Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Structure and Curriculum of Four-Year Multidisciplinary Degree (Honors/Research) Programme with Multiple Entry and Exit option

Under Graduate Programme (II Year) of Physics

B.Sc. in Physics

Approved by

Board of Studies

in

Physics

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

[UG II Year]

w.e.f. June, 2024

(In accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **B.Sc. (Honors/Research) in Physics** Programme to be effective from the **Academic Year 2024-25.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 12/03/2024

Place: Latur

NEP Cell
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **B.Sc. (Honors/Research) in Physics** Programme to be effective from the **Academic Year 2024-25.**

Date: 12/03/2024

Place: Latur

(Dr A. A. Yadav)
Chairperson
Board of Studies in Physics
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Members of Board of Studies in the Subject Physics
Under the Faculty of Science and Technology
Department of Physics and Electronics

Sr. No.	Name	Designation	In position
1	**Dr A. A. Yadav** Head, Department of Physics & Electronics Rajarshi Shahu Mahavidyalaya (Autonomous), Latur	Chairperson	HoD
2	**Prof. Dr. V. P. Pawar,** Head, Department of Physics, Maharashtra Udayagiri Mahavidyalaya, Udgir Dist: Latur	Member	V.C. Nominee
3	**Dr R. H. Kadam,** Shrikrishna Mahavidyalaya, Gunjoti, Omerga	Member	Academic Council Nominee
4	**Mrs Shyamala Bodhane** Head, Department of Physics, Xt. Xaviers College, Mumbai	Member	Expert from outside for Special Course
5	**Shri Gundu Sabde** Relyon Industries, Pune	Member	Expert from Industry
6	**Dr K. N. Shivalkar** Head, Department of physics, Mahatma Gandhi Mahavidyalaya, Ahmedpur Dist. Latur	Member	P.G. Alumni
7	**Dr D. G. Palke** Head, Department of Chemistry,	Member	Faculty Member
8	**Dr Dayanand Raje**	Member	Member from same Faculty
9	**Mr Swapnil Undalkar**	Member	Member from same Faculty
10	**Mr Atul More**	Member	Member from same Faculty
11	**Miss Mayuri Hawaldar**	Member	Member from same Faculty
12	**Miss Vishakha Patil**	Member	Member from same Faculty
13	**Mr. Suraj Gund**	Member	Member from same Faculty

From the Desk of the Chairperson…

"Creativity is intelligence having fun" – Albert Einstein

I welcome you all. We have immense pleasure to share that our department is one of the star departments with the state-of-the-art facilities and has highly qualified and dignified faculty. The department addresses the critical challenges to face the society, industry and the academia. I take great pride in sharing that from the academic year 2023-24, development of our Physics curriculum is with the objectives and guidelines as per the National Education Policy 2020. National Education Policy 2020 is a comprehensive framework for education in India that aims to transform the existing education system. The NEP 2020 emphasizes a holistic and multidisciplinary approach to education, focusing on the overall development of students.

Our curriculum as per NEP 2020 reflects: A balanced mix of theoretical concepts, practical applications, and problem-solving skills. Incorporate interdisciplinary connections and encourage the integration of Physics with other subjects where appropriate. Inclusion of emerging topics and advancements in Physics, such as Quantum mechanics, Astrophysics, Nuclear Physics, Renewable Energy, etc. Design learning outcomes that emphasize conceptual understanding, critical thinking, analytical skills, and practical applications. Encourage project-based learning, hands-on experiments, and inquiry-based activities to foster active student engagement and exploration. Explore the integration of technology tools and resources. Promotes inclusivity, gender sensitivity, and addresses the needs of students with diverse backgrounds and abilities.

Our department organizes workshops, training programs, and seminars to update physics teachers about the revised curriculum, instructional strategies, and assessment methods. Encourage teachers to engage in professional development activities, research, and collaboration to enhance their pedagogical skills. Provide support and resources for teachers to integrate technology effectively into their teaching practices.

Our assessment methods are innovative, such as project portfolios, oral presentations, demonstrations, and performance-based assessments in addition to traditional written exams. Facilitate collaborations with research institutions, industries, and organizations to provide students with real-world exposure and opportunities for internships or mentor-ship programs.

Let me take the opportunity to thank and wish you all a great success.

(Dr A.A. Yadav)
Chairperson
Board of Studies in Physics

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Physics and Electronics

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Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Structure for Four Year Multidisciplinary Undergraduate Degree Programme in Physics

Multiple Entry and Exit (In accordance with NEP-2020)

Year & Level	Sem	Major		Minor	OE	VSC/ SEC (VSEC)	AEC/ VEC	OJT, FP, CEP, RP	Credit per Sem.	Cum./Cr. per exit
		DSC	DSE							
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**10**
II 5.0	III	DSC V: 04 Cr. DSC VI: 04 Cr.	NA	Minor I: 04 Cr.	OE-III: 02 Cr.	SEC-III: 02 Cr.	AEC-III Eng. : 02 Cr.	CC-II: 02 Cr. (NSS, NCC, Sports, Cultural)/ (SES-I)/ FP: 02 Cr.	22	88 Cr. UG Diploma
	IV	DSC VII: 04 Cr. DSC VIII: 04 Cr.	NA	Minor II: 04 Cr.	OE-IV: 02 Cr.	SEC-IV: 02 Cr.	AEC-IV Eng. : 02 Cr. VEC-II: 02 Cr.	CC-III: 02 Cr. (NSS, NCC, Sports, Cultural)/ CEP-I: 02 Cr.	22	
	Cum. Cr.	16	-	08	04	04	06	08	44	
Exit Option: Award of UG Diploma in Major with 88 Credits and Additional 04 Credits Core NSQF Course/Internship or continue with Major and Minor										

Note:

A) Co-Curricular Courses (CC) includes –

1. Health and Wellness
2. Yoga education
3. Sports and fitness
4. Cultural activities
5. NSS
6. NCC
7. Fine Applied Visual Performing Arts
8. Study Tour
9. Publication of articles in newspaper / magazine.

B) Field Project concerned with Major

Abbreviations:

1.	DSC	: Discipline Specific Core (Major)
2.	DSE	: Discipline Specific Elective (Major)
3.	DSM	: Discipline Specific Minor
4.	OE	: Open Elective
5.	VSEC	: Vocational Skill and Skill Enhancement Course
6.	VSC	: Vocational Skill Courses
7.	SEC	: Skill Enhancement Course
8.	AEC	: Ability Enhancement Course
9.	MIL	: Modern Indian Languages
10.	IKS	: Indian Knowledge System
11.	VEC	: Value Education Courses
12.	OJT	: On Job Training
13.	FP	: Field Projects
14.	CEP	: Fostering Social Responsibility & Community Engagement (FSRCE)
15.	CC	: Co-Curricular Courses
16.	RP	: Research Project/Dissertation
17.	SES	: Shahu Extension Services

Shiv Chhatrapati Shikshan Sanstha's

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Faculty of Science and Technology

Department of Physics and Electronics

B.Sc. (Honors/Research) in Physics

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
I 4.5	I	201PHY3101 (DSC-V)	Optics and Lasers	03	45
		201PHY3103	Lab Course-V	01	30
		201PHY3102 (DSC-VI)	Mathematical Physics and Transducers	03	45
		201PHY3104	Lab Course-VI	01	30
		(Minor-I)	From Basket	04	60
		OE-III	From Basket	04	60
		(SEC-III)	From Basket	02	45
		(AEC-III)	From Basket	02	30
		CC	CC-II	02	30
		AIPC/OJT-I	Field Project	02	60
	Total Credits			**22**	
	II	201PHY4101 (DSC-VII)	Nuclear Physics and Relativity	03	45
		201PHY4103	Lab Course-VII	01	30
		201PHY4102 (DSC-VIII)	Waves, Oscillations and Acoustics	03	45
		201PHY4104	Lab Course-VIII	01	30
		(Minor-II)	From Basket	04	60
		OE-II	From Basket	04	60
		(SEC-IV)	From Basket	02	45
		(AEC-IV)	From Basket	02	30
		CC	CC - III	02	30
		AIPC/OJT-III	CEP-I	02	30
	Total Credits			**22**	
Total Credits (Semester I & II)				**44**	

Programme Outcomes (POs) for B.Sc. Programme	
PO1	**Disciplinary Knowledge** Comprehensive knowledge of science subjects which constitute the graduate programme and execution of scientific knowledge in the specific area.
PO2	**Scientific Outlook** The qualities of a science graduate such as observation, precision, analytical mind, logical thinking, clarity of thought and expression and systematic approach.
PO3	**Self-Directed Life-long Learning** Ability to appear for various competitive examinations or choose the post graduate programme or other related programme of their choice.
PO4	**Research Skills** Functional knowledge and applications of instrumentation and laboratory techniques to do independent experiments, interpret the results and develop research ethos.
PO5	**Problem Solving Skills** Analytical and logical skills and critical thinking to extract information from qualitative and quantitative data, formulate and solve problems in a systematic and rational manner.
PO6	**Professional Competence and Ethics** Aptitude and skills to perform the jobs in diverse fields such as science, engineering, industries, survey , education, banking, development and planning, business, public service, self-business etc. with human rationale and moral values.

Programme Specific Outcomes (PSOs) for B.Sc. Physics (Honors/Research)	
PSO No.	Upon completion of this programme the students will be able to
PSO 1	Distinguish core knowledge on various courses of Physics.
PSO 2	Recognize the concepts which help them in understanding physical phenomenon in nature.
PSO 3	Classify skills and competencies to conduct scientific experiments related to Physics.
PSO 4	Identify their area of interest and further specialize in the Physics.
PSO 5	Operate advanced knowledge and skills in job market for various technical industries.
PSO 6	Relate their knowledge and skills in carrying out independent work.
PSO 7	Analyze situations, search for truth and extract information, formulate and solve problems in a systematic and logical manner.
PSO 8	Discuss debate and communicate in a clear and logical way, with graduates in Physics and other fields.
PSO 9	Demonstrate relevant generic skills and global competencies.

Curriculum

Major Courses

Semester - III

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Rajarshi Shahu Mahavidyalaya, Latur

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Faculty of Science and Technology

Department of Physics and Electronics

Course Type: DSC-V

Course Title: Optiscs and Lasers

Course Code: 201PHY3101

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning objective

LO 1. To develop understanding of the concept of the light wave phenomena: interference, diffraction, and polarization

LO 2. To inculcate the idea of interference and diffraction among the students

LO 3. To have a comprehensive overview of resolving and dispersive power

LO 4. To develop understanding of the fundamentals of LASER and its properties

Course outcomes

After completion of the course, students will be able to-

CO 1. Explain the phenomenon of Interference, Diffraction, and Polarization,

CO 2. Interpret wavelength, resolving power, dispersive power, and specific rotation,

CO 3. State the properties of various lasers and the propagation of laser beams,

CO 4. Determine specific rotation of sugar like solution.

Unit No.	Title of Unit & Contents	Hrs.
I	**Interference**	**11**
	1. Introduction, Constructive and Destructive Interference, Interference Due to Reflected Light (Thin Film), Interference Due to Transmitted Light, 2. Condition for Maxima and Minima, 3 Newton's Rings: Condition for Bright and Dark Rings, Circular Fringes, Radii of Dark Circular Fringes, Spacing between Fringes, Fringes of Equal Thickness, Dark Central Spot, 4. Determination of Wavelength of Light. 5. Michelson Interferometer: Principle, Construction and Working, Circular Fringes, Localized Fringes, Determination of Wavelength of Monochromatic Light, Determination of Difference in the Wavelength of Two Waves, 7. Mach-Zender Interferometer 8. Application of interference in LIGO, 9. Numerical Problems.	
	Unit Outcomes:	

Unit No.	Title of Unit & Contents	Hrs.
	UO1. Predict the interference pattern of Newton's Ring and Michelson Interferometer. UO2. Determine the wavelength of the laser using interference pattern of Michelson Interferometer.	
II	**Diffraction**	**11**
	1. Introduction 2. Fresnel and Fraunhofer Diffraction, 3. Fraunhofer's Diffraction due to Single and Double Slit, 4. Diffraction due to Circular Aperture 5. Diffraction Pattern due to Straight Edge 6. Determination of Wavelength of Sodium Light using Transmission Grating 7. Rayleigh Criterion 8. Resolving Power of Transmission Grating, Dispersive Power of Grating, 9. Resolving Power of Prism, 10. Numerical Problems	
	Unit Outcomes: UO1. Can differentiate the Fresnel and Fraunhoffer Diffraction of light wave. UO2. Resolve two points that are close enough and identified using Plane Diffraction Grating	
III	**Polarization**	**12**
	1. Introduction, Polarization by Reflection, Brewster's Law 2. Polarized Light, Polarization by Refraction, Polarization by Double Refraction, 3. Nicol Prism as Polarizer and Analyzer 4. Malu's Law, Optic Axis, Principal Section, 5. Birefringence, 6. Huygens's Explanation of Double Refraction 7. Elliptically and Circularly Polarized Light, Quarter Wave Plate, Half Wave Plate, 8. Optical Activity, Specific Rotation, Laurent's Half Shade Polarimeter. 9. Numerical Problems	
	Unit Outcomes: UO1. Verify the Malu's law. UO2. Determine specific rotation of solution.	
IV	**Lasers**	**11**

Unit No.	Title of Unit & Contents	Hrs.
	1. Introduction, Interaction of Light with Matter, 2. Absorption, Spontaneous and Stimulated Emission, Einstein Coefficients and their Relations, Components of Laser, 3. Population Inversion: Condition for Stimulated Emission, Optical and Electrical Pumping, 4. Pumping Scheme: Three Level, Four Level, 5. Optical Resonators Cavity, Laser Action, 6. Properties of Lasers, 7. Ruby Laser, Helium-Neon Laser, Applications of Lasers (Qualitative Only).	
	Unit Outcomes: UO1. Understand and compare the working of various lasers. UO2. Identify the Spontaneous and Stimulated Emission of light.	

Learning Resources:

1. A Text Book of Optics – Brij Lal and Subrahmanyam (S. Chand & Co.)
2. Introduction to Laser Theory and its Applications- M. N. Avadhanulu (S. Chand Publication-2001)
3. B.Sc. Physics Volume-I- C.L. Arora (S. Chand)
4. Lasers and Nonlinear Optics – B.B. Laud (Willey, Eastern Limited)
5. Optics and Atomic Physics – D.P. Khandelwal. (Himalaya Publishing House)
6. Optics (Second Edition) – A.K. Ghatak
7. Geometrical & Physical Optics by D. S. Mathur.
8. A Text Book of Optics – Brij Lal and Subrahmanyam (S. Chand & Co.)
9. Introduction to Laser Theory and its Applications- M. N. Avadhanulu (S. Chand Publication-2001)
10. B.Sc. Physics Volume-I- C.L. Arora (S. Chand)
11. Lasers and Nonlinear Optics – B.B. Laud (Willey, Eastern Limited)
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Rajarshi Shahu Mahavidyalaya, Latur

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Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Laboratory Course- V

Course Title: Lab Course –V

Course Code: 201PHY3103

Credit: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective

LO1. To equip students with hands-on skills and knowledge, enabling them to understand and apply fundamental concepts through experiments and problem-solving, focusing on laser principles, optical systems, and experimental techniques.

Course Outcomes

After completion of the course, students will be able to-

CO 1. Apply the principles of geometrical and physical optics to determine optical parameters such as angle, refractive index, and dispersive power using prisms and gratings.

CO 2. Analyze polarization effects and determine specific rotation of optically active substances using polarimetry techniques.

CO 3. Utilize interferometric and diffraction techniques, including air wedge and diffraction gratings, to measure physical dimensions and wavelengths with high precision.

CO 4. Investigate the characteristics of laser beams, including divergence and coherence, and apply them to measure surface tension and optical properties of materials.

List of Experiments:

Practical No.	Unit
1	Determination of Angle of prism
2	Determination of Dispersive power of prism
3	Determination of Dispersive power of gratings
4	Determination of Refractive Index of prism material by i-d curve using spectrometer
5	Determination of specific rotation by Lorentz half shade polarimeter
6	Verification of Hartmann's dispersion formula using spectrometer and Lamp and scale arrangement
7	Determination of Thickness of thin wire by Air wedge method.
8	Determination of surface tension of liquid using laser
9	Determination of wavelength of laser by diffraction gratings

10	Study of divergence of laser beam

Learning Resources:

1. A Text Book of Optics – Brij Lal and Subrahmanyam (S. Chand & Co.)
2. Introduction to Laser Theory and its Applications- M. N. Avadhanulu (S. Chand Publication-2001)
3. B.Sc. Physics Volume-I- C.L. Arora (S. Chand)
4. Lasers and Nonlinear Optics – B.B. Laud (Willey, Eastern Limited)
5. Optics and Atomic Physics – D.P. Khandelwal. (Himalaya Publishing House)
6. Optics (Second Edition) – A.K. Ghatak
7. Geometrical & Physical Optics by D. S. Mathur.
8. A Text Book of Optics – Brij Lal and Subrahmanyam (S. Chand & Co.)
9. Introduction to Laser Theory and its Applications- M. N. Avadhanulu (S. Chand Publication-2001)
10. B.Sc. Physics Volume-I- C.L. Arora (S. Chand)
11. Lasers and Nonlinear Optics – B.B. Laud (Willey, Eastern Limited)
12. Optics and Atomic Physics – D.P. Khandelwal. (Himalaya Publishing House)
13. Optics (Second Edition) – A.K. Ghatak
14. Geometrical & Physical Optics by D. S. Mathur.

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Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: DSC-VI

Course Title: Mathematical Physics and Transducers

Course Code: 201PHY3102

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning objectives

LO 1. Introduce students to use mathematical methods to solve Physics problems.

LO 2. Provide students with basic skills of the application of Mathematical methods in Physics.

LO 3. To make students familiar with the most important special operators of mathematical physics, including Gradient, Divergence and Curl.

Course outcomes

After completion of course the student will be able to-

CO 1. Calculate with vectors and scalars in physics,

CO 2. Determine the difference between complex numbers and real numbers,

CO 3. Find Fourier Series of periodic function,

CO 4. Differentiate between the types of transducers available.

Unit No.	Title of Unit & Contents	Hrs.
I	**Vector Analysis**	**12**
	1. Introduction to Vector Analysis, Addition of Vectors, Properties of Addition of Vectors, Subtraction of Vectors, Multiplication of Vectors by a Number. 2. Product of Two Vectors: Scalar Product, Vector Product, Scalar Triple Product, Vector Triple Product 3. Scalar and Vector Fields, Gradient of a Scalar Field, Gradient of Scalar Function, Divergence of a Vector Function, Physical Interpretation of Divergence. 4. Curl of a Vector Field and their Physical Interpretation, 5. Laplacian Operator (∇^2), 6. The Vector Integration: Line Integral, Surface Integral, Volume Integral 7. Statements of Gauss's Divergence Theorem, Stoke's Theorem, Green's Theorem. 8. Proof of Vector Identities:	

Unit No.	Title of Unit & Contents	Hrs.
	i) $\nabla \times \nabla\phi = 0$ ii) $\nabla \cdot (\nabla \times A) = 0$ iii) $\nabla \cdot (\phi A) = \phi(\nabla \cdot A) + A \cdot (\nabla\phi)$ iv) $\nabla \times (\phi A) = \phi(\nabla \times A) + (\nabla\phi) \times A$ v) $\nabla . (\nabla\phi) = \nabla^2\phi$ vi) $\nabla . (A \times B) = B \cdot (\nabla \times A) - A \cdot (\nabla \times B)$	
	Unit Outcomes: UO1. Understand the basic concepts of vectors and vector algebra UO2. Apply vector analysis techniques to solve problems in physics, engineering, and mathematics.	
II	**Complex Numbers and Complex Variables**	**10**
	1.Introduction, Definition of Complex Number, Modulus of Complex Numbers, Equality of Complex numbers 2. Complex Algebra: Addition, Subtraction, Multiplication, Division. 3. Conjugate of Complex Numbers 4. Argand Diagram: Graphical Representation of Complex Numbers, Polar Form of Complex Numbers. 5. Geometrical Representation of Sum, Difference, Product and Quotient of Complex Numbers 6. Properties of Moduli, Arguments and Geometry of Complex Numbers. 7. Rectangular, Polar and Exponential form of Complex Numbers 8. De-Movie's Theorem, Extraction of Roots of Complex Numbers	
	Unit Outcomes: UO1. Understand the concept of complex numbers as extension of real numbers. UO2. Apply complex numbers to solve problems in mathematics and engineering.	
III	**Fourier Series and Laplace Transform**	**12**
	1. Periodic Functions, Introduction to Fourier Series, Definition, Advantages of Fourier Series, Useful Integrations, Cosine Series, Sine Series, 2. Dirichlet's Conditions for Fourier Series, Advantages of Fourier Series, Useful Integrals. 3. Evaluation of The Coefficients of Fourier Series (Euler's Formulae), 4. Graphical Representation of Even and Odd Function 5. Physical Applications of Fourier Series Analysis: Square Wave, Full and	

Unit No.	Title of Unit & Contents	Hrs.
	Half Wave Rectifiers, 6. Laplace Transform: Conditions for Existence of Laplace Transform 7. Laplace Inverse Transformation, 8. Some Simple Properties of Laplace Transform, Piecewise or Sectional Continuity.	
	Unit Outcomes: UO1. Understand the conditions under which a periodic function can be represented by a cosine or sine series. UO2. Analyze the symmetry properties of even and odd functions and their implications for Fourier series representation.	
IV	**Transducers:**	**11**
	1. Introduction, Definition, Types and Classification of Transducers, Characteristics of transducers, Classification Based on Electrical Principle Involved, 2. Resistive Pressure Transducer 3. Inductive Pressure Transducer 4. Capacitive Pressure Transducer 5. Linear Variable Differential Transformer (LVDT) 6. Strain Gauge, Temperature Transducers, 7. Resistance Temperature Detectors, Thermistors 8. Carbon Microphone, Moving Coil Microphone 9. Loudspeaker.	
	Unit Outcomes: UO1. Understand the basic concept and importance of transducers in engineering and technology. UO2. Analyze the characteristics of transducers including sensitivity, accuracy, resolution, linearity, and frequency response	

Learning Resources:

1. Mathematical Physics - B.S. Rajput and Yog Prakash.
2. Mathematical Physics- B.D. Gupta (Vikas Publishing House)
3. Basic Electronics- B.L. Theraja (Solid State- Multicolor Edition)
4. Vector Analysis- Murray R. Spigel.
5. Advanced Engineering Mathematics- H.K. Das.
6. Methods of Mathematical Physics by Laud Talbout and Gambhir

7. Mathematical Methods in Physical Sciences- Masy and Bias.
8. Modern Electronic Instrumentation and Measurement - Albert D. Helfrick and William David Cooper.
9. Transducers and Instrumentation by D. V. S. Murthy-PHI Publication

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Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Laboratory Course- VI

Course Title: Lab Course–VI

Course Code: 201PHY3104

Credit: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Leaning Objectives

LO 1. To perform the various experiments based on Mathematical Physics and Transducers

LO 2. To handle and make use of equipment's/ software's to determine some quantities.

Course Outcomes

After completion of the course, students will be able to-

CO 1. Develop and implement C programs to perform mathematical operations on complex numbers and vectors, including Fourier transformation for signal analysis.

CO 2. Analyze and interpret complex waveforms and their harmonic content using Fourier techniques.

CO 3. Understand the working principles and characteristics of sensors and transducers, including capacitive transducers and LVDTs, through practical measurement experiments.

CO 4. Apply vector principles and experimental methods to determine equilibrium conditions using a force table.

Practical No.	Unit
1	C-Program for addition of two complex number
2	C-Program for multiplication of two complex numbers
3	C-program for maximum scalar product of two vectors.
4	C-program for Fourier transformation
5	To analyze complex wave (square and triangular wave etc.)
6	To verify the existence of different harmonics and measure their relative amplitudes.
7	To study capacitive transducer
8	To measure output voltage w.r.t the displacement of the core on the LVDT kit
9	To determine the force that balances two other forces using a force table.

Learning Resources:

1. Mathematical Physics - B.S. Rajput and Yog Prakash.
2. Mathematical Physics- B.D. Gupta (Vikas Publishing House)
3. Basic Electronics- B.L. Theraja (Solid State- Multicolor Edition)
4. Vector Analysis- Murray R. Spigel.
5. Advanced Engineering Mathematics- H.K. Das.
6. Methods of Mathematical Physics by Laud Talbout and Gambhir
7. Mathematical Methods in Physical Sciences- Masy and Bias.
8. Modern Electronic Instrumentation and Measurement - Albert D. Helfrick and William David Cooper.
9. Transducers and Instrumentation by D. V. S. Murthy-PHI Publication

Semester - IV

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: DSC-VII
Course Title: Nuclear Physics and Relativity
Course Code: 201PHY4101
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning objectives

LO 1. Develop understanding of the basic nuclear structure,

LO 2. Inculcate idea of forces that hold the nucleus together and under what circumstances it might break apart,

LO 3. Introduce different types of Radioactive decays and information about computation of the daughter nuclei for these decays,

Course outcomes

After completion of course, the student will be able to-

CO 1. Demonstrate knowledge and broad understanding of Nuclear Physics,

CO 2. Demonstrate knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter,

CO 3. Discuss fission and fusion process,

CO 4. Understand of the basic principles of the special theory of relativity.

Unit No.	Title of Unit & Contents	Hrs.
I	**Nuclear Structure and General Properties of Nuclei**	**10**
	1. Introduction, 2. Nuclear Mass and Binding Energy, 3. Importance of Accurate Determination of Atomic Masses, 4. Systematic of Nuclear Binding Energy, Nuclear Size, Nuclear forces 5. Measurement of the Charge Radius: Electron Scattering Experiment, 6. Measurement of Potential Radius, 7. Nuclear Spin, 8. Parity of Nuclei, 9. Numerical Problems	
	Unit Outcomes: UO1. Analyze the factors influencing nuclear stability and instability based on mass and binding energy considerations. UO2. Understand the principles and techniques of electron scattering	

Unit No.	Title of Unit & Contents	Hrs.
	experiments for probing nuclear structure.	
II	**Peaceful use of Nuclear Energy**	**12**
	1. Introduction, The Discovery of Nuclear Fission, 2. Energy Released in Fission, The Nature of Fission Fragments 3. The Energy Distribution Between the Fission Fragments 4. Emission Of Neutrons in Nuclear Fission 6. Energies Of Fission Process 7. Bohr Wheeler Theory of Fission Process. 8. Nuclear Cross Section and Thresholds 8. Nuclear Fusion, Nuclear Fusion and Thermonuclear Reactions 9. Numerical Problems	
	Unit Outcomes: UO1. Apply knowledge of fission cross sections to predict and analyze nuclear reaction rates and probabilities. UO2. Explore the mechanisms of neutron emission in nuclear fission reactions.	
III	**Radioactivity**	**12**
	1. Introduction, Discovery of Radioactivity, 2. Radioactive Disintegration and Displacement Law 3 Law of radioactive disintegration 4. Half Life of radioactive substance, Mean Life Time of a Radioactive Substance, Half Lives for Complex Decays, 5. Successive Disintegration, Radioactive Equilibrium 6. Discovery of Radium, Radon Gas, 7. Unit of Radioactivity, Measurement of decay constant 8. Age of Minerals and Rocks: Age of the Earth, Numerical Problems.	
	Unit Outcomes: UO1. Demonstrate the fundamental principles of radioactivity. UO2. Estimate the age of the Earth, considering radioactive dating methods.	
IV	**Special Theory of Relativity:**	**11**
	1. Introduction, Inertial and non-inertial Frame of References 2. Newtonian Relativity, 3. Galilean transformation equations, 4. Postulates of Special Theory of Relativity, 5. Lorentz Transformation Equations, 6. Length Contraction, Time Dilation,	

Unit No.	Title of Unit & Contents	Hrs.
	7. Velocity Addition, Variation of Mass with Velocity, 8. Mass-Energy Relation, 9. Numerical Problems.	
	Unit Outcomes: UO1. Explain the concept of time dilation and its consequences for moving clocks, both from the perspective of an observer at rest and an observer in motion. UO2. Describe how lengths appear shorter in the direction of motion when measured in a moving frame of reference. UO3. Understand the equivalence between mass and energy	

Learning Resources:

1. Atomic and Nuclear Physics – V.W. Kulkarni
2. Nuclear Physics- S.N. Ghoshal (S. Chand and Company, Ltd)
3. Nuclear Physics –Irving Kaplan (Narosa Publishing House, New Delhi)
4. Modern Physics- R. Murugeshan (S. Chand and Company Ltd, XI Edition)
5. Nuclear Physics-D. C. Tayal (Himalaya Publishing House)
6. Perspective of Modern Physics- Arthur Beiser
7. Atomic Physics- J.B. Rajam, (S. Chand and Company Ltd)
8. Nuclear Physics – An Introduction–Patel S.B.
9. Nuclear Physics- S.P. Sahu
10. Relativity-- Satyaprakash

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Laboratory Course- VII

Course Title: Lab Course–VII

Course Code: 201PHY4103

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective

LO 1. To create awareness and understanding about radiation hazards and safety.

Course Outcomes

After completion of course, students will be able to-

CO 1. Study the attenuations of radiations by matter

CO 2. Investigate the relation between the count rate and thickness of the material which demonstrates exponential attenuation

CO 3. Determines the value of Planck's constant and studies the nature of light.

Practical No.	Unit
1	To determine of operating voltage and plateau of G. M. tube.
2	To investigate the relation between the count rate and the thickness of the material for gamma ray source demonstrating exponential attenuation
3	To determine linear and mass attenuation coefficient of Aluminum foil
4	To verify inverse square law for gamma rays
5	To determine wavelength of LASER by diffraction gratings
6	To study of divergence of laser beam
7	To determine solar cell efficiency and fill factor
8	To determine Planck's constant using Solar cell
9	To determine 'h/e' using Photo Cell
10	To determine Planck's constant 'h' by LED

Learning Resources:

1. Atomic and Nuclear Physics – V.W. Kulkarni
2. Nuclear Physics- S.N. Ghoshal (S. Chand and Company, Ltd)
3. Nuclear Physics –Irving Kaplan (Narosa Publishing House, New Delhi)
4. Modern Physics- R. Murugeshan (S. Chand and Company Ltd, XI Edition)
5. Nuclear Physics-D. C. Tayal (Himalaya Publishing House)

6. Perspective of Modern Physics- Arthur Beiser
7. Atomic Physics- J.B. Rajam, (S. Chand and Company Ltd)
8. Nuclear Physics – An Introduction–Patel S.B.
9. Nuclear Physics- S.P. Sahu
10. Relativity-- Satyaprakash

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: DSC-VIII

Course Title: Waves, Oscillations and Acoustics

Course Code: 201PHY4102

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning objectives

LO 1. To acquaint students with the fundamentals of vibrations and acoustics,

LO 2. To improve students' knowledge of physics related to the fields of acoustics and oscillations,

Course outcomes

After completion of course the student will be able to-

CO 1. Assess fluctuations and acoustic processes in nature and technology in various forms,

CO 2. Analyze the mechanism and the machinery noise levels,

CO 3. Distinguish between different sounds and noise levels in the environment.

CO 4. Determine the intensity and hence the loudness of any musical sound.

Unit No.	Title of Unit & Contents	Hrs.
I	**Free, Forced and Resonant Vibrations**	**9**
	1. Introduction, 2. Free Vibrations, Undamped Vibration, Damped Vibrations 3 Forced Vibrations, 4. Resonance and Sharpness of Resonance, Phase of Resonance 5. Quality Factor, 6. Examples of Forced and Resonant Vibrations, 7. Numerical Problems	
	Unit Outcomes: UO1. Understand the different types of vibrations in mechanical systems. UO2. Obtain solution of the oscillator using differential equations.	
II	**Wave Motion**	**14**
	1. Introduction: Comparison of Properties of Longitudinal and Transverse Waves, 2. Differential Equation of Wave Motion, 3. Particle Velocity and Wave Velocity 4. Energy of Plane Progressive Wave, Equation of Motion of Vibrating String	

	(Transverse Vibration of String), 5. Velocity of Transverse Waves along a String, Frequency and Period of Vibration of String, General equation for displacement of a vibrating string, 6. Newton's formula for velocity of sound and Laplace correction, 7. Newton's formula for velocity of sound and Laplace correction, Velocity of longitudinal waves in gases, Numerical Problems	
	Unit Outcomes: UO1. Solve the differential equation of wave motion and understand its significance. UO2. Gain the knowledge on applications of transverse and longitudinal waves.	
III	**Stationary Waves**	**10**
	1. Introduction to Stationary Waves, 2. Properties of Stationary Longitudinal Waves 3. Analytical Treatment of Stationary Wave: Case-I: Closed End Organ Pipe or String Fixed at the Other End. Case-II: Open End Organ Pipe or String Free at the Other End. 5. Energy of Stationary Waves 6. Stationary waves in a resonating air column, 7. Numerical Problems.	
	Unit Outcomes: UO1. Differentiate the longitudinal and transverse stationary waves. UO2. Analyze the stationary waves that are produced in closed end organ pipe.	
IV	**Acoustics and Ultrasonic**	**12**
	1. **Acoustics:** Introduction, Noises and Musical Sounds 2. Characteristics of Musical Sound, Intensity of Sound, 3. Measurement of Intensity of Sound-Decibel Bel and Phone 4. Doppler's Effect: i) Observer at Rest, Source in Motion, ii) Source at Rest and Observer in Motion, iii) When both in Motion., 5. **Ultrasonics:** Piezo-Electric Effect 6. Piezo-Electric Generator for Ultrasonic Waves, Applications of Ultrasonic Waves, 7. Magnetostriction Effect and Magnetostriction Oscillator, 8. Numerical Problems.	
	Unit Outcomes:	

	UO1. Determine the intensity and hence the loudness of any musical sound. UO2. Able to understand the specific frequency sound.	

Learning Resources:

1. Waves and Oscillations- N. Subrahmanyam and Brij Lal. (Vikas Publishing House PVT. LTD)
2. A Text Book of Sound- D.R. Khanna and R.S. Bedi. (Atma Ram and Sons Delhi)
3. A Textbook of Oscillations, Waves and Acoustics- M. Ghosh and D. Bhattacharya (S. Chand and Company LTD.)
4. A Textbook of Sound – R.L. Saihgal (S. Chand and Company LTD.)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Laboratory Course-VIII

Course Title: Lab Course-VIII

Course Code: 201PHY4104

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective

LO 1. In a practical course on Waves, Oscillations, and Acoustics, students should learn to experimentally demonstrate, analyze, and apply the principles of wave motion, oscillations, and sound propagation, including identifying wave types, analyzing oscillatory systems, and understanding acoustic phenomena

Course Outcomes

After completion of the course, students will be able to-

CO 1. Apply principles of acoustics and resonance to determine physical parameters such as frequency, speed of sound, and neck correction using Helmholtz resonator, resonance tube, and sonometer.

CO 2. Evaluate the resolving power of optical instruments like telescopes, prisms, and diffraction gratings to understand their performance in distinguishing spectral lines.

CO 3. Determine the wavelength of light using interference and diffraction phenomena through experiments such as Newton's Rings and normal incidence diffraction grating.

CO 4. Analyze the characteristics of simple harmonic motion using pendulum and spring systems to study the dependence of oscillation on mass and restoring forces.

Practical No.	Practical
1	To determine neck correction by Helmholtz Resonator
2	To determine frequency of a tuning fork by using Sonometer
3	To determine Resolving power of telescope
4	To determine Resolving power of gratings
5	To determine Resolving power of prism
6	To determine wavelength of given of source by using Diffraction grating (Normal incidence)
7	To investigate the relationship between the period of oscillation & the mass of a simple pendulum.
8	To determine speed of sound in air using a resonance tube
9	To determine wavelength of sodium light (Newton's Rings)

10	To investigate simple harmonic motion in a spring

Learning Resources:

1. Waves and Oscillations- N. Subrahmanyam and Brij Lal. (Vikas Publishing House PVT. LTD)
2. A Text Book of Sound- D.R. Khanna and R.S. Bedi. (Atma Ram and Sons Delhi)
3. A Textbook of Oscillations, Waves and Acoustics- M. Ghosh and D. Bhattacharya (S. Chand and Company LTD.)
4. Chand and Company LTD.)

Minor course offered by the Department

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

Department of Physics and Electronics

Course Type: Minor-I

Course Title: Laws of Motions and Properties of Matter

Course Code: 201PHY3301

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objective:

LO 1. This course will provide students with Newton's law of gravitation and its implications for gravitational interactions between objects

Course Outcomes:

After completion of course, the students will be able to-

CO 1. Apply the laws of mechanics and gravitational principles to analyze the motion of celestial bodies and mechanical systems.

CO 2. Describe surface tension phenomena and perform experiments to measure surface tension using various methods.

CO 3. Analyze fluid flow characteristics and viscosity properties using principles of fluid dynamics and viscosity measurements.

CO 4. Understand the principles of elasticity and apply them to analyze material behavior under different loading conditions.

Unit No.	Title of Unit & Contents	Hrs.
I	**Mechanics**	**11**
	1. Laws of Mechanics (Newton's Laws of Motion), 2. Newton's Law of Gravitation 3. Keplar's Law of Planetary Motion 4. Gravitational Field, Gravitational Intensity, Gravitational Potential, Gravitational Potential energy 5. Conservation Law, Work, Power, Kinetic Energy (Work Energy Theorem), 6. Conservation of Energy for a Particle Energy Function 7. Motion of A Body Near the Surface of Earth, 8. Types of Conservative and Non- Conservative Forces.	
	Unit Outcomes: UO 1. Understand Newton's laws of motion and their applications to the motion of objects. UO 2. Apply Kepler's laws to analyze the motion of celestial bodies in the solar system.	
II	**Surface Tension**	**11**

Unit No.	Title of Unit & Contents	Hrs.
	1. Molecular Forces, 2. Surface Tension & its Explanation 3. Pressure Difference Across a Curved Surface 4. Expression for Excess Pressure inside a Spherical Drop and spherical Soap Bubble 5. Surface Tension by Jaeger's Method, 6. Surface Tension by Ferguson Method	
	Unit Outcomes: UO 1. Explain surface tension and its physical significance in terms of energy minimization at the surface of liquids. UO 2. Describe experimental methods for measuring surface tension, including Jaeger's method and Ferguson's method.	
III	**Viscosity**	**12**
	1. Introduction, Coefficient of Viscosity, 2. Streamline flow, Critical velocity 3. Reynolds Number & its Significance 4. Bernoulli's Theorem, 5. Poiseuille's equation for the flow of liquid through a tube 6. Experimental determination of coefficient viscosity by Poiseuille's Method	
	Unit Outcomes: UO 1. Understand the coefficient of viscosity and its units. UO 2. Explain Poiseuille's method for experimentally determining the coefficient of viscosity.	
IV	**Elasticity**	**11**
	1. Introduction, Hooke's Law, Elastic Constants (Y, κ & η), Poisson's Ratio, 2. Twisting Couple on A Cylinder or A Wire, Torsional Pendulum, 3. Bending of Beam, Bending Moment, Cantilever (Weight of the Beam is Ineffective, Weight of the Beam is Effective), 4. Depression of A Beam Supported at The Ends and Loaded at The Centre, 5. Determination of Y by Bending of Beam.	
	Unit Outcomes: UO 1. Understand elastic constants such as Young's modulus, shear modulus, and bulk modulus. UO 2. Analyze the behavior of cantilever beams under different loading conditions.	

Learning Resources:

1) Elements of Properties of Matter –D.S. Mathur, Shamlal Charitable trust, New Delhi.
2) General Properties of Matter – J. C. Upadhyaya, Ram Prasad & Sons, Agra.
3) Mechanics- J. C. Upadhyaya, Ram Prasad & Sons, Agra
4) Properties of Matter- Brijlal and Subramanyam, S. Chand and Co.
5) Fundamentals of Physics, David Halliday, Robert Resnick, Jearl Walker, Wiley India Pvt. Ltd (2016) Tenth Edition
6) University Physics with Modern Physics, Hugh D. Young, Roger A. Freedman, Pearson (2016) Fourteenth Edition

7) A Text Book of Mechanics and Properties of Matter, B. S. Agarwal, and Dr R.N. Mishra, Kedar Nath Ram Nath (S.J Publications) Meerut
8) Concepts of Physics, H.C. Verma, Bharati Bhawan (Publishers & Distributors); Noida

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Minor Laboratory Course-I

Course Title: Minor Lab Course–I

Course Code: 201PHY3302

Credit: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective:

LO 1. To handle and make use of equipment's for making error free measurements and to determine some unknown quantities.

Course Outcomes:

After completion of course, students will be able to-

CO 1. Apply experimental techniques to determine moment of inertia and verify the perpendicular axis theorem.

CO 2. Determine Young's modulus and shear modulus of materials using various experimental methods.

CO 3. Perform viscosity measurements of liquids using Poiseuille's method

CO 4. Determine surface tension using Jaeger's and Ferguson's methods.

List of Experiments:

Practical No.	Practical
1	Determination of moment of inertia and verification of perpendicular axis theorem by Bifilar suspension.
2	Determination of acceleration due to gravity using bar pendulum.
3	Determination of Y by flat spiral spring.
4	Determination of Y by bending of beam loaded at middle.
5	Determination of η by flat spiral spring.
6	Determination of η by Maxwell's needle
7	Determination of η by Torsional Pendulum
8	Viscosity of liquid by Poiseuille's method.
9	Determination of Surface tension of liquid by Jaeger's method.
10	Determination of Surface tension by Ferguson's method.

Learning Resources:

1) Elements of Properties of Matter –D.S. Mathur, Shamlal Charitable trust, New Delhi.
2) General Properties of Matter – J. C. Upadhyaya, Ram Prasad & Sons, Agra.
3) Mechanics- J. C. Upadhyaya, Ram Prasad & Sons, Agra
4) Properties of Matter- Brijlal and Subramanyam, S. Chand and Co.
5) Fundamentals of Physics, David Halliday, Robert Resnick, Jearl Walker, Wiley India Pvt. Ltd (2016) Tenth Edition
6) University Physics with Modern Physics, Hugh D. Young, Roger A. Freedman,

Pearson (2016) Fourteenth Edition
7) A Text Book of Mechanics and Properties of Matter, B. S. Agarwal, and Dr R.N. Mishra, Kedar Nath Ram Nath (S.J Publications) Meerut
8) Concepts of Physics, H.C. Verma, Bharati Bhawan (Publishers & Distributors); Noida

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

Department of Physics and Electronics

Course Type: Minor-II

Course Title: Thermal Physics

Course Code: 201PHY4301

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objective:

LO 1. This course will review the basic concepts of thermodynamics and kinetic theory of gases.

Course Outcomes:

After completion of the course, the students will be able to-

CO 1. Apply conversion formulas to convert temperatures between different temperature scales,

CO 2. Analyze the behavior of gases under high-pressure conditions,

CO 3. Apply the first law of thermodynamics to analyze cyclic, adiabatic, isochoric, isobaric, and isothermal processes,

CO 4. Understand the principles of the Carnot cycle and its significance in defining the maximum efficiency of heat engines.

Unit No.	Title of Unit & Contents	Hrs.
I	**Thermometry**	**11**
	1. Concept of Heat and Temperature 2. Thermometry 3. Types of Thermometers 4. Centigrade, Fahrenheit and Rankine scales 5. Relation between Celsius, Kelvin, Fahrenheit & Rankine scales 6. Liquid Thermometers 7. Errors and corrections in Mercury Thermometer 8. Gas Equations 9. Advantages of Gas Thermometers 10. Platinum resistance thermometer, Seebeck effect	
	Unit Outcomes: UO 1. Identify different types of thermometers and understand their principles of operation. UO 2. Understand the principles and units of the Celsius and Fahrenheit temperature scales.	
II	**Real Gases and Their Behavior**	**11**
	1. Introduction 2. Andrew's Experiment on CO_2 3. Critical Constants, Behavior of gases at high pressure, 4. Boyle temperature, 5. Vander wall's Equation of State, Critical Constants, Corresponding states, 6. Constants of Vander wall's Equation, 7. Reduced Equation of State,	

Unit No.	Title of Unit & Contents	Hrs.
	8. Joule Thomson Porous Plug Experiment, 9. Temperature of Inversion, Relation between Boyle temperature and Temperature of Inversion.	
	Unit Outcomes: UO 1. Define critical constants and their significance in characterizing gas properties near the critical point. UO 2. Define temperature of inversion and its relationship to the Boyle temperature.	
III	**Zeroth and First Law of Thermodynamics**	**12**
	1. Thermodynamic System 2. Zeroth law of thermodynamics, 3. Concept of Heat, Thermodynamic Equilibrium: Work and Internal Energy 4. First Law of Thermodynamics and its differential form, Internal Energy, First Law of thermodynamics & various processes 5. Work done in an isothermal and adiabatic process for an ideal gas, Internal Energy as a state function, Equation of state for an adiabatic process, 6. Application of the first law of thermodynamics to (i) Cyclic Process (ii) Adiabatic Process (iii) Isochoric Process (iv) Isobaric Process and (v) Isothermal Process	
	Unit Outcomes: UO 1. Understand the Zeroth law of thermodynamics and its implications for temperature measurement. UO 2. Explain internal energy and its relationship to work and heat transfer.	
IV	**Second and Third Laws of Thermodynamics**	**11**
	1. Second law of thermodynamics (Kelvin & Clausius statements and their equivalence) 2. Reversible and irreversible processes with examples 3. Heat engines: Carnot Engine; Carnot Cycle and its efficiency 4. Refrigerators 5. Steam Engine 6. Internal combustion engine (Otto Cycle) 7. Diesel Engine 8. Entropy and its physical significance, Entropy change in adiabatic process, free expansion, cyclic process, isobaric process 9. Third Law of Thermodynamics (Statement only)	
	Unit Outcomes: UO1. Explain the equivalence of Kelvin and Clausius statements of the second law. UO2. Understand the principles of the Carnot cycle and its significance in defining the maximum efficiency of heat engines	

Learning Resources:

1) Heat and Thermodynamics- Brij Lal, N. Subrahmanyam, P. S. Hemne for B.Sc. Students as per UGC Model Syllabus, Sultan Chand & Company Ltd.
2) Heat and Thermodynamics -D. S. Mathur, Sultan Chand & Sons, New Delhi.
3) Thermodynamics and Statistical Physics, S.L. Kakani.

4) Thermodynamics, Kinetic Theory and Statistical Thermodynamics-Sears and Salinger, Narosa Publishing House, New Delhi.
5) Heat and Thermodynamics -Brijlal, N. Subrahmanyam, S. Chand and Co. Ltd.
6) Thermal and Statistical Physics- Brijlal & N. Subrahmanyam, S. Chand and Co. Ltd.
7) Thermal Physics: with Kinetic Theory, Thermodynamics and Statistical Mechanics, S.C. Garg, R.M. Bansal, C.K. Ghosh Tata McGraw Hill Education Private Limited (2017) Second Edition.
8) Engineering Thermodynamics, P.K. Nag (Publisher: McGraw-Hill Education)
9) A Textbook of Thermal Physics, R.K. Rajput (Publisher: S. Chand Publishing)
10) Introduction to Thermodynamics, Y.V.C. Rao (Publisher: Universities Press)
11) Thermodynamics and Statistical Physics, B.B. Laud (Publisher: New Age International Publishers)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Minor Laboratory Course-II

Course Title: Minor Lab Course–II

Course Code: 201PHY4302

Credit: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective:

LO 1. To handle and make use of equipment's for making error free measurements and to determine some unknown quantities.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Learn the experimental techniques involved in determining thermal conductivity using Lee's disc method.

CO 2. Apply experimental techniques to measure the thermal conductivity of rubber.

CO 3. Analyze experimental data to calculate the specific heat capacity of the material under study.

CO 4. Understand the relationship between temperature and thermocouple voltage.

List of Experiments:

Practical No.	Unit
1	Determination of thermal conductivity by Lee's disc method
2	Determination of thermal conductivity of a rubber tube
3	To record and analyze the cooling temperature of a hot object as a function of time using a thermocouple
4	Determination of specific heat by calorimeter
5	Study of Platinum resistance thermometer
6	Determination of thermocouple voltages
7	Study of thermistor
8	Determination of thermal conductivity by Forbes method
9	To determine the coefficient of thermal conductivity of copper by Searle's apparatus.

Learning Resources:

1) Heat and Thermodynamics- Brij Lal, N. Subrahmanyam, P. S. Hemne for B.Sc. Students as per UGC Model Syllabus, Sultan Chand & Company Ltd.
2) Heat and Thermodynamics -D. S. Mathur, Sultan Chand & Sons, New Delhi.
3) Thermodynamics and Statistical Physics, S.L. Kakani.
4) Thermodynamics, Kinetic Theory and Statistical Thermodynamics-Sears and Salinger, Narosa Publishing House, New Delhi.
5) Heat and Thermodynamics -Brijlal, N. Subrahmanyam, S. Chand and Co. Ltd.
6) Thermal and Statistical Physics- Brijlal & N. Subrahmanyam, S. Chand and Co. Ltd.
7) Thermal Physics: with Kinetic Theory, Thermodynamics and Statistical Mechanics,

S.C. Garg, R.M. Bansal, C.K. Ghosh Tata McGraw Hill Education Private Limited (2017) Second Edition.
8) Engineering Thermodynamics, P.K. Nag (Publisher: McGraw-Hill Education)
9) A Textbook of Thermal Physics, R.K. Rajput (Publisher: S. Chand Publishing)
10) Introduction to Thermodynamics, Y.V.C. Rao (Publisher: Universities Press)
11) Thermodynamics and Statistical Physics, B.B. Laud (Publisher: New Age International Publishers)

Open Elective Courses Offered by the Department

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

Department of Physics and Electronics

Course Type: OE-III

Course Title: Physics of Daily Life

Course Code: 201PHY3401

Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO 1. To facilitate the students to achieve a clear conceptual understanding of technical aspects of Physics in daily life.

LO 2. Discuss how changes in pressure, temperature, and density affect atmospheric properties and behavior.

LO 3. Teach applications of optical instruments in scientific research, education, and entertainment.

Course Outcomes:

After completion of course, the student will be able to-

CO 1. Describe the characteristics of the Sun and Earth's atmosphere and their roles in atmospheric processes.

CO 2. Apply the Rayleigh criterion and resolving power concept to analyze the performance of optical instruments.

CO 3. Apply principles of rotational motion and dynamics to analyze the behavior of rotating objects.

CO 4. Understand the principles of operation and applications of optical instruments such as telescopes, microscopes, and projectors.

Unit No.	Title of Unit & Contents	Hrs.
I	**Physics in Earth's Atmosphere**	**08**
	1. Sun, Earth's Atmosphere as An Ideal Gas; 2. Pressure, Temperature, and Density, 3. Pascal's Law, and Archimedes' Principle, 4. Coriolis Acceleration and Weather Systems, 5. Rayleigh Scattering, The Red Sunset, 6. Reflection, Refraction, and Dispersion of Light, 7. Total Internal Reflection, 8. Rainbow.	
	Unit Outcomes: UO1. Define the characteristics of the Sun and Earth's atmosphere. UO2. Analyze the influence of Coriolis acceleration on weather systems and global climate patterns.	
II	**Physics in Human Body**	**07**
	1. The Eyes as An Optical Instrument, 2. Vision Defects, 3. Rayleigh Criterion and Resolving Power,	

	4. Sound Waves and Hearing, 5. Sound Intensity, Decibel Scale, 6. Energy Budget and Temperature Control,	
	Unit Outcomes: UO1. Explain the structure and function of the human eye as an optical instrument and its role in vision. UO2. Identify and diagnose common vision defects and understand the principles of corrective measures.	
III	**Physics in Sports**	**07**
	1. The Sweet Spot, 2. Dynamics of Rotating Objects, 3. Running, Jumping and Pole Vaulting, 4. Motion of A Spinning Ball, 5. Continuity and Bernoulli Equations, 6. Turbulence and Drag.	
	Unit Outcomes: UO1. Describe the biomechanics of running, jumping, and pole vaulting and analyze techniques for optimizing performance. UO2. Understand the aerodynamics of a spinning ball and analyze its trajectory and flight characteristics.	
IV	**Physics in Technology**	**08**
	1. Microwave Ovens, 2. Lorentz Force, 3. Global Positioning System, 4. CCDs, Lasers, Displays, 5. Optical Recording, CD, DVD Player, Tape Records, 6. Electric Motors, Hybrid Car, 7. Telescope, Microscope, Projector etc.	
	Unit Outcomes: UO1. Explain the principles of operation and applications of microwave ovens. UO2. Understand the concept of the Lorentz force and its applications in electromagnetism.	

Learning Resources:

1) H. C. Verma, Concepts of Physics (Bharati Bhawan publishers and distributers, New Delhi, India) 2011.
2) Sears and Zeemansky, University Physics (Addison Wesley, Boston, USA) 2007.
3) B. Lal and Subramaniam, Electricity and Magnetism (Ratan Prakashan Mandir, Agra, India) 2013.
4) Physics in Daily Life, Jo Hermans, EDP Sciences
5) E. Hecht, Optics (Addison Wesley, Boston, USA) 2001.
6) M. Nelkon and P. Parker, Advanced Level Physics (Heinemann International, London, U.K.) 2012.
7) Louis A. Bloomfield, How Things Work, The Physics of Everyday Life, Wiley, 2013.
8) D.S. Mathur, Elements of Properties of Matter, S. Chand & Co. (2010).
9) Arthur Beiser, Fundamentals of Physics with Applications
10) Ajay Ghatak, Optics, Tata McGraw-Hill publishing Co. Ltd., New Delhi (1998).

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

Department of Physics and Electronics

Course Type: OE-IV

Course Title: Observational Astronomy

Course Code: 201PHY4401

Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective:

LO 1. Students will learn the composition and nature of the universe, from our own solar system, to stars and stellar evolution, interstellar matter, galaxies, etc.

Course Outcomes:

After completion of course, the student will be able to-

CO 1. Apply various methods and units to measure distances in astronomy.

CO 2. Analyze redshift and magnitude scale data to interpret the properties of celestial objects.

CO 3. Describe the characteristics of the solar system, including planets, asteroids, comets, and lunar phases.

CO 4. Utilize observational software and imaging techniques to capture and analyze celestial objects.

Unit No.	Title of Unit & Contents	Hrs.
I	**Distances and Measurements**	**08**
	1. Celestial Sphere, 2. Celestial Co-Ordinate System, 3. Astronomical Unit, 4. Red Shift, 5. Magnitude Scale.	
	Unit Outcomes: UO 1. Apply various methods and units to measure distances in astronomy. UO 2. Locate celestial objects using the celestial coordinate system and understand the concept of the astronomical unit.	
II	**Solar System**	**07**
	1. Planets and Their Orbits, 2. Asteroids, 3. Comets, 4. Moon Phases, 5. Tides and Types of Eclipses.	
	Unit Outcomes: UO 1. Explain the motion of planets in the solar system and describe Kepler's laws of planetary motion. UO 2. Identify the characteristics of asteroids and their role in the solar system.	
III	**Telescopes and Detectors**	**07**
	1. Types of Telescopes, 2. Types of Mounts,	

	3. Types of Detectors, 4. Eye as a Detector	
	Unit Outcomes: UO 1. Explain the principles of telescopes, mounts, and detectors used in astronomical observations. UO 2. Utilize observational software and imaging techniques to capture and analyze celestial objects.	
IV	**Observation and Imaging**	**08**
	1. Use of Stellarium, 2. Imaging of Celestial Objects With CCD, 3. DSLR and Photometer, 4. Atmospheric Effects and Limitations, 5. Differential Photometry	
	Unit Outcomes: UO 1. Conduct differential photometry to measure the brightness of celestial objects and compare their relative magnitudes. UO 2. Identify and mitigate atmospheric effects on astronomical observations.	

Learning Resources:

1) Electronic Imaging in Astronomy: Detectors and Instrumentation by Ian S. McLean, Publication: Spinger
2) Practical Astronomy with Your Calculator by Peter Duffett-Smith by Cambridge University Press
3) Observational Astrophysics by R. C. Smith, Publication Cambridge University Press
4) Astronomical Techniques by W. A. Hiltner (Ed), Publication: Cambridge University Press
5) Astronomical Photometry by Henden and Kaitchuck, Publication: Van Nostrand Reinhold.

Skill Enhancement Courses Offered by the Department

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

Department of Physics and Electronics

Course Type: SEC-III

Course Title: Applied Optics

Course Code: 201PHY3601

Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective:

LO 1. The course typically focusses on understanding fundamental optical principles, their practical applications, and gaining skills in designing and analyzing optical systems, including lasers, fiber optics, and optoelectronics

Course Outcomes:

After completion of the course, the student will be able to-

CO 1. Explain the principles of laser operation, including spontaneous and stimulated emissions, Einstein's coefficients, light amplification, and analyze the working mechanisms and applications of different lasers such as He-Ne, semiconductor, ruby, and CO_2 lasers.

CO 2. Explain the principles of light propagation in optical fibers, analyze key parameters such as numerical aperture, acceptance angle, and attenuation, and differentiate between single-mode and multimode fibers.

CO 3. Demonstrate the principles of wave optics by performing experiments using lasers and interferometers to measure physical parameters such as wire width, track spacing, and wavelength.

CO 4. Analyze and interpret the optical properties and characteristics of optical fibers and transparent media, including numerical aperture and refractive index, for practical applications in photonics and communication.

Unit No.	Title of Unit & Contents	Hrs.
I	**Lasers**	**08**
	1. Lasers, 2. Spontaneous and Stimulated Emissions, 3. Theory of Laser Action, Einstein's Coefficients (Only Formula), 4. Light Amplification, 5. Characteristics of Laser Beam, 6. He-Ne Laser, 7. Semiconductor Laser, 8. Ruby Laser, 9. CO_2 Laser.	
	Unit Outcomes: UO 1. Understand the basic principles of laser operation and the unique properties of laser light. UO 2. Analyze the factors influencing the amplification process such as population inversion, pumping, and cavity losses.	
II	**Fiber Optics**	**07**

	1. Optical Fibers and Their Properties, 2. Principal of Light Propagation Through a Fiber, 3. The Numerical Aperture, 4. Acceptance Cone and Acceptance Angle, 5. Attenuation in Optical Fiber and Attenuation Limit, 6. Single Mode and Multimode Fibers.	
	Unit Outcomes: UO 1. Identify the key properties of optical fibers such as refractive index profile, core diameter, cladding diameter, and numerical aperture. UO 2. Analyze the relationship between numerical aperture, acceptance angle, and light-gathering capability of an optical fiber.	
III	**Practical**	**15**
	1. To determine the data track spacing of the CD/DVD by laser. 2. To find the width of the wire by using laser. 3. To set the Michelson interferometer. 4. To determine unknown wavelength of given source using Michelson interferometer. 5. To observe of total internal reflection of light through transparent bar and find the refractive index of transparent bar. 6. To study the electrical to optical characteristics of OFC. 7. To determine numerical aperture of given OFC.	

Learning Resources: -

1) Optics- Brijlal Subramanyam
2) An introduction to laser - Avadhanalu
3) Fibre optics- S. K. Sarkar

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

Department of Physics and Electronics

Course Type: SEC-IV

Course Title: Radiation Safety

Course Code: 201PHY3602

Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objective:

The aim of this course is to create awareness and understanding about radiation hazards and safety.

Course Outcomes:

After completion of course, the student will be able to-

CO 1. Explain the composition and properties of the atomic nucleus, including mass number, isotopes, and binding energy.

CO 2. Calculate linear and mass attenuation coefficients and apply them to describe the attenuation of radiation through matter.

CO 3. Analyze the biological effects of ionizing radiation and describe safety measures and risk management strategies for working with radioactive materials.

CO 4. Demonstrate awareness of ethical considerations and regulatory requirements in the field of radiation safety and management.

Unit No.	Title of Unit & Contents	Hrs.
I	**Basics of Nuclear Physics and Types of Radiations**	**08**
	1. The Composition of Nucleus and Its Properties, 2. Mass Number, Isotopes of Element, Spin, Binding Energy, 3. Stable and Unstable Isotopes, 4. Law of Radioactive Decay, 5. Characteristics of Alpha, Beta and Gamma Radiations, 6. Photoelectric Effect, 7. Compton Scattering (Qualitative Only), 8. Linear and Mass Attenuation Coefficients.	
	Unit Outcomes: UO 1. Explain the composition and properties of the atomic nucleus, including mass number, isotopes, and binding energy. UO 2. Describe the processes of radioactive decay and the characteristics of alpha, beta, and gamma radiations.	
II	**Radiation Detection and it's Safety Management**	**07**
	1. Basic Idea of Different Units of Radioactivity, 2. Basic Concept and Working Principle of Gas Detectors (Ionization Chambers, Proportional Counter, Geiger Muller Counter), 3. Scintillation Detector, 4. Biological Effects of Ionizing Radiation, 5. Introduction of Safety and Risk Management of Radiation, 6. Nondestructive Testing.	
	Unit Outcomes: UO 1. Apply the principles of nondestructive testing utilizing ionizing	

	radiation for inspection and quality control purposes. UO 2. Demonstrate awareness of ethical considerations and regulatory requirements in the field of radiation safety and management.	
III	**Practical**	**15**
	1. To determine the operating voltage and Plateau length of GM tube using gamma source. 2. To verify inverse square law for gamma rays. 3. To estimate efficiency of G.M. detector for a gamma Source. 4. To study the absorption of beta particles in Aluminum using GM counter. 5. To determine linear and mass attenuation coefficient of aluminum foil using gamma source. 6. To determine linear and mass attenuation coefficient of copper foil using gamma source.	

Learning Resources:

1) Nuclear Physics – Dr S.N. Ghoshal- S. Chand & Company Pvt. Ltd, New Delhi
2) Nuclear Physics – D.C. Tayal- Himalaya Publishing House
3) Atomic and Nuclear Physics- Dr. V.W. Kulkarni- Himalaya Publishing House
4) W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology". John Wright and Sons, UK, 1989.
5) J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics Handbook Series, No.6, Adam Hilger Ltd., Bristol 1981.
6) Practical Applications of Radioactivity and Nuclear Radiations, G.C. Lowenthal and P.L. Airey, Cambridge University Press, U.K., 2001
7) A. Martin and S.A. Harbisor, An Introduction to Radiation Protection, John Willey & Sons, Inc. New York, 1981

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

UG Second Year (Semester III / IV)

Basket I: Open Elective (OE)

(GEs offered to the Science and Technology students in Sem.-III/IV)

Sr. No.	BoS Proposing OE	Course Title	Credits	Hrs.
1.	Commerce	Digital Marketing	2	30
2	Commerce	Introduction to Personal Taxation	2	30
3	Commerce	Fundamentals of Accounting	2	30
4	Hindi	Rojgar Abhimulak Hindi	2	30
5	English	English Proficiency Course	2	30
6	Geography	Fundamentals of GIS & RS	2	30

Note: Student can choose any one OE from the basket.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

UG Second Year (Semester III / IV)

Basket II: Skill Enhancement Courses (SEC)

(SEC offered to the Commerce and Management students in Sem.-III/IV)

Sr. No.	BoS Proposing SEC	Course Title	Credits	Hrs.
1	Commerce	Financial Management	2	30
2	Analytical Chemistry	Skills In Chemistry	2	30
3	Commerce	Wealth Management	2	30
4	Biotechnology	Good Laboratory Practices	2	30
5	Biotechnology	Dairy Technology	2	30
6	Botany	Herbal Technology	2	30
7	Information technology	Software Development Techniques	2	30
8	Information technology	Information Security	2	30
9	Computer Science	Web Development using WordPress	2	30
10	Electronics	Internet of Things	2	30
11	English	English for Careers	2	30
12	Geography	Disaster Management	2	30
13	Commerce	Business Law	2	30
14	Microbiology	Production of Bio fertilizers	2	30
15	Physics	Applied Optics	2	30
16	Political Science	Political Journalism	2	30
17	Chemistry	Chemistry of Biomolecules	2	30
18	Mathematics	Essential Statistics for Data Science	2	30
19	Information Technology	Android Aap Development	2	30
20	English	English for Competitive Examinations	2	30

Note: Student can choose any one SEC from the basket.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

UG Second Year

Basket III: Ability Enhancement Courses (AEC)

(AEC offered to the Science & Technology students in Sem.-III/IV)

Sr. No.	BoS Proposing AEC	Course Title	Credits	Hrs.
1.	English	English Communication	2	30
2.	English	English for Professionals	2	30

Note: Student can choose any one AEC from the basket.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Extra Credit Activities

Sr. No.	Course Title	Credits	Hours T/P
1	MOOCs	Min. of 02 credits	Min. of 30 Hrs.
2	Certificate Courses	Min. of 02 credits	Min. of 30 Hrs.
3	IIT Spoken English Courses	Min. of 02 credits	Min. of 30 Hrs.

Guidelines:

Extra -academic activities

1. All extra credits claimed under this heading will require sufficient academic input/ contribution from the students concerned.
2. Maximum 04 extra credits in each academic year will be allotted.
3. These extra academic activity credits will not be considered for calculation of SGPA/CGPA but will be indicated on the grade card.

Additional Credits for Online Courses:

1. Courses only from SWAYAM and NPTEL platform are eligible for claiming credits.
2. Students should get the consent from the concerned subject Teacher/Mentor/Vice Principal and Principal prior to starting of the course.
3. Students who complete such online courses for additional credits will be examined/verified by the concerned mentor/internal faculty member before awarding credits.
4. Credit allotted to the course by SWAYAM and NPTEL platform will be considered as it is.

Additional Credits for Other Academic Activities:

1. One credit for presentation and publication of paper in International/National/State level seminars/workshops.
2. One credit for measurable research work undertaken and field trips amounting to 30 hours of recorded work.
3. One credit for creating models in sponsored exhibitions/other exhibits, which are approved by the concerned department.
4. One credit for any voluntary social service/Nation building exercise which is in collaboration with the outreach center, equivalent to 30 hours
5. All these credits must be approved by the College Committee.

Additional Credits for Certificate Courses:

1. Students can get additional credits (number of credits will depend on the course duration) from certificate courses offered by the college.
2. The student must successfully complete the course. These credits must be approved by the Course Coordinators.
3. Students who undertake summer projects/ internships/ training in institutions of repute through a national selection process, will get 2 credits for each such activity. This must be done under the supervision of the concerned faculty/mentor.

Note:

1. The respective documents should be submitted within 10 days after completion of Semester End Examination.
2. No credits can be granted for organizing or for serving as office bearers/ volunteers for Inter-Class / Associations / Sports / Social Service activities.
3. The office bearers and volunteers may be given a letter of appreciation by the respective staff coordinators. Besides, no credits can be claimed for any services/ activities conducted or attended within the college.
4. All claims for the credits by the students should be made and approved by the mentor in the same academic year of completing the activity.
5. Any grievances of denial/rejection of credits should be addressed to Additional Credits Coordinator in the same academic year.
6. Students having a shortage of additional credits at the end of the third year can meet the Additional Credits Coordinator, who will provide the right advice on the activities that can help them earn credits required for graduation.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Examination Framework

Theory:

40% Continuous Assessment Tests (CATs) and 60% Semester End Examination (SEE)

Practical:

50% Continuous Assessment Tests (CATs) and 50% Semester End Examination (SEE)

Course	Marks	CAT & Mid Term Theory				CAT Practical		Best Scored CAT & Mid Term	SEE	Total
1	2	3				4		5	6	5 + 6
		Att.	CAT I	Mid Term	CAT II	Att.	CAT			
DSC/DSE/ GE/OE/Minor	100	10	10	20	10	-	-	40	60	100
DSC	75	05	10	15	10	-	-	30	45	75
Lab Course/AIPC/ OJT/FP/SEC (Science & Technology)	50	-	-	-	-	05	20	-	25	50
VSC/SEC/ AEC/VEC/CC	50	05	05	10	05	-	-	20	30	50

Note:

1. All Internal Exams are compulsory
2. Out of 02 CATs best score will be considered
3. Mid Term Exam will be conducted by the Exam Section
4. Mid Term Exam is of Objective nature (MCQ)
5. Semester End Exam is of descriptive in nature (Long & Short Answer)
6. CAT Practical (20 Marks): Lab Journal (Record Book) 10 Marks, Overall Performance 10 Marks