclosed spaces, reverberation time and acoustic design principles.

Audio Technology: Principles of sound recording, playback and amplification, including microphones, speakers, and amplifiers.

Unit IV **8 Hrs**

Applications of Physics in Music Performance and Production: Musical Instrument Design: Role of physics in the design and construction of musical instruments for optimal sound quality and performance.

Digital Signal Processing: Basics of digital audio processing, effects processing, and synthesis techniques in music production**.**

Text Books and Reference Books:

1. Ghatak, Ajoy and Lokanathan, S. "Wave Mechanics and Sound", Tata McGraw-Hill Education 2012.
2. Fletcher, Neville H. and Rossing, Thomas D. "Acoustics of Musical Instruments", Springer 1998.
3. Crowhurst, N. H., "Room Acoustics and Sound Reproduction", Butterworth-Heinemann 2015.
4. Ghosh, Dipak and Mallik, Rajeev. "Physics in Music Performance and Production", CRC Press 2009.
5. Kinsler, Lawrence E., et al. "Fundamentals of Acoustics", Wiley 1999.
6. Rossing, Thomas D. "The Science of Sound", Addison-Wesley 2001.
7. Harper, Graeme, and Doughty, Ruth. "Sound and Music in Film and Visual Media: A Critical Overview", Bloomsbury Academic 2012.
8. Fastl, Hugo, and Zwicker, Eberhard. "Psychoacoustics: Facts and Models", Springer 2007.
9. Proakis, John G., and Manolakis, Dimitris G. "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson 2014.
10. Subramanian, V., and Krishnamoorthy, B. "Indian Classical Music and the Physics of Sound", Aryan Books International 2006.

VSC: (Any one) (STUG01PHY003)

Credit: 02 Practical Hrs: 60

1. Mechanical Measurement Techniques

Course Objectives:

- To study the Basic measurement techniques with error analysis
- To help develop habit of practice in the experimental skill developments.

- To develop experimental skills in due course of time.
- To introduce students to different apparatus & instruments, and demonstrate the skill-based experiments.
- To help grow confidence while performing the practical individually

Course Outcomes:

After successfully completing this laboratory course, the students will be able to do the following:

- Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
- Apple the basic measurement techniques to various situations
- Evaluate the associated error involved with any measurements.
- Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
- To correlate their physics theory concepts through practical.
- To understand and practice the skills while doing physics practical.

Course Outline:

1**.** Introduction to Measuring Instruments

- Measurement of least count:
  - Vernier caliper (analog)
  - Vernier caliper (digital)
  - Micrometer screw gauge
  - Travelling microscope
  - Spectrometer
  - Adjustable slit

2. Measurement of Geometrical Parameters

- Diameter measurement:
  - Using micrometer screw gauge for wires of different diameters
- Thickness measurement:
  - Using Vernier caliper for rectangular bodies of varying thickness
- Volume measurement:
  - Using Vernier caliper for cylindrical bodies of different volumes

3. Optical Measurements

- Diameter measurement:
  - Using travelling microscope for inner and outer diameters of capillary tubes
- Refractive index measurement:
  - Using travelling microscope for liquids
- Angle measurement:

- Using spectrometer for determining the angle of prisms
- Resolution measurement:
- Using spectrometer to find the width of adjustable slit for resolving two objects

4. Advanced Optical Experiments
   - Radius measurement:
   - Using optical lever to determine radius of curvature
   - Concentration measurement:
   - Using Polarimeter to determine concentration of sugar solutions
   - Refractive index measurement:
   - Determining refractive index of glass slabs
   - Focal length measurement:
   - Using short focus lens to determine focal length of long focus lenses

List of Experiments (Perform any Seven Experiments):

1. Measurement of Least Count of Measuring Instruments
   Aim: To determine the least count of Vernier caliper (analog and digital), micrometer screw gauge, travelling microscope, spectrometer and adjustable slit.
2. Diameter Measurement of Wires
   Aim: To measure the diameter of different wires using a micrometer screw gauge.
3. Thickness Measurement of Rectangular Bodies
   Aim: To determine the thickness of different rectangular bodies using a Vernier caliper.
4. Volume Measurement of Cylindrical Bodies
   Aim: To determine the volume of different cylindrical bodies using a Vernier caliper.
5. Diameter Measurement of Capillary Tube
   Aim: To determine the inner and outer diameter of a capillary tube using a travelling microscope.
6. Refractive Index Measurement of a Liquid
   Aim: To determine the refractive index of a liquid using a traveling microscope.
7. Angle Measurement of Prism
   Aim: To determine the angle of a prism using a spectrometer.
8. Resolution Measurement of Adjustable Slit
   Aim: To determine the width of the adjustable slit when two objects are just resolved using a spectrometer.
9. Radius of Curvature Measurement using Optical Lever
   Aim: To determine the radius of curvature of a mirror using an optical lever.
10. Concentration Measurement of Sugar Solution
    Aim: To determine the concentration of sugar in a solution using a Polarimeter.
11. Refractive Index Measurement of Glass Slab

Aim: To determine the refractive index of a material of a glass slab.

12. Focal Length Measurement of Long Focus Lens

    Aim: To determine the focal length of a long-focus lens using a short-focus lens.

Text Books and Reference Books:

1. B. L. Flint and H. T.Worsnop, "Advanced Practical Physics for students", Asia Publishing House 1971.
2. Michael Nelson and Jon M. Ogborn, "Advanced level Physics Practicals", 4th edition, reprinted 1985, Heinemann Educational Publishers.
3. S.Panigrahi & B.Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd. 2015.
4. Indu Prakash and Ramakrishna, "A Textbook of Practical Physics", 11th Edition, Kitab Mahal, New Delhi 2011.

2. Advance Instrumentation and Measurement Techniques

Course objectives:

- To provide an in-depth understanding of modern instrumentation and measurement techniques used in Physics.
- To focuse on hands-on training with advanced instruments and the application of these tools in various physical experiments.

Course Outcomes:

After successfully completing this laboratory course, the students will be able to:

- Understand the principles and operations of advanced measuring instruments.
- Gain proficiency in using oscilloscopes, spectrometers, and other analytical tools.
- Develop skills in data acquisition, analysis, and interpretation.
- Apply measurement techniques to solve complex physical problems.

Course Outline:

1. Introduction to Measurement Techniques
   - Overview of measurement systems and errors
   - Calibration of instruments
2. Oscilloscopes
   - Operating oscilloscopes
   - Analysing waveforms
3. Signal Generators

- Using function generators

4. Spectrometry

- Principles of spectrometry
- Using spectrometers for different applications (e.g., optical, mass spectrometry)

List of Experiments (Perform any Seven Experiments):

1. Comparative Study of Measurement Instruments

   Aim: To compare the precision and accuracy of different measurement instruments (analogue & digital multimeter, Vernier caliper, and micrometer screw gauge) in measuring physical quantities.

2. Error Analysis in Repeated Measurements

   Aim: To identify and analyze systematic, random, and human errors in repeated measurements of a physical quantity (length, time, or temperature) and to calculate the mean, standard deviation, and relative error.

3. Calibration of Multimeter and Thermocouple Thermometer

   Aim: To perform calibration of a digital multimeter for voltage and resistance measurements and a thermocouple thermometer for temperature measurements, ensuring the instruments' readings align with known standards.

4. Name of Experiment: Introduction to Oscilloscope Operation

   Aim: To familiarize students with the basic operation of an oscilloscope, including setting up the device, understanding the controls, and displaying simple waveforms.

5. Measurement of Signal Parameters using an Oscilloscope

   Aim: To measure and analyze key parameters of electrical signals such as amplitude, frequency, period, and phase difference using an oscilloscope.

6. Advanced Waveform Analysis with Oscilloscopes

   Aim: To build upon the basic operation of oscilloscopes and explore advanced waveform analysis techniques.

7. Basic Operation of Function Generators

   Aim: To understand the basic operation of function generators, including setting up the device, generating different types of waveforms (sine, square, and triangle), and adjusting parameters such as frequency and amplitude.

8. Exploring Signal Superposition and Interference Patterns

   Aim: To use a function generator to create and study the superposition and interference of two signals, examining how phase and frequency differences affect the resultant waveform.

9. Generation and Analysis of Modulated Signals

   Aim: To generate amplitude-modulated (AM) and frequency-modulated (FM) signals using a function generator and analyze their characteristics, understanding the principles and applications of signal modulation in communication systems.

10. Introduction to Spectrometry Principles

    Aim: To introduce students to the principles of spectrometry and the basic operation of spectrometers.

11. Calibration and Measurement with an Optical Spectrometer

    Aim: To calibrate an optical spectrometer using known spectral lines and to use it to measure and analyze the emission spectra of various light sources, such as gas discharge lamps (e.g., hydrogen, neon, mercury.

Text Books and Reference Books:

1. Holman, J. P., "Experimental Methods for Engineers", Tata McGraw-Hill Education 2014..
2. Hayward, W., Campbell, R., & Larkin, B., "Experimental Methods in RF Design", ARRL Inc. 2003
3. Sawhney, A. K., "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai Publications 2018.
4. Chattopadhyay, D., & Rakshit, P. C., "Electronics for Physics and Engineering", New Age International (P) Ltd. 2019.
5. Mehta, V. K., & Mehta, R., "Principles of Electronics", S. Chand Publishing 2017.
6. Bell, D. A., "Electronic Instrumentation and Measurements", Oxford University Press 2014.
7. Bell, D. A., "Fundamentals of Electronic Devices and Circuits", Oxford University Press 2012.
8. Theraja, B. L., & Theraja, A. K., "A Textbook of Electrical Technology", S. Chand Publishing 2016.
9. Lathi, B. P., "Modern Digital and Analog Communication Systems", Oxford University Press 2019.
10. Mahajan, Y. R., "Spectroscopy", New Age International (P) Ltd.

SEC: (Any one) (STUG01PHY004)

Credit: 02 Theory Hrs: 30

1. Physics Workshop Skills

Course Objectives:

- To make familiar and experience with various mechanical and electrical tools through hands-on mode.
- Understand the use of various equipment and circuits.

Course Outcomes:

After successfully completing this course, the students will be able to:

1. Use measuring devices like Vernier callipers, Screw gauge, travelling microscope and Sextant for measuring various length scales.
2. Acquire skills in the usage of multimeters, soldering iron, oscilloscopes, power supplies and relays.
3. Develop the mechanical skill such as casting, foundry, machining, forming and welding and will become familiar with common machine tools like lathe, shaper, drilling, milling, surface machines and Cutting tools.

4. Get acquaintance with prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axle. Lever mechanism. Lifting of heavy weight using lever. braking systems, pulleys.

Unit I **8 Hrs**

Introduction of Measurement: Measuring units Conversion in to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains etc.

Unit II **7 Hrs**

Electrical and Electronic Skill: Use of Multimeter, Soldering of electrical circuits having discrete components (R, L, C, diode etc) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronics witch using transistor and relay.

Unit III **7 Hrs**

Introduction to prime movers (Machines): Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.

Unit IV **8 Hrs**

Uses of Bread Board: Designing of circuits like Half wave rectifiers, Full wave rectifiers, Bridge rectifiers with L- section, π- section filters and measurement of output voltage.

Designing of basic gates: AND, OR, NOT, NAND and NOR gates and verifications of their truth tables.

Text Books and Reference Books:

1. B. L. Theraja, “A text book in Electrical Technology”, S. Chand and Company.
2. M.G.Say, “Performance and design of A C machines” , ELBSE dn.
3. K.C.John, “Mechanical Workshop Practice”, 2010,PHIL earning Pvt.Ltd.
4. Bruce J Black, “WorkshopProcesses,PracticesandMaterials”,2005,3rdEdn.,Editor Newnes
5. LawrenceSmyth/LiamHennessy,“NewEngineeringTechnology”,TheEducational Company of Ireland

2. Laboratory Techniques

Course Objectives:

1. Understand and apply laboratory safety protocols for a secure working environment in Physics experiments.
2. Develop precision measurement skills for reliable experimental outcomes.
3. Familiarize with common laboratory equipment and its proper usage.
4. Learn principles for designing experimental setups and selecting appropriate instruments.
5. Acquire knowledge of data acquisition systems and calibration techniques.
6. Develop proficiency in error analysis and statistical methods for data enhancement.

7. Gain expertise in interpreting experimental results and trends for meaningful conclusions.

Course Outcomes:

After successfully completing this course, the students will be able to:

1. Demonstrate proficiency in laboratory safety protocols and emergency response.
2. Apply precision measurement techniques for accurate data analysis.
3. Correctly use laboratory equipment and safety gear.
4. Design experimental setups and select suitable instruments.
5. Utilize data acquisition systems effectively, ensuring proper calibration.
6. Identify and quantify sources of error for improved data quality.
7. Apply statistical methods and graphical representation techniques for data analysis.
8. Interpret experimental results accurately, identifying trends and patterns.

Unit I **8 Hrs**

Introduction to Laboratory Techniques: Overview of Laboratory Safety Protocols and Procedures: Exploration of safety protocols for laboratory work, including chemical handling, electrical safety, and emergency procedures. Importance of personal protective equipment (PPE) and adherence to safety guidelines to prevent accidents and injuries. Precision and Accuracy in Experimental Measurements: Concepts of precision and accuracy in experimental measurements, focusing on their importance for reliable results.Brief discussion on error sources and strategies to minimize them for improved data quality. Introduction to Common Laboratory Equipment: Study of basic measuring instruments like rulers, vernier calipers, and micrometers. Overview of analytical instruments such as spectrometers, oscilloscopes, and multimeters. Introduction to safety equipment like fire extinguishers, emergency showers, and eyewash stations.

Unit II **7 Hrs**

Experimental Setup and Instrumentation: Design Principles for Constructing Experimental Setups: Examination of fundamental principles guiding experimental setup design. Consideration of factors such as objectives, constraints, and resources influencing design. Brief discussion on optimizing setup design for efficient achievement of research goals. Selection and Use of Appropriate Laboratory Instruments: Study of commonly used laboratory instruments in physics experiments. Criteria for selecting instruments based on experiment requirements. Practical considerations for instrument setup, operation, and maintenance. Calibration Techniques for Ensuring Instrument Accuracy: Overview of calibration methods for maintaining instrument accuracy. Brief examination of calibration standards and reference materials. Demonstrations to illustrate calibration techniques for instrument accuracy validation.

Unit III **8 Hrs**

Data Acquisition and Measurement Techniques: Techniques for Precise Measurement of Physical Quantities: Exploration of techniques for precise measurement in physics experiments. Discussion on methods like direct, indirect, and comparative measurement. Overview of tools and instruments for precise measurement, their principles, and applications. Data Acquisition Systems and Sensors: Study of data acquisition systems (DAS) for

collecting experimental data. Analysis of sensor types used in DAS for measuring physical quantities. Exploration of sensor characteristics including sensitivity and resolution. Error Analysis and Uncertainty Estimation in Experimental Measurements: Examination of sources of errors in measurements, systematic and random. Brief discussion on error analysis and uncertainty estimation methods such as error propagation. Practical exercises to illustrate error analysis techniques and their application in measurements.

Unit IV **7 Hrs**

Data Analysis and Interpretation: Statistical Methods for Analyzing Experimental Data: Study of statistical techniques for analyzing experimental data. Brief discussion on descriptive statistics including measures of central tendency and dispersion. Overview of inferential statistics such as hypothesis testing and confidence intervals. Graphical Representation and Visualization Techniques: Examination of various graphical methods for representing experimental data. Analysis of different types of graphs including histograms and scatter plots. A brief discussion on visualization techniques for interpreting datasets effectively. Interpretation of Experimental Results and Drawing Conclusions: Strategies for interpreting experimental results. A brief discussion on identifying trends and patterns in data emphasis on drawing conclusions based on data analysis and experimental findings.

Text Books and Reference Books:

1. Sharma, S., & Gupta, R., "Laboratory Safety Protocols and Procedures." New Delhi: Pearson Education India 2020.
2. Singh, A., & Kumar, P., "Precision and Accuracy in Experimental Measurements", Mumbai: Himalaya Publishing House 2019.
3. Patel, N., & Desai, M., "Introduction to Common Laboratory Equipment", Chennai: Oxford University Press 2021.
4. Banerjee, S., & Chatterjee, D., "Design Principles for Constructing Experimental Setups", Kolkata: S. Chand & Company Ltd. 2018.
5. Mishra, R., & Jain, R.,"Selection and Use of Appropriate Laboratory Instruments", New Delhi: McGraw Hill Education 2020.
6. Mehta, P., & Shah, N., "Calibration Techniques for Ensuring Instrument Accuracy", Mumbai: Tata McGraw-Hill Education 2019.
7. Joshi, A., & Sharma, S., "Techniques for Precise Measurement of Physical Quantities", Pune: Nirali Prakashan 2021.
8. Das, S., & Mukherjee, R. (2017). "Data Acquisition Systems and Sensors", New Delhi: PHI Learning Private Limited.
9. Gupta, R., & Singh, R., "Error Analysis and Uncertainty Estimation in Experimental Measurements", Hyderabad: Universities Press 2018.
10. Chatterjee, D., & Basu, S., "Statistical Methods for Analyzing Experimental Data", Kolkata: Academic Publishers 2019.

Programme Name – GUGSTUGPHY Sem II

Core Subject- (STUG02PHY001) Magnetostatics and Electromagnetic Waves

Credit: 02 Theory Hrs: 30

Course Objectives:

- Learn various magnetic properties of materials and types of magnetism.
- Understand the concept of Electromagnetic induction and its application in transformer.
- Introduce the concept of Maxwell`s equations, propagation of electromagnetic waves.
- To understand Kirchhoff`s circuit rules, alternating electric currents and their applications
- Develop proficiency in solving problems related to magnetostatics and electromagnetic waves using mathematical techniques and physical principles.

Course Outcomes:

Upon completion of the course successfully, students would be able to

- Learn and understand the basic concept of Magnetostatics, Biot-Savart's law, Ampere's circuital law and their applications.
- Understand magnetic properties of materials and differentiate between various types of magnetic materials.
- Learn Faraday's law, Lenz's law and basics of electromagnetic induction.
- Understand the construction and working of transformer and its applications.
- Understand the different Maxwell's equations, Poynting vector, Poynting theorem and propagation of electromagnetic waves.
- Understand Kirchhoff`s circuit laws, basics of alternating currents and apply it in circuit analysis.

Unit I **8 Hrs**

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.

Magnetic properties of materials: Magnetic intensity, magnetic field, permeability, magnetic susceptibility. Brief introduction of diamagnetic, paramagnetic, and ferromagnetic materials.

Numericals

Unit II **7 Hrs**

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self (L) and mutual inductance (M), L of single coil, M of two coils. Energy stored in magnetic field.

Transformer – Construction and working, Energy losses, parameters and application.

Numericals

Unit III **8 Hrs**

Maxwell`s equations and Electromagnetic Wave Propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector and Poynting theorem, energy density in electromagnetic field, electromagnetic wave propagation through vacuum, transverse nature of EM waves.
Numericals

Unit IV **7 Hrs**

Steady Electric current: Kirchoff's laws and its applications (Wheatstone bridge and Carry-foster bridge), Rise and decay of current in LR, CR circuits, time Constants.

Alternating electric current: AC circuits, Complex numbers, j-operator and applications to LR and CR circuits.
Numericals

Text Books and Reference Books:

1. Edward M. Purcell, "Electricity and Magnetism", Cambridge University Press
2. J.H. Fewkes & J. Yarwood, "Electricity and Magnetism", University Tutorial Press
3. D C Tayal, "Electricity and Magnetism", Himalaya Publishing House
4. C.L. Arora, Dr P.S. Hemne, "Physics for degree students B.Sc. First Year", S. Chand & Co.
5. E.C. Jordan, K. G. Balmain, "Electromagnetic Waves and Radiating Systems", PHI
6. S.S. Atwood, "Electricity and Magnetism", Wiley
7. A.S. Mahajan and A.A. Rangwala, "Electricity and Magnetism", McGraw Hill Education
8. Brijlal and Subramanyam, "Electricity and Magnetism", Ratan Prakashan Mandir
9. D.N. Wasudeva, "Electricity and Magnetism", S. Chand & Co.
10. S.L. Gupta and R. Singh, "Electrodynamics", Pragati Edition
11. Brijlal and Subramanyam, "Mechanics and Electrodynamics" S. Chand & Co.
12. D.J. Griffiths, "Introduction to Electrodynamics", Pearson
13. Halliday and Resnic, "Fundamentals of Physics", Jeari Walker

Practical based on Core Subject (Magnetostatics and Electromagnetic Waves)

Credit: 02 Practical Hrs: 60

List of Experiments (Perform any 10 experiments)

1. To measure the inductance of inductor using impedance at different frequencies.
2. To measure the capacitance of capacitor using impedance at different frequencies.
3. To study the decay of currents in LR circuits.
4. To study the frequency response curve of LCR circuit and determine its quality factor.
5. To study the characteristic of Choke.

6. To determine the high resistance by Leakage method
7. To determine a Low Resistance by Carey -Foster's Bridge.
8. To construct and verify the Thevenin's theorem.
9. To construct and verify the Norton's Theorem.
10. To construct and verify the Superposition electrical network.
11. To construct and verify the Maximum Power Transfer Theorem.
12. To construct and verify the Milliman's Theorem.
13. To calibrate an ammeter by Potentiometer.
14. To determine the resistance of Galvanometer by half deflection method.
15. To determine Low resistance by Potentiometer
16. Use of vibration magnetometers to study a field.
17. To compare capacitance using De'Sauty's bridge .
18. To study the Transformer.

Note: Teacher can introduce new and relevant experiments which are not in the above list.

Text Books and Reference Books:

1. Harnam Singh, P. S. Hemne, " B. Sc. Practical Physics", S. Chand & Co.
2. D.P. Khandelwal : A laboratory manual of Physics for undergraduate classes, 1st Edition, Vikas Publications.
3. C. L Arora, P. S. Hemne, "B.Sc. Practical Physics (Revised Edition)", S. Chand & Co.
4. D. Chatopadhyay, P.C.Rakshit, B. Saha, "An Advanced Course in Practical Physics", New Central Book Agency Pvt Ltd.

OE : Group-A (Any one) (STUG02PHY002.1)

Credit: 02 Theory Hrs: 30

1. Environmental Physics

Course objectives:

- To provide an interdisciplinary understanding of environmental physics, focusing on climate change, air and water quality and renewable energy.
- To gain the knowledge to assess and address environmental challenges.

Course outcomes:

Upon completing this course, students will be able to:

- Understand the role of physics in environmental science and climate change mechanisms.
- Identify sources and types of air pollution and methods for improving air quality.
- Analyze water cycle dynamics and water pollution sources and treatment methods.

- Evaluate renewable energy sources and energy efficiency measures for sustainable development**.**

Unit I **7 Hrs**

Introduction to Environmental Physics: Overview of Environmental Physics: Interdisciplinary nature of environmental science, the role of physics in understanding environmental phenomena.

Climate Change: Greenhouse effect, global warming, and climate feedback mechanisms.

Environmental Measurements: Techniques for measuring environmental parameters, including temperature and atmospheric composition.

Unit II **8 Hrs**

Air Quality and Pollution: Air Pollution: Sources of air pollution, types of pollutants (particulate matter & gases) and health effects.

Indoor Air Quality: Indoor pollutants and strategies for improving indoor air quality.

Pollution Control Technologies: Air pollution control devices and emission standards.

Unit III **7 Hrs**

Water Resources and Quality: Hydrology: Water cycle, precipitation, and groundwater dynamics.

Water Pollution: Sources of water pollution and types of contaminants.

Water Treatment: Drinking water treatment processes and wastewater treatment technologies.

Unit IV **8 Hrs**

Renewable Energy and Sustainability: Renewable Energy Sources: Solar, wind, hydroelectric and geothermal energy.

Energy Efficiency: Energy conservation measures and sustainable energy planning.

Sustainable Development: Principles of sustainable development and environmental policy frameworks.

Text Books and Reference Books:

1. A.K. Jain, "Environmental Physics: Sustainable Energy and Climate Change", New Age International 2017.
2. S. M. Ghazi, "Air Quality and Pollution Control", Tata McGraw-Hill Education 2014.
3. K. Subramanian, "Water Resources and Quality Management", CRC Press 2019.
4. G.D. Rai, "Renewable Energy: Sources and Sustainable Development", PHI Learning Private Limited 2016.
5. Gilbert M. Masters, "Introduction to Environmental Science and Engineering", PHI Learning Private Limited 2013.
6. P. Venugopala Rao, "Principles of Environmental Science and Engineering", Cengage Learning India 2018.
7. C.S. Rao, "Environmental Pollution Control Engineering", McGraw-Hill Education 2015.
8. V.K. Ahluwalia, "Water Pollution: Causes, Effects, and Control", New Age International 2012.
9. S.P. Sukhatme, "Renewable Energy Systems", Tata McGraw-Hill Education 2010.

10. S. Meenakshi Sundaram, "Sustainable Development: Principles and Practices", Pearson Education India 2011.

2. Introduction to Geophysics

Course objectives:

- To introduce Geophysics to the study of the Earth's physical properties and processes.
- To understand applications of Geophysics and Environmental impact.

Course outcomes:

Upon completing this course, students will be able to:

- To explore key topics in geophysics, including seismology, geomagnetism, and plate tectonics, and their applications to geology, environmental science and natural hazards.

Unit I **7 Hrs**

Seismology and Earthquake Mechanics: Introduction to Seismology: Basics of seismic waves, types of seismic waves (P-waves, S-waves, surface waves) and seismograph instrumentation. Earthquake Mechanics: Causes of earthquakes, seismicity patterns, faulting mechanisms, and earthquake magnitude and intensity scales. Seismic Imaging Techniques: Reflection seismology, refraction seismology, and tomography methods for imaging Earth's subsurface structures. Seismic Hazard Assessment: Methods for assessing earthquake hazards, seismic risk analysis, and earthquake-resistant design principles.

Unit II **8 Hrs**

Geomagnetism and Earth's Magnetic Field: Earth's Magnetic Field: Structure and origin of Earth's magnetic field, geomagnetic poles, and magnetic declination. Magnetic Anomalies: Measurement of magnetic anomalies, interpretation of magnetic anomaly maps, and magnetic field reversals. Palaeomagnetism: Use of paleomagnetic data for reconstructing past positions of continents and understanding plate tectonics. Magnetotellurics: Principles of magnetotelluric surveys for imaging Earth's subsurface conductivity structure.

Unit III **7 Hrs**

Plate Tectonics and Earth's Interior: Plate Tectonics Theory: Evidence for plate tectonics, plate boundaries (divergent, convergent, transform), and plate motions. Earth's Interior Structure: Composition and properties of Earth's interior layers (crust, mantle, core), seismic tomography, and mantle convection. Continental Drift: Development of continental drift hypothesis, Wegener's evidence, and modern understanding of continental drift and plate motion. Geodynamics: Principles of lithospheric deformation, mountain building processes, and crustal dynamics.

Unit IV **8 Hrs**

Geophysical Applications and Environmental Impacts: Geophysical Exploration Methods: Overview of geophysical exploration techniques, including gravity, magnetic, seismic, and electrical methods. Environmental Geophysics: Applications of geophysics to environmental monitoring, groundwater exploration, and pollution assessment. Natural Hazards and Risk Assessment: Geophysical methods for studying natural hazards such as

landslides, volcanic eruptions, and tsunamis, and assessing associated risks. Geophysical Contributions to Environmental Science: Role of geophysics in understanding climate change, geohazards, and environmental sustainability.

Text Books and Reference Books:

1. P. Murali Krishna, "Principles of Geophysics"(for an introduction to seismology and earthquake mechanics)
2. G.B. Pant, "Geophysics: Principles and Applications"(for insights into Geomagnetism and Earth's magnetic field)
3. D.S. Parihar, "Principles of Geodynamics"(for insights into plate tectonics and Earth's interior)
4. B.P. Singh, "Environmental Geophysics: Principles and Applications"(for insights into geophysical applications and environmental impacts)

OE : Group-B (Any one) (STUG02PHY002.2)

Credit: 02 Theory Hrs: 30

1. Energy Sources

Course Objective:

- To provide a comprehensive understanding of energy sources, including their classifications, production methods and environmental impacts, while emphasizing the importance of sustainable and renewable energy technologies in global and Indian contexts.

Course Outcomes:

Upon completing this course, students will be able to:

- Understand the definition and classification of energy sources and their roles in economic development.
- Analyze conventional energy sources, their production, limitations, and environmental impacts.
- Evaluate renewable energy sources, including solar and wind energy, and their applications.
- Describe geothermal and hydroelectric power technologies and their advantages and disadvantages.
- Explain biomass and ocean energy sources and their future potential**.**

Unit I **7 Hrs**

Energy: Definition and units of energy, Classification of energy sources: Primary and Secondary energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Role of energy in economic development and social transformation, Overview of Indian & world energy scenario with latest statistics-consumption & necessity.

Unit II **8 Hrs**

Conventional Energy Sources: Fossil fuels, & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues & challenges. Need of eco-friendly & green energy & their related technology.

Renewable Energy Sources: Forms and characteristics of renewable energy sources, Solar energy: Key features, its importance, Merits & demerits of solar energy, Applications of solar energy - Solar water heater, solar cooker (brief discussion), photovoltaic (PV) Solar cell - Module, panel and array.

Unit III **7 Hrs**

Wind Energy: Introduction, Principle of wind energy conversion, Wind Turbines and different electrical machines in wind turbines, Advantages and disadvantages of wind mills, Applications of wind energy.

Geothermal Energy: Introduction to Geothermal Energy: Definition, history, types of geothermal resources and potential advantages and disadvantages, Geothermal Power Plant Technologies: Overview of the different types of geothermal power plants, including dry steam, flash steam, and binary cycle plants, and their operating principles, Applications of Geothermal energy.

Unit IV **8 Hrs**

Hydroelectric Power: Definition of hydro energy, Importance of hydro energy, Hydrological cycle, Selection of site for a hydroelectric plant, Types of hydropower plants, Components of hydropower plants, Types and Operational Aspects hydro turbines, Types of hydro generators, Working principle of hydro generators, the environmental impact of hydropower sources.

Other Energy Sources: Overview of Biomass energy, Ocean energy, their working principle, Advantages and disadvantages of Biomass and Ocean energy, future of energy sources.

Text Books and Reference Books:

1. B.H. Khan, “Non-Conventional Energy Resources”, Tata McGraw Hill Pub.,2009
2. G.D. Rai, “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi
3. M P Agarwal, “Solar energy”, S. Chand and Co. Ltd.
4. Dickson, Mary H. and Fane Mi, Mario, “Geothermal Energy: Utilization and Technology”, (2006) Editors, Earthscan, 205 pgs. ISBN - 13: 978-1-844047-184-5
5. Gupta, Harsh and Roy, Sukanta, “Geothermal Energy: An Alternative Resource” for the 21st Century, (2008), Elsevier, 279 pgs. ISBN: 978-0-444-52875-9
6. https://en.wikipedia.org/wiki/Renewable_energy

2. Energy Audit

Course Objectives:

- To understand energy efficiency, scope, conservation and technologies.
- To design energy-efficient lighting systems.
- To estimate/calculate the power factor of systems and propose suitable compensation techniques.
- To understand energy conservation in HVAC systems.
- To calculate life cycle costing analysis and return on investment on energy-efficient technologies.

Course Outcomes:

After the completion of the course, the student should be able to:

- Explain energy efficiency, conservation and various technologies.
- Design energy efficient lighting systems.
- Calculate power factor of systems and propose suitable compensation techniques.
- Explain energy conservation in HVAC systems.
- Calculate life cycle costing analysis and return on investment on energy efficient technologies.
- Select efficient technology in electric systems.
- Organize a structure of an energy audit for a case study.

Unit I **7 Hrs**

Energy sources: Energy consumption – world energy reserves – prices – alternative sources – power – energy policies – choice of fuels. Energy Basic Principles of Energy Audit and management, Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Pie charts – Snakey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems – Principles of energy management – Initiating, planning, controlling, promoting, monitoring, reporting.

Unit II **8 Hrs**

Heat Transfer Theory : Heat – Heat content – Rate of heat transfer – Heat transfer coefficient – Conduction – Convention and radiation. Thermal insulation & its importance – space heating – HVAC system – Heating of Buildings – District heating – Factors & affecting the choice of district heating.

Unit III **7 Hrs**

Energy Efficient Instruments: Digital Energy Meter – Data loggers – Thermo couples – Pyranometer – Lux meters – Tong testers – Power analyzers – Power factor – effects with non-linear loads – effect of harmonics on power factor – Power Factor Improvement – Capacitor rating – Effects of power factor improvements – Electric lighting – Types of lighting – Luminaries – Energy efficient lighting.

Unit IV **8 Hrs**

Economic Aspects & Financial Analysis: Costing Techniques – cost factors – break-even charts – sources of capital and hire charges – capital recovery – depreciation – budgeting and standard costing – charging energy – cash flow diagrams and activity charts.

Financial appraisal and profitability : investment decision- methods of investment appraisal- discounted cash flow – summary of investment appraisal techniques – Cost optimization – optimization with one variable – optimization with more than one variable.

Text Books and Reference Books:

1. W.R. Murphy & G. Mckay Butter worth, “Energy Management”, Elsevier publications 2012.
2. Sonal Desai, “Hand Book of Energy Audit”, Tata McGraw hill.
3. John .C. Andreas, Marcel Dekker, “Energy Efficient Electric Motors”, Inc Ltd–2nd edition, 1995.

3. S C Tripathy, “Electric Energy Utilization and Conservation”, Tata McGraw Hill Publishing Company Ltd. New Delhi.
4. Paul o’ Callaghan, “Energy management”, Mc–Graw Hill Book Company–1st edition 1998.
5. W.C.Turner, “Energy Management Hand Book”, John Wiley and Sons.
6. K. V. Sharma and P. Venkataseshaiah, “Energy management and conservation”, I K International Publishing House Pvt. Ltd 2011.
7. Arry C. White, Philip S. Schmidt, David R. Brown, “Industrial Energy Management Systems”, Hemisphere Publishing Corporation, New York 1994.
8. Albert Thumann, “Fundamentals of Energy Engineering”, Prentice Hall Inc, Englewood Cliffs, New Jersey 1984.

VSC: (Any one) (STUG02PHY003)

Credit: 02 Practical Hrs: 60

1. Basic Electronic Instrumentation and Measurement Skills

Course Objectives:

- To explain basic concepts and definitions in measurement.
- To understand the basic working principles of electrical and electronic measuring instruments.
- To describe the bridge configurations and their applications.
- To elaborate discussion about the importance of signal generators and analyzers in Measurement

Course Outcomes:

After successfully completing this laboratory course, the students will be able to:

- Identify various types of electronic instruments suitable for specific measurements.
- Classify various errors present in measuring instruments.
- Identify the various parameters that are measurable in electronic instrumentation.
- Employ appropriate instruments to measure given sets of parameters.
- To correlate their Physics theory concepts through practical.
- To understand and practice the skills while doing Physics practical.

Course outline:

1. Introduction to Basic Electronic Components

- Understanding the function of resistors, capacitors, and inductors.
- Testing and understanding the function of diodes and transistors.
- Studying Zener diode characteristics.
- Characteristics and functions of LEDs.
- Familiarization with switches, fuses, batteries, plugs, connectors, wires, and cables.

2. Electronic Component Testing and Equipment Handling

- Testing and understanding the function of integrated circuits.
- Equipment handling and usage procedures for Digital Multimeter (DMM).
- Function and operation of regulated power supply.

3. Electronic Instruments and Equipment

- Equipment handling and waveform visualization for Function Generator.
- Equipment handling and calibration of Cathode Ray Oscilloscope (CRO).
- Galvanometer resistance measurement using the half-deflection method.

4. Practical Applications and Mechanisms

- Studying the mechanism of electronic appliances like remote controls and electronic watches.

List of Experiments (Perform any Seven experiments):

1. Introduction to Basic Electronic Components
   Aim: To become familiar with and understand the function of basic electronic components such as resistors, capacitors, and inductors.
2. Diode and Transistor Testing
   Aim: To become familiar with, test, and understand the function of diodes and transistors.
3. Study of Zener Diode Characteristics
   Aim: To study the Zener diode and understand its characteristics.
4. Integrated Circuit Familiarization
   Aim: To become familiar with, test, and understand the function of integrated circuits (ICs).
5. Light Emitting Diode (LED) Characteristics
   Aim: To become familiar with the characteristics and understand the function of light-emitting diodes (LEDs).
6. Familiarization with Basic Electronic Components
   Aim: To become familiar with and understand the function of basic electronic components such as switches, fuses, batteries, power plugs, connectors, wires, and cables.
7. Digital Multimeter (DMM) Usage
   Aim: To become familiar with the equipment handling and usage procedure for a Digital Multimeter (DMM).
8. Study of Regulated Power Supply
   Aim: To study the function and operation of a regulated power supply.
9. Function Generator Operation
   Aim: To become familiar with the equipment handling and visualize the types of waveforms generated by a Function Generator.
10. Calibration of Cathode Ray Oscilloscope (CRO)

Aim: To become familiar with the equipment handling and calibrating a Cathode Ray Oscilloscope (CRO).

11. Galvanometer Resistance Measurement

    Aim: To study the resistance of a Galvanometer using the half-deflection method.

12. Electronic Appliance Mechanisms

    Aim: To study of mechanism of Electronic Appliances like Remote Control, Electronic Watch etc.

Text Books and Reference Books:

1. U.A. Bakshi, A.V. Bakshi & K.A. Bakshi, "Electronic Measurements and Instrumentation", Technical Publications.
2. H.S. Kalsi, "Electronic Instrumentation and Measurements", McGraw-Hill.
3. Gupta Jitendra B., "Electronics Measurement & Instrumentation", Katson Books 2013.
4. Raghbir Singh Khandpur, "Printed Circuit Boards: Design, Fabrication and Assembly", McGraw-Hill Electronic Engineering-2006 .
5. Sawhney Ashok K., "A course in Electrical and Electronic Measurements and Instrumentation" Dhanpat Rai & Co, New Delhi 2015.

2. Advanced Electromagnetism and Circuit Design

Course objectives:

- To understand the principle of electromagnetism and their application in designing and constructing electrical circuits.
- To do the hands-on experience in building and analyzing circuits, understanding their components, and exploring their practical uses.

Course Outcomes:

After successfully completing this laboratory course, the students will be able to:

- Comprehend advanced concepts in electromagnetism.
- Design and construct various electrical circuits.
- Use instruments to measure and analyze electrical properties.
- Apply theoretical knowledge to practical circuit problems.

Course Outline:

1. Fundamentals of Electromagnetism

- Electric fields and potentials
- Magnetic fields and electromagnetic induction

2. Circuit Components and Tools

- Resistors, capacitors, inductors, and transistors
- Using Multimeter and oscilloscopes

3. DC and AC Circuits

- Constructing and analyzing DC circuits
- Understanding AC circuits and their applications

4. Circuit Design and Analysis

- Designing complex circuits using circuit simulation software (e.g., LT Spice)
- Building and testing designed circuits

5. Electromagnetic Applications

- Exploring applications such as transformers, motors, and wireless communication

List of Experiments (Perform any Seven experiments):

1. Studying Electromagnetic Induction

   Aim: To demonstrate electromagnetic induction by moving a magnet through a coil and varying the magnetic field through a coil, measure the induced electromotive force (emf), and verify Faraday's Law of Induction.

2. Measurement and Analysis of Resistors, Capacitors, and Inductors

   Aim: To measure and analyze the resistance, capacitance, and inductance of various passive components using a multimeter, and to understand their behavior in simple circuits.

3. Studying the Characteristics of Bipolar Junction Transistors (BJTs)

   Aim: To investigate the input and output characteristics of NPN and PNP transistors, plot the characteristic curves, and understand the operation of transistors as amplifiers and switches.

4. Multimeter and Oscilloscope Usage for Circuit Analysis

   Aim: To learn the proper use of multimeters and oscilloscopes for measuring voltage, current, resistance, and analyzing waveforms in various electronic circuits, including both DC and AC signals.

5. Series and Parallel DC Circuits

   Aim: To construct and analyze series and parallel DC circuits, measure current and voltage across components, verify Kirchhoff's laws, and understand the principles of voltage and current division.

6. Transient Response in RC Circuits

   Aim: To study the transient response of RC circuits by constructing a resistor-capacitor circuit, measuring the charging and discharging curves of the capacitor, and understanding the time constant and its significance in DC circuits.

7. AC Circuits and Resonance in LCR Circuits

   Aim: To construct and analyze an LCR circuit, measure impedance, phase angles, and resonance frequency, and understand the behavior of AC circuits, including the concepts of inductive and capacitive reactance, and the application of resonance in tuning circuits.

8. Designing and Testing Filter Circuits (Low-pass, High-pass)

   Aim: To design and construct low-pass and high-pass filter circuits and evaluate their frequency response.

9. Prototype Construction and Testing of Designed Circuits

Aim: To construct prototype circuits on breadboards based on designs created using simulation software, and to test the functionality, performance, and characteristics of the circuits using laboratory instruments such as oscilloscopes, function generators, and multimeters.

10. Study of Transformer Operation and Characteristics

    Aim: To investigate the principles of electromagnetic induction and transformer operation, measure voltage transformation ratios, analyze the efficiency and losses in transformers, and understand their applications in power distribution and voltage regulation.

11. Exploring the Principles of Transformers and Constructing a Simple Transformer

    Aim: To explore the principles of electromagnetic induction and transformer operation by constructing a simple transformer and analyzing its performance.

Text Books and Reference Books:

1. Nair, S. K., & Menon, R., "Studying Electromagnetic Induction", New Delhi: S. Chand Publishing 2018.
2. Gupta, A., & Sharma, R., "Measurement and Analysis of Resistors, Capacitors, and Inductors". Mumbai: Pearson India Education Services Pvt. Ltd. 2019.
3. Kumar, M., & Singh, R., "Studying the Characteristics of Bipolar Junction Transistors (BJTs)", New Delhi: McGraw Hill Education 2017.
4. Patel, N. K., & Desai, P., "Multimeter and Oscilloscope Usage for Circuit Analysis", Bangalore: Wiley India Pvt. Ltd. 2016.
5. Choudhary, A., & Jain, R., "Series and Parallel DC Circuits", Kolkata: Oxford University Press India 2015.
6. Sharma, V., & Verma, S., "Transient Response in RC Circuits", New Delhi: Cambridge University Press India Pvt. Ltd. 2018.
7. Mishra, A., & Gupta, S., "AC Circuits and Resonance in LCR Circuit", Chennai: Vikas Publishing House Pvt. Ltd. 2019.
8. Singh, P., & Jain, M., "Designing and Testing Filter Circuits (Low-pass, High-pass)", Mumbai: Cengage Learning India Pvt. Ltd.
9. Agarwal, R., & Gupta, S., "Prototype Construction and Testing of Designed Circuits", New Delhi: PHI Learning Pvt. Ltd. 2016.
10. Gupta, A., & Singh, B., "Study of Transformer Operation and Characteristics", Hyderabad: BS Publications 2018.
11. Sharma, M., & Singh, K., "Exploring the Principles of Transformers and Constructing a Simple Transformer", New Delhi: Vikas Publishing House 2015.

SEC: (Any one) (STUG02PHY004)

Credit: 02 Theory Hrs: 30

1. Electrical Circuits and Network Skills

Course objectives:

- To design and troubleshoot electrical circuits, networks, and appliances through hands-on learning.
- To understand the basic electricity principles like voltage, current, resistance and power.
- To study Ohm's law and series-parallel circuit combinations.

Course Outcomes:

After successfully completing this laboratory course, the students will be able to:

- Demonstrate good comprehension of basic principles of electricity including ideas about voltage, current and resistance.
- Develop the capacity to analyze and evaluate schematics of power efficient electrical circuits while demonstrating insight into tracking of interconnections within elements while identifying current flow and voltage drop.
- Gain knowledge about generators, transformers and electric motors. The knowledge would include interfacing aspects and consumer defined control of speed and power.
- Acquire capacity to work theoretically and practically with solid-state devices.
- Develop into practical aspects related to electrical wiring like various types of conductors and cables, wiring-Star and delta connections, voltage drop and losses.
- Measure current, voltage, power in DC and AC circuits, acquire proficiency in fabrication of regulated power supply.
- Develop capacity to identify and suggest types and sizes of solid and stranded cables, conduit lengths, cable trays, splices, crimps, terminal blocks and solder

Unit I **8 Hrs**

Basic Electricity Principles: Introduction to Voltage, Current, Resistance, and Power. Ohm's law. Series - parallel combinations of resistance and capacitances. AC Electricity and DC Electricity. Familiarization with galvanometer, voltmeter, ammeter and multimeter.

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.

Unit II **7 Hrs**

Electrical Drawing and Symbols: Drawing symbols. Blue prints. 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. Generators and Transformers: DC Power sources. AC/DC generators. Concept conductance, capacitance and impedance. Operation of transformers.

Unit III **8 Hrs**

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

Solid State Devices: Diodes, Transistors, Thermister and LED, Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources.

Unit IV **7 Hrs**

Electrical Protection: Relays, Fuses and disconnecting witches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Interfacing DC or AC sources to control elements (relay protection device).

Text Books and Reference Books:

1. B. L. Theraja, "A text book in Electrical Technology", S. Chand &Co.
2. A. K. Theraja, "A textbook of Electrical Technology"
3. M.G. Say, "Performance and design of AC Machines", ELBS Edn

2. Applied Measurement and Instrumentation Skills

Course objectives:

- To master accurate measurement techniques for DC voltage and current using a multimeter.
- To understand the importance of multimeter specifications for ensuring measurement accuracy and reliability.
- To develop proficiency in measuring AC voltage, current, and resistance with a multimeter.
- To interpret multimeter specifications tailored for AC measurements to improve measurement accuracy.
- To learn effective utilization of a CRO for measuring DC and AC voltage, frequency, and period.
- To explore components and functionalities of low-frequency signal and pulse generators.

Course Outcomes:

After successfully completing this laboratory course, the students will be able to:

- Perform precise measurements of DC voltage and current using a multimeter.
- Apply multimeter specifications effectively for accurate measurement outcomes.
- Conduct proficient measurements of AC voltage, current, and resistance with a multimeter.
- Enhance measurement precision by interpreting multimeter specifications for AC measurements.
- Analyze CRO specifications to assess its suitability for specific tasks.
- Utilize a CRO effectively for precise measurement of voltage, frequency, and period.
- Identify components and functionalities of low-frequency signal and pulse generators.
- Explain the advantages of digital storage oscilloscopes (DSOs) over traditional analog oscilloscopes and understand their operational principles.

Unit I **8 Hrs**

Multimeter (DC): Measurement of DC voltage and DC current: Detailed exploration of the procedure and techniques involved in measuring DC voltage and current using a multimeter.Understanding the specifications of electronic voltmeters/multimeters and their significance: In-depth analysis of multimeter specifications such as accuracy, resolution, range, and input impedance, and their importance in measurement accuracy and reliability.

Unit II **7 Hrs**

Multimeter (AC): Measurement of AC voltage, AC current, and resistance: Comprehensive study of the methods and considerations for measuring AC voltage, current, and resistance using a multimeter.Interpretation of multimeter specifications for AC measurements: Examination of multimeter specifications specific to AC measurements, including RMS voltage, frequency response, and crest factor, and their implications on measurement accuracy.

Unit III **7 Hrs**

Cathode Ray Oscilloscope (CRO): Understanding the specifications of CRO with a block diagram and their significance: Detailed analysis of CRO specifications such as bandwidth, sensitivity, sweep rate, and triggering, along with the block diagram representation and their impact on CRO functionality and performance.

Measurement of voltage (DC and AC), frequency, and period using CRO: Practical demonstration and explanation of how CRO is used to measure DC and AC voltages, frequency, and period, including the setup and interpretation of waveforms.

Unit IV **8 Hrs**

Signal and Pulse Generators: Exploration of the block diagram and specifications of low-frequency signal and pulse generators: Study of the components and functionality of low-frequency signal and pulse generators, including specifications such as frequency range, amplitude, and waveform types.

Introduction to the principle of working of a digital storage oscilloscope: Overview of the operating principles of a digital storage oscilloscope (DSO), including signal acquisition, storage, and display, and its advantages over traditional analog oscilloscopes.

Text Books and Reference Books:

1. Patranabis, D., “A Textbook of Electrical Technology: Volume I - Basic Electrical Engineering”, New Delhi: Oxford University Press 2017.
2. Rajput, R. K., “Electrical and Electronics Measurements and Instrumentation”, New Delhi: S. Chand Publishing 2018.
3. Sawhney, A. K., “A Course in Electrical and Electronic Measurements and Instrumentation”, New Delhi: Dhanpat Rai Publications 2016.
4. Gupta, J. B., “Fundamentals of Electrical and Electronics Measurements”, New Delhi: S.K. Kataria & Sons 2019.
5. Bakshi, A. V., & Bakshi, U. A., “Electronic Instrumentation”, Pune: Technical Publications 2018.

6. Cooper, W. D., “Introduction to Biomedical Equipment Technology”, New Delhi: Pearson India 2017.
7. Ghatak, A., & Thyagarajan, K., “Optical Electronics”, New Delhi: Cambridge University Press India 2018.
8. Singh, J., & Jain, R., “Electrical Measurement and Instrumentation”, New Delhi: Khanna Publishers 2019.
9. Singh, S. P., “Electronic Instruments and Instrumentation Technology”, New Delhi: PHI Learning Pvt. Ltd 2016.
10. Maheshwari, S. N., “Principles of Electronic Instrumentation”, New Delhi: S. Chand Publishing 2017.