FOUR YEAR UNDERGRADUATE PROGRAM (NEP- 2020)
PROGRAM: BACHELOR IN SCIENCE (2024 – 28)
DISCIPLINE – PHYSICS
SESSION - 2024 – 25

DSC- 01 to 08		DSE- 01 to 12		DGE- 01 to 02	
Code	Course Title	Code	Course Title	Code	Course Title
PHSC- 01 T	Mechanics	PHSE- 01	Introduction to Statistical Mechanics	PHGE- 01 T	Mechanics
PHSC- 01P	Lab Course			PHGE- 01 P	Lab Course
PHSC- 02 T	Electricity & Magnetism	PHSE- 02	Mathematical Physics-I	PHGE- 02 T	Electricity & Magnetism
PHSC- 02 P	Lab Course			PHGE- 02 P	Lab Course
PHSC- 03 T	Heat & Thermodynamics	PHSE- 03	Nuclear Physics		
PHSC- 03 P	Lab Course				
PHSC- 04 T	Waves & Optics	PHSE- 04 T	Numerical Methods &C Programming	VAC	
PHSC- 04 P	Lab Course	PHSE- 04 P	Lab Course		
PHSC- 05 T	Introduction to Quantum Mechanics	PHSE- 05	Mathematical Physics-II	PHVAC- 01	Renewable Energy and Energy Harvesting
PHSC- 05 P	Lab Course				
PHSC- 06 T	Solid State Physics &SolidStateDevices	PHSE- 06	Classical Electrodynamics & Electromagnetic theory	SEC	
PHSC- 06 P	Lab Course				
PHSC- 07	Classical Mechanics	PHSE- 07 T	Digital Electronics		
		PHSE- 07 P	Lab Course		
PHSC- 08	Quantum Mechanics	PHSE- 08 T	Operational Amplifier& Its Applications	PHSEC- 01	BasicElectrical Skill
		PHSE- 08 P	Lab Course		
		PHSE- 09 T	Solid State Physics		
		PHSE- 09 P	Lab Course		
		PHSE- 10	Atomic and Molecular Physics		
		PHSE- 11	Statistical Mechanics		
		PHSE- 12 T	Microprocessor		
		PHSE- 12 P	Lab Course		

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Program Outcomes (PO):

The learning outcomes of the undergraduate degree course in physics are as follows:

- **In-depth disciplinary knowledge**: The student will acquire comprehensive knowledge and understanding of the fundamental concepts, theoretical principles and processes in the main and allied branches of physics.
- **Hands-on/ Laboratory Skills**: Comprehensive hands-on/ laboratory exercises will impart analytical, computational and instrumentation skills. The students will be able to demonstrate mature skills for the collation, evaluation, analysis and presentation of information, ideas, concepts as well as quantitative and/or qualitative data.
- **Role of Physics**: The students will develop awareness and appreciation for the significant role played by physics in current societal and global issues. They will be able to address and contribute to such issues through the skills and knowledge acquired during the programme
- **Communication and Skills**: Various DSCs, DSEs, SECs, and GEs have been designed to enhance student's ability to write methodical, logical and precise reports. The courses will, in addition, guide the student to communicate effectively through presentations, writing laboratory/ project reports and dissertations.
- **Critical and Lateral Thinking**: The programme will develop the ability to apply the underlying concepts and principles of physics and allied fields beyond the classrooms to real life applications, innovation and creativity.
- **Research skills**: The course provides an opportunity to students to hone their research and innovation skills through assignment/internship/dissertation. It will enable the students to demonstrate mature skills in literature survey, information management skills, data analysis and research ethics.

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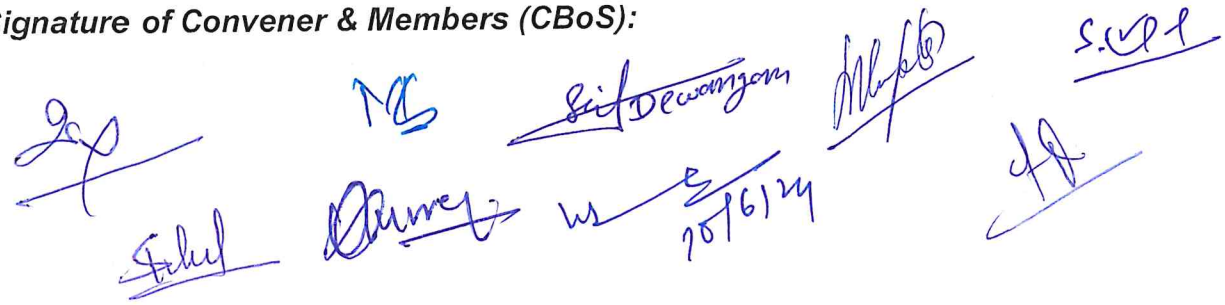

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION				
Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)			Semester: I	Session: 2024-25
1	Course Code	PHSC-01T		
2	Course Title	Mechanics		
3	Course Type	Discipline Specific Course		
4	Pre-requisite (if any)	As per Program		
5	Course Learning Outcomes (CLO)	*After going through the course, the student should be able to:* ➢ *Analyze and apply the laws of motion to various dynamical situations.* ➢ *Explain and demonstrate the principle of conservation of momentum and energy including their application in real-world scenario such as collision and energy transformation.* ➢ *Evaluate and calculate moment of inertia for objects of different shapes and analyze how these properties affect the motion of rotating bodies.* ➢ *Analyze flow of fluids.* ➢ *Describe special relativistic effects and their effects on the mass and energy of a moving object.*		
6	Credit Value	03 Credits	1 Credit= 15 Hours for Learning &Observation	
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks: 40	

PART – B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Historical Background:** Contribution of Aryabhatta and Varahmihir to science and society, Brief biography of Vikram Sarabhai with his contribution.**Vectors:** Scalar and vector quantities &fields, Scalar & Vector products of two vectors, Derivatives of a vector, Gradient of scalar field and its physical significance.**Laws of Motion:** Review of Newton's Laws of motion, Dynamics of a system of particles, Concept of Center of Mass, Motion of center of mass, Conservation of linear momentum, Motion of Rocket.**Work and Energy:** Work-Energy theorem for conservative forces, Force as a gradient of Potential Energy, Conservation of energy, Elastic and in-elastic Collisions	12
II	**Rotational Dynamics**: Angular momentum, Torque, Conservation of angular momentum, Moment of Inertia, Theorem of parallel and perpendicular axes(statements only), Calculation of Moment of Inertia of discrete and continuous objects (Rectangular lamina, disc, solid cylinder, solid sphere).**Elasticity:** Stress & Strain, Hooke's law, Elastic constants, Poisson's Ratio,Relationship between various elastic modulii (without derivation), Work done in twisting a cylinder.**Fluid Dynamics**: Flow of fluids, Coefficient of viscosity,Derivation of Poiseulli's formula, Motion of a spherical body falling in a viscous fluid, Stoke's law, Expression for terminal velocity.	12
III	**Gravitation**: Newton's Law of Gravitation, Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant), Kepler's Laws (statements only), Satellite in circular orbit and applications, Geosynchronous orbits. **Oscillations**: Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Compound pendulum, Differential equations of damped oscillations and forced oscillations (Conceptual only).	11
IV	**Special Theory of Relativity:** Frame of reference, Galilean Transformations, Inertial and Non-inertial frames, Outcomes of Michelson Morley's Experiment, Postulates of Special Theory of Relativity, Lorentz Transformation, Length contraction, Time dilation, Relativistic transformation of velocity, Relativistic variation of mass, Mass-energy equivalence, Transformation of Energy and Momentum.	10
Keywords:	Aryabhatta, Vectors, Newton's Laws, Angular Momentum, Elasticity, Gravitation, Oscillations, Relativity	

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program:Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)		Semester: I	Session: 2024-25
1	Course Code	PHSC- 01P	
2	Course Title	Mechanics	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	After the completion of the course, Students are expected to understand working mechanism and laws of classical mechanics. The Students will be able to ➢ Assemble required parts/devices and arrange them to perform experiments. ➢ Record/ observe data as required by the experimental objectives. ➢ Analyze recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to laws of mechanics and its applications	
6	Credit Value	01 Credit	1 Credit = 30 HoursLaboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

TotalNo.of learning-Training/performance Periods-30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Period
1	Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.	30
2	To study the random error in observations.	
3	To study the motion of the spring and calculate (a) Spring constant and, (b) g.	
4	To determine the Moment of Inertia of a Flywheel.	
5	To determine g and velocity for a freely falling body using Digital Timing Technique.	
6	To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).	
7	To determine the Young's Modulus of a Wire by Optical Lever Method.	
8	To determine the Modulus of Rigidity of a Wire by Maxwell's needle.	
9	To determine the elastic constants of a wire by Searle's method	
10	To determine the value of g using Bar Pendulum.	
11	To determine the value of g using Kater's Pendulum.	
12	Study of bending of a beam/ cantilever	
13	To determine Moment of Inertia of an irregular body by Inertia Table	
Keywords	Moment of Inertia, Pendulum,VernierCallipers, Screw Gauge, Travelling microscope, Elastic Constant, Searle's Method, Stoke's Method, Cappilary Rise Method, Viscosity, Surface Tension	

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PART – C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books Recommended-

1. Mechanics & Properties of matter, D.C. Tayal & P. Tayal, 2023, Pub. By Authors.
2. Unified Physics I –R.P.Goyal, Shivlal Agrawal Publication
3. Unified Physics I, Navbodh Publication

Reference Books Recommended-

1. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
2. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
3. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

Online Resources (e-books/ learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics text book in PDF
3. https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
4. Cambridge University Books for Physics https://www.cambridgeindia.org/
5. Books for solving physics problems https://bookboon.com/en/physics-ebooks
6. NPTEL Online courses https://nptel.ac.in/courses/115105098; https://archive.nptel.ac.in/courses/115/106/115106123/;
7. BSc Lectures by Prof. H C Verma: https://bsc.hcverma.in/index.php/course/relativity; https://bsc.hcverma.in/index.php/course/cm1

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 100Marks
Continuous Internal Assessment (CIA):30 Marks
End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20~~+~~20** Assignment/ Seminar (1):**10** Total Marks: **30**	Better marks out of the two Test / Quiz **+** marks obtained in Assignment shall be considered against **30 Marks**
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type,**1out of 2** from each unit-**4x10=40 Marks**	

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PART – C: Learning Resources

Text Books, Reference Books and others

Text Books Recommended-

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
2. Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. Practical Physics B.Sc. I : R P Goyal, Shivlal Publications

Reference Books Recommended-

1. Advanced Practical Physics for Students by B.L. Worsnop and H.T. Flint
2. Practical Physics by G.L. Squires
3. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements by John R. Taylor
4. Mechanics and Properties of Matter by J.C. Upadhyaya

Online Resources (e-books/ learning portals/ other e-resources)

1. Link for e-Books for Physics:Physics Practical:
   https://www.uou.ac.in/sites//default/files/slm/BSCPH-104.pdf
2. Virtual Lab :https://vlab.amrita.edu/?sub=1&brch=74
3. https://vlab.amrita.edu/?sub=1&brch=74&sim=571&cnt=1
4. https://www.ae.msstate.edu/vlsm/

PART – D : ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
EndSemester Exam(ESE):35 Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz - (2): **10 & 10** Assignment/Seminar +Attendance –**05** Total Marks - **15**	Better marks out of the two Test/Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work -20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)	Semester: II	Session: 2024-25

1	**Course Code**	**PHSC-02T**	
2	**Course Title**	**ELECTRICITY AND MAGNETISM**	
3	**Course Type**	**Discipline Specific Course**	
4	**Pre-requisite (if any)**	**As per Program**	
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: ➢ State various laws related with electrostatics, dielectric, electric current, magnetism and electromagnetic induction. ➢ Apply vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics. ➢ Compare rise and decay of current in LR, CR, LCR circuits. ➢ Apply Biot-Savart law for calculation of magnetic field in simple geographic situations. ➢ Derive and analyze Maxwell's equations.	
6	**Credit Value**	**03 Credits**	**1 Credit= 15 Hours for Learning &Observation**
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**

PART – B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Power plants in Chhattisgarh:** An overview of thermal and hydroelectric power plants in Chhattisgarh. **Vector Analysis**: Divergence & Curl of Vector fields, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors and its application in electrostatics and magnetostatics.**Electrostatics field:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics, Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, plane charged sheet, charged conductor.	12
II	**Electrostatic potential:**Electric potential as line integral of electric field, potential due to a point charge, Calculation of electric field from potential, Capacitance of Parallel plate capacitor, Energy per unit volume in electrostatic field. **Dielectric & Electric Currents:** Dielectric medium, Polarisation, Displacement vector, Gauss's theorem in dielectrics, Parallel plate capacitor completely filled with dielectric.Steady current, current density J, non – steady current and Continuity equation, Rise and decay of current in LR, CR, LCR circuits.	13
III	**Magnetism:** Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law, Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, Brief introduction of dia, para and ferro-magnetic materials.	10
IV	**Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils, Energy stored in magnetic field. **Maxwell`s equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Wave equation in free space.	10

Keywords:	Vector calculus, Electrostatics, Dielectrics and Electric Current, Magnetism, Electromagnetic Induction, Maxwell's Equation and Electromagnetic Wave Propagation

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books

1. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
2. Unified Physics – Part II, R. P.Goyal, Shivlal Agrawal and Sons
3. Unified Physics – Navbodh Publications
4. Introduction to Electrodynamics and Electromagnetism, H.C.Verma,

Reference Books

1. Vector analysis – Schaum's Outline, M.R. Spiegel, S. Lipschutz, D. Spellman, 2nd Edn., 2009, McGraw- Hill Education.
2. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Online Resources (e-books/ learning portals/ other e-resources)

1. *All e-books of physics* https://www.e-booksdirectory.com/listing.php?category=2
2. *Free physics text book in PDF* https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. *Cambridge University Books for Physics* https://www.cambridgeindia.org/
4. *Books for solving physics problems* https://bookboon.com/en/physics-ebooks
5. *NPTEL Online courses:* https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. https://archive.nptel.ac.in/courses/115/104/115104088/
7. *Classical Electromagnetism - 1 (Electrostatics)* https://bsc.hcverma.in/course/cee1
8. *Classical Electromagnetism - 2 (Electrostatics)* https://bsc.hcverma.in/course/cee2

PART – D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100Marks
Continuous Internal Assessment (CIA):30 Marks
End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20+20**Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Examination (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type,**1out of 2** from each unit-**4x10=40 Marks**	

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program:Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)	Semester: II	Session: 2024-25

1	Course Code	PHSC- 02P	
2	Course Title	Electricity & Magnetism	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	*After the completion of the course, Students are expected to understand working laws of Electricity, Magnetism and EMWs. The students will also be able to* ➢ *Verify various circuit laws, network theorems, using simple electric circuits. Assemble required parts/devices and arrange them to perform experiments.* ➢ *Verify various laws in electricity and magnetism such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments* ➢ *Record/ observe data as required by the experimental objectives. Analyze recorded data and formulate it to get desired results.* ➢ *Interpret results and check for attainment of proposed objectives related to laws of Electricity, Magnetism and its applications*	
6	Credit Value	01 Credit	1 Credit = 30 Hours Laboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

TotalNo.of learning-Training/performance Periods -30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Periods
1	To use a Multimeter for measuring (a) Resistances, (b) AC and DCVoltages,(c) DC Current, and (d) checking electrical fuses.	30
2	To compare capacitances using De'Sauty's bridge.	
3	Measurement of field strength B and its variation in a Solenoid Determine (dB/dx).	
4	To study the Characteristics of a Series RC Circuit.	
5	To study a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor.	
6	To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and(b) Quality factor Q.	
7	To determine a Low Resistance by Carey Foster's Bridge.	
8	To verify the Thevenin and Norton theorem.	
9	To verify the Superposition, and Maximum Power Transfer Theorem.	
10	To use a vibration magnetometer and study magnetic field.	
11	Study of magnetic field due to a current loop.	
12	Study of magnetic fields using Deflection Magnetometer	
13	Mini Project: Construction and Study of Solenoid and measurement of its magnetic field	

Keywords:	Multimeter, Capacitance Comparison, Magnetic Field, RC Circuit, Series LCR Circuit, Parallel LCR Circuit, Low Resistance Measurement, Electrical Theorems

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Engineering Practical Physics, S.Panigrahi&B.Mallick,2015, Cengage Learning India Pvt. Ltd.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Unified Practical Physics : R P Goyal, Shivlal Agrawal & Sons
4. Unified Practical Physics: YugbodhPrakashan
5. Unified Practical Physics: NavbodhPrakashan

Reference Books Recommended-

1. Basic Electrical and Electronics Engineering by S. K. Bhattacharya
2. A Textbook of Electrical Technology by B.L. Theraja and A.K. Theraja (Volumes 1 and 2)
3. Engineering Circuit Analysis by William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin
4. Practical Physics by G.L. Squires

Online Resources (e-books/ learning portals/ other e-resources)

1. Link for e-Books for Physics: Physics Practical:
   https://www.uou.ac.in/sites//default/files/slm/BSCPH-104.pdf
2. Virtual Lab :https://vlab.amrita.edu/index.php?sub=1&brch=192
3. http://emv-au.vlabs.ac.in/#
4. https://www.ae.msstate.edu/vlsm/
5. https://nationalmaglab.org/magnet-academy/watch-play/interactive-tutorials
6. https://jigyasa-csir.in/cgcri/n12-t4-a3/

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
EndSemester Exam(ESE):35 Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance –**05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) –10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Diploma/ Degree/ Honors)	Semester: III	Session: 2024-25

1	Course Code	PHSC-03T	
2	Course Title	Heat and Thermodynamics	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	After going through the course, the student should be able to: • Demonstrate a deep comprehension of the fundamental principles of thermodynamics, including concepts such as energy, entropy and laws of thermodynamics. • Apply the laws of thermodynamics to analyze and solve problems related with energy transfer, heat engines, refrigeration system and other thermodynamic processes. • Analyze basic aspects of kinetic theory and transport phenomenon in gases.	
6	Credit Value	03 Credits	1 Credit= 15 Hours for Learning &Observation
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks: 40

PART – B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Historical background:** A brief historical background of thermodynamics and statistical physics in the context of India and Indian culture, Contribution of S. N. Bose in Statistical mechanics. **Laws of Thermodynamics:** Thermodynamic Description of system, Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, various Thermodynamical Processes, Work Done during Isothermal and Adiabatic Processes, Reversible & irreversible processes. Second law of thermodynamics & Entropy, Carnot's cycle, Carnot's theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics.	12
II	**Thermodynamic Potentials:** Internal Energy, Enthalpy, Helmholtz Free Energy and Gibbs function. Maxwell's relations & applications, Clausius- Clapeyron Equation, Expression for ($C_P - C_V$), C_P/C_V, TdS equations, Thermodynamic energy equation- change in internal energy of an ideal and Vander Waal's gas, Joule-Thompson Effect, Cooling by adiabatic demagnetization.	11
III	**Kinetic Theory of Gases:** Maxwellian distribution of speeds in an ideal gas: distribution of speeds and velocities, experimental verification, distinction between mean, rms and most probable speed values, Molecular Collision and Mean Free Path. **Transport Phenomena in gases**: Viscosity, Conduction and Diffusion, Law of equipartition of energy.	11
IV	**Theory of Radiation:** Blackbody radiation, Spectral distribution, Concept of Energy Density, Stefan Boltzmann Law, Newton's law of cooling from Stefan Boltzmann's law. Wien's displacement law and Rayleigh-Jeans Law (Only qualitative). Planck's radiation Law, Deduction of Wien's distribution law and Rayleigh- Jeans Law from Planck's law. Experimental verification of Planck's radiation law.	11

Keywords:	Zeroth and First Law of Thermodynamics, Second Law of Thermodynamics,Entropy, Thermodynamic Potentials, Maxwell's Thermodynamic RelationsKinetic Theory of Gases, Distribution of Velocities, Molecular Collisions, Real Gases, Laws of radiation

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books

1. Heat and Thermodynamics: Singhal, Agrawal and Satya Prakash, Pragati Prakashan 1984
2. Physics (Part-2): Editor, Prof. B.P.Chandra, M.P. Hindi Granth Academy
3. Unified Physics –II ,R.P.Goyal, Shivlal Agrawal &Sons
4. Unified Physics –II. NovbodhPrakashan

Reference Books

1. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears&G.L.Salinger. 1988, Narosa
2. Energy Science in Vedas: A Treatise on Vedic Thermodynamics and Free Energy (Exploring Lost Science and Technology in Vedas), Ramesh Kumar Mineria; Priya Veda Publications

Online Resources (e-books/ learning portals/ other e-resources)

1. Basics of thermodynamics ***https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8***
2. Thermodynamics ***https://www.youtube.com/watch?v=E9cOAMhFUz0***
3. Second law of thermodynamics ***https://www.youtube.com/watch?v=F_flGosPY8o***
4. ***NPTEL Online Lectures: https://archive.nptel.ac.in/courses/115/105/115105129/***
5. ***https://archive.nptel.ac.in/courses/115/106/115106090/***
6. ***https://bsc.hcverma.in/course/penopcyc***
7. Vedic Science and Thermodynamics :***https://www.puranavedas.com/vedic-physics/***
8. ***https://www.amazon.in/Vedic-Physics-Raja-Ram-Mohan/dp/0968412009?asin=1988207045&revisionId=&format=4&depth=2***
9. https://ia903100.us.archive.org/3/items/wholelottabooks/The%20Astronomical%20Code%20of%20the%20Rgveda%20-%20Shubash%20Kak.pdf

PART – D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100Marks
Continuous Internal Assessment (CIA): 30 Marks
End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20÷20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz+ marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type,**1out of 2** from each unit-**4x10=40 Marks**	

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program:Bachelor in Science (Diploma/ Degree/ Honors)		Semester: III	Session: 2024-25
1	Course Code	PHSC- 03P	
2	Course Title	Heat and Thermodynamics	
3	Course Type	Discipline Core Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	➢ Lab Proficiency: Thermometers, pressure gauges, calorimeters, heat transfer apparatus, experimental setup, data acquisition. ➢ Hands-on Learning**: Heat transfer, work done, entropy, phase transitions, experiments. ➢ Data Analysis: Experimental data, theoretical discrepancies, analysis. ➢ Predictive Skills: Thermodynamic behavior, varying conditions, experimentation. ➢ Theory-Practice Integration: Theoretical knowledge, practical lab work, synthesis, applications.	
6	Credit Value	01 Credit	1 Credit = 30 HoursLaboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

TotalNo.of learning-Training/performance Periods -30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Periods
1	To determine the thermal conductivity of a non-conducting material by Lee's disc method.	30
2	To study the variation of thermo emf across two junctions of a thermocouple with temperature.	
3	To verify Newton's law of cooling.	
4	To determine the temperature co-efficient of resistance by Platinum resistance thermometer.	
5	To determine the coefficient of thermal conductivity(k) of a rubber tube.	
6	To study the heat efficiency of an electric kettle with varying voltage.	
7	To determine the ratio of specific heat at constant pressure and constant volume (γ=Cp/Cv) of air Clement and Desorme's method.	
8	To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.	
9	To study the variation of thermos-Emf of thermos couple with Difference of Temperature of its Two Junctions.	
10	To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.	
11	Measurement of Planck's constant using black body radiation.	
12	To determine Stefan's Constant.	

Keywords:	Thermal conductivity, Thermocouple, Newton's law of cooling, Temperature coefficient of resistance, Heat efficiency, Specific heat ratio, Mechanical equivalent of heat, Planck's constant

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
5. Unified Practical Physics B.Sc II : R P Goyal, Shivlal Agrawal &Sons Publications

Reference Books Recommended-

1. Practical Physics by C.L. Arora
2. Practical Physics by S.L. Gupta and Vijay Kumar
3. Advanced Practical Physics for Students by B.L. Worsnop and H.T. Flint

Online Resources (e-books/ learning portals/ other e-resources)

Link for e-Books for Physics Practicaland Virtual labs

1. Thermal Physics and Statistical Mechanics: Laboratory Collectionhttps://egyankosh.ac.in/handle/123456789/67450
2. Virtual Lab :https://vlab.amrita.edu/index.php?sub=1&brch=194
3. https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=802&cnt=1
4. https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=801&cnt=4
5. https://srmap.edu.in/seas/physics-virtual-lab/
6. https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab
   https://www.pbslearningmedia.org/resource/lsps07-sci-phys-thermalenergy/thermal-energy-transfer/#.WdJiOJIrLIU

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
EndSemester Exam(ESE):35 Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance –**05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Diploma/ Degree/ Honors)	Semester: IV	Session: 2024-25

1	**Course Code**	**PHSC-04T**
2	**Course Title**	**Waves and Optics**
3	**Course Type**	**Discipline Specific Course**
4	**Pre-requisite (if any)**	**As per Program**
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: ➢ Analyze the behavior of waves propagating through different mediums and predict how factors such as density, elasticity, and temperature affect wave propagation. ➢ Demonstrate an understanding of interference phenomena, including constructive and destructive interference, and apply this knowledge to solve problems involving wave superposition. ➢ Explain the concept of diffraction and its implications for wave propagation, including how waves bend around obstacles and spread out after passing through narrow openings. ➢ Describe the polarization of waves, including linear, circular, and elliptical polarization, and apply polarization concepts to analyze and manipulate electromagnetic waves.
6	**Credit Value**	**03 Credits** | **1 Credit= 15 Hours - Learning &Observation**
7	**Total Marks**	**Maximum Marks: 100** | **Minimum Pass Marks: 40**

PART – B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Contribution of C. V. Raman:** Brief biography of C. V. Raman with his contribution in field of acoustics and optics. **Waves in Medium:** Speed of transverse waves on uniform string, Speed of longitudinal waves in a fluid, Energy density and energy transmission in waves. Group velocity and phase velocity and relationship between them. **Reflection, refraction and diffraction of sound:** Acoustic impedance of a medium, percentage reflection & refraction at a boundary, diffraction of sound, principle of a sonar system.	11
II	**Interference:** Principle of superposition, Division of wavefront and division of amplitude, Young's Double Slit experiment. Fresnel's Biprism, Phase change on reflection, Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings, measurement of wavelength and refractive index. Michelson's Interferometer, Formation of fringes, Determination of wavelength, Wavelength difference.	12
III	**Diffraction:** Fresnel Diffraction; Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. Fraunhofer diffraction; Single slit, Double slit. Multiple slits & Plane Diffraction Grating, Resolving Power of Grating.	11
IV	**Polarization:** Polarized light and its mathematical representation, Electromagnetic theory of double refraction, Nicol Prism, Double image prism, Polaroid, Phase retardation plates, Circular and elliptical polarization. Polarization by double refraction and Huygens's theory, Rotation of plane of polarization, Biquartz polarimeter.	11
Keywords:	*Longitudinal and transverse waves, principle of superposition, Haidinger Fringes, Fresnel Diffraction, Fraunhofer diffraction, Polarization*	

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PART – C: LEARNING RESOURCES

Text Book, Reference Book and Others

Text Books Recommended-

1. Berkely Physics Course: Vol.-III, 'Waves and Oscillations'
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, S. Chand Publication
4. Physical Optics, A.K. Ghatak
5. Unified Physics- II, R. P. Goyal, Shivlal Agrawal Publications
6. Unified Physics- II, Navbodh Publications

Reference Books Recommended

1. Concepts of Physics by H.C. Verma
2. Fundamentals of Physics by R. Shankar
3. Optics by Ajoy

Online Resources (e-books/ learning portals/ other e-resources)

1. Wave an introductionhttps://youtu.be/SuQE7eUEriU
2. Interference https://youtu.be/hvpYKPyT-vc
3. Diffraction https://youtu.be/3RZZQvEVrEA
4. Polarization https://youtu.be/nELYaf_N528
5. Waves and Oscillations- https://archive.nptel.ac.in/courses/115/106/115106119/
6. Optics- https://archive.nptel.ac.in/courses/115/107/115107131/

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 100Marks
Continuous Internal Assessment (CIA):30 Marks
End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20+20**Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Examination (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type,**1out of 2** from each unit-**4x10=40 Marks**	

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program:Bachelor in Science (Diploma/ Degree/ Honors)		Semester: IV	Session: 2024-25
1	Course Code	PHSC- 04P	
2	Course Title	Waves and Optics	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After the completion of the course, Students are expected to understand laws and principles behind various optical phenomena, specially related to wave nature of light. The students will also be able to ➢ Gain proficiency in operating laboratory equipment such as light source i.e. mercury, sodium and Laser, spectrometers, polarimeter, demonstrating competence in setting up experiments, calibrating instruments, and collecting accurate data. ➢ Develop a deep understanding of optical principles such as refraction, diffraction, dispersion, and interference, as well as their applications in various scientific disciplines ➢ Analyze recorded data and formulate it to get desired results.	
6	Credit Value	01 Credit	1 Credit = 30 HoursLaboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

TotalNo.of learning-Training/performance Periods -30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Period
1	To determine the Frequency of AC mains with the help of Sonometer.	30
2	Determination of angle of prism using spectrometer.	
3	To determine the Refractive Index of the Material of a given Prism using Spectrometer.	
4	To determine Dispersive Power of the Material of a given Prism using Spectrometer	
5	To determine the value of Cauchy Constants of a material of a prism.	
6	To determine the Resolving Power of a Prism.	
7	To determine wavelength of sodium light using Fresnel Biprism.	
8	To determine wavelength of sodium light using Newton's Rings Method.	
9	To determine the wavelength of Laser light using Single Slit Diffraction.	
10	To determine wavelength of Sodium light by laser diffraction.	
11	To determine wavelength of spectrum of Mercury light using plane diffraction Grating and Spectrometer.	
12	To determine the Resolving Power of a Plane Diffraction Grating.	
13	To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.	
14	Determination of resolving power telescope.	
15	Study of polarization of sugar solution using polarimeter.	

Keywords: Waves Motion – General, Velocity of Waves, Wave Optics, Interference, Interferometer, Diffraction, Polarization, Spectrometer.

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
5. Practical Physics B.Sc II : R P Goyal, Shivlal Publications

Reference*Books Recommended*

1. Practical Physics by S.L. Gupta and V. Kumar
2. Advanced Practical Physics for Students by B.L. Worsnop and H.T. Flint
3. B.Sc. Practical Physics by C.L. Arora
4. Experimental Physics: Modern Methods by R.A. Dunlap

Online Resources (e-books/ learning portals/ other e-resources)

1. Link for e-Books for Physics:Physics Practical: https://egyankosh.ac.in/handle/123456789/82374; https://www.lightandmatter.com/lab_223.pdf;
2. Virtual Lab : https://vlab.amrita.edu/index.php?sub=1&brch=281
3. https://www.compadre.org/books/?ID=70&FID=63273
4. https://www.edutech.com/category/higher-education/engineering-labs/virtual-labs-1
5. https://phet.colorado.edu/en/simulations/wave-interference
6. https://egyankosh.ac.in/handle/123456789/82374

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
EndSemester Exam(ESE):35 Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance –**05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

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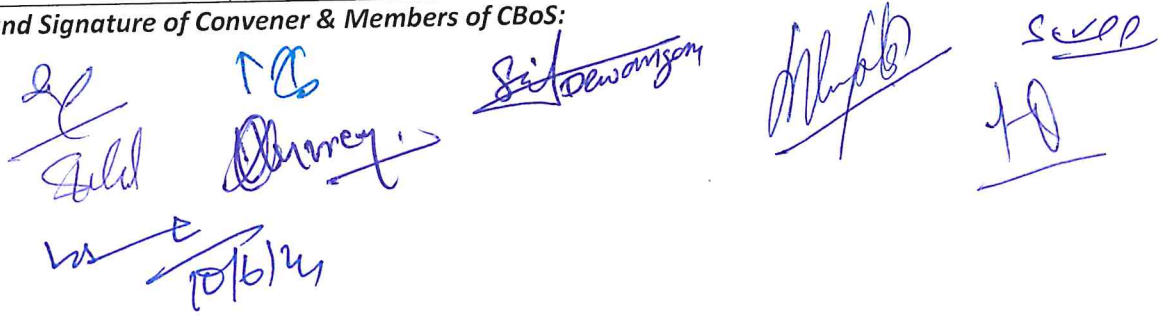

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science *(Degree/ Honors)*	Semester: V	Session: 2024-25

1	Course Code	**PHSC-05T**
2	Course Title	**Introduction to Quantum Mechanics**
3	Course Type	**Discipline Specific Course**
4	Pre-requisite (if any)	**As per Program**
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ Explain the basic postulates of quantum mechanics ➢ Explain the concept of the wave packet ➢ Describe the principle of Heisenberg's uncertainty principle and its applications ➢ Gain knowledge about physical quantities as operators ➢ Apply the Schrodinger equation to various quantum systems
6	Credit Value	**03 Credits** | **1 Credit = 15 Hours - Learning & Observation**
7	Total Marks	**Maximum Marks: 100** | **Minimum Pass Marks: 40**

PART – B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 45 Periods (45 Hours)

Unit	Topics	No. of Period
I	**Wave-particle duality:** Limits of classical mechanics, Theoretical and experimental consequences and their explanation such as black body radiation, Planck's law, Photoelectric effect, Compton's effect, Specific heat of solids at low temperatures, wave-particle duality and demonstration of matter waves, Bohr's complementary principle and correspondence principle, Concept of the wave packet and its spread with time, Gaussian wave packet, Phase and Group velocity, de-Broglie wavelength using phase velocity and group velocity.	12
II	**Uncertainty principle:** Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables), Experiments for the verification of uncertainty principle, mathematical derivation of uncertainty principle for the one-dimensional wave packet, Applications and consequences of the uncertainty principle.	10
III	**Schrodinger equation:** Representation of dynamic variables by operators (operators for the position, momentum, energy, angular momentum), Schrodinger's wave equation, Wave function, Probabilistic interpretation of wave function, Probability current densities in one dimension, Equation of continuity, Normalization of wave function, Orthogonality property of wave function, Expectation value of dynamical variables, Ehrenfest's theorem, Postulates of Quantum Mechanics.	11
IV	**Application of Schrodinger wave-equation** Solution for free particle, Free particle in a box and density of states, Transmission through potential step, Rectangular potential barrier and tunnelling phenomena, Linear harmonic oscillator with the concept of zero-point energy and parity, Schrodinger equation in spherical polar co-ordinates, spherical symmetric potential, energy states of hydrogen using Schrodinger equation.	12

Keywords:	Black body radiation, Planck's, Photoelectric effect, de-Broglie wavelength, Uncertainty principle, Schrodinger equation.

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books *Recommended*

1. Unified Physics- III, R. P. Goyal, Shivlal Agrawal Publications
2. Unified Physics- III, Navbodh Publications

Reference Books*Recommended*

1. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
2. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill
3. Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan

Online Resources (e-books/ learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics textbook in PDFhttps://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. Cambridge University Books for Physics https://www.cambridgeindia.org/
4. Books for solving physics problems https://bookboon.com/en/physics-ebooks
5. NPTEL Online courses: https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. Quantum Mechanics https://archive.nptel.ac.in/courses/115/101/115101107/
7. Quantum Mechanics https://nptel.ac.in/courses/115106066

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 100Marks
Continuous Internal Assessment (CIA): 30 Marks
End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20+20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam(ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type, **1 out of 2** from each unit- **4x10 =40 Marks**	

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION			
Program : Bachelor in Science (Degree/ Honours)		**Semester: V**	**Session: 2024-25**
1	Course Code	**PHSC- 05 P**	
2	Course Title	**Introduction to Quantum Mechanics**	
3	Course Type	**Discipline Specific Course**	
4	Pre-requisite (if any)	**As per Program**	
5	Course Learning Outcomes (CLO)	After the completion of the course, get opportunity to perform the following experiments on measurement and verification basicconcepts of Quantum mechanics. The studentsare expected to: ➢ Assemble required parts/devices and arrange them to perform experiments. Record/ observe data as required by the experimental objectives. ➢ Analyze recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to laws of Quantum Mechanics and its applications ➢ Apply the learnt concepts for different problems in laser systems, nuclear physics and EMW related problems.	
6	Credit Value	**01 Credit**	**1 Credit = 30 Hours Laboratory Work**
7	Total Marks	**Maximum Marks: 50**	**Minimum Pass Marks: 20**

PART – B: CONTENT OF THE COURSE

Total No.of learning-Training/performance Periods - 30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Period
1	Measurement of Planck's constant using black body radiation and photo-detector	30
2	Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light	
3	To determine work function of material of filament of directly heated vacuum diode.	
4	To determine the Planck's constant using LEDs of at least 4 different colours.	
5	To determine the wavelength of H-alpha emission line of Hydrogen atom.	
6	To determine the ionization potential of mercury.	
7	To determine the absorption lines in the rotational spectrum of Iodine vapour.	
8	To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.	
9	To setup the Millikan oil drop apparatus and determine the charge of an electron.	
10	To show the tunneling effect in tunnel diode using I-V characteristics.	

Keywords:	Planck's constant, tunneling effect, Photo-electric effect, spectrum –Rotational and vibrational, e/m

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash& Ramakrishna, 11th Edn, 2011,Kitab Mahal
4. Practical Physics B. Sc III : R P Goyal, Shivlal Publications

Reference Books Recommended-

1. Practical Physics by Dr. Giasuddin Ahmad and Md. Shahabuddin
2. Practical Physics by Dr. Harnam Singh
3. Practical Physics by R. K. Shukla and N. K.

Online Resources (e-books/ learning portals/ other e-resources)

1. Virtual Lab :https://vlab.amrita.edu/?sub=1&brch=195
2. https://mpv-au.vlabs.ac.in/
3. https://mpv-au.vlabs.ac.in/modern-physics/Hall_Effect_Experiment/
4. https://www.falstad.com/qmatomrad/
5. https://www.falstad.com/mathphysics.html : Quantum mechanics

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
End Semester Exam(ESE):35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance – **05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science *(Degree/ Honors)*		Semester: VI	Session: 2024-25
1	Course Code	PHSC-06 T	
2	Course Title	Solid State Physics and Solid State Devices	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ To give knowledge of some basic electronic components and circuits. Understand the basic principles and industrial applications of semiconductor diode, Zener diode and transistor ➢ Use diodes and transistors in electronic circuits ➢ Understand the construction working and applications of transistor ➢ Understand the construction and working principles of various instruments that are used in the physics laboratory ➢ Gain knowledge on importance of filter a circuit. Describe the working of oscillators	
6	Credit Value	03 Credits	1 Credit = 15 Hours- Learning & Observation
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks:40

PART – B: CONTENTSOF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 45 Periods (45 Hours)

Unit	Topics	No. of Period
I	**India Semiconductor Mission** Vision, objectives and schemes of India Semiconductor Mission (ISM). **Crystallography** Amorphous and crystalline solids, Elements of symmetry, seven crystal system, Cubic lattice, crystal planes, Miller indices, Laue's equation for X-ray diffraction, Bragg's law, Bonding in solids, Classification, Cohesive energy of solids, Madelung constant, evaluation of parameters, vibrational modes of one-dimensional monoatomic lattice, Dispersion relation, Brillouin Zone.	11
II	**Introduction to semiconductors** Intrinsic and extrinsic semiconductors, concept of Fermi level, generation and recombination of electron hole pairs in semiconductors, Mobility of electrons and holes, drift and diffusion currents, Carrier Concentration at Normal Equilibrium inIntrinsic Semiconductors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. **Semiconductor Diodes** p and n type semiconductors, Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode, PN junction and its characteristics, depletion width and potential barrier, junction capacitance, Structure and working of Zener diode and Tunnel diode.	12

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III	**Opto-electronic devices** Construction, working and applications of LEDs, Photodiode and Solar cell. **Power Supply** Half-wave Rectifier, Full-wave Rectifiers, Central-tapped and Bridge rectifier, Calculation of Ripple Factor and Rectification Efficiency,Zener diode as voltage regulator. Basic idea about capacitor filter, L-section filter and π-section filter.	10
IV	**Transistors:** n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions. Current gains α, β and γ. Relations between α, β and γ. Load Line analysis of Transistors. DC Load line and Q-point, FET, **Bipolar transistor as amplifier**: h-parameters (low frequency), h-parameter equivalent circuit (CE small signal amplifier), Classification of Amplifiers: Class A, B, and C **Sinusoidal Oscillator** Barkhausen's criterion for Self-sustained oscillations, Determination frequency of RC oscillator. Wein Bridge Oscillator, Hartley oscillator and Phase shift oscillator.	12
Keywords:	Crystalline solids, Miller indices, Bragg's law, semiconductors, Fermi level, junction diodes, transistors, filter circuits, amplifiers, oscillators	

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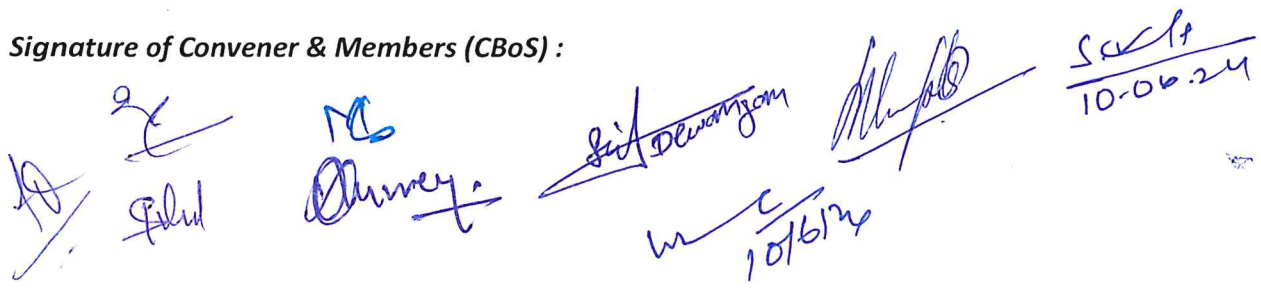

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Basic electronics (Solid state), B L Thareja
2. Electronics: Fundamentals and Applications, D Chattopadhyay, PC Rakshit
3. Basic Electronics A Simplified Approach, Raghunandan G. H, Chaithanya G. H.
4. Basic Electronics, D.P. Kothari, I. Nagrath
5. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
6. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.

Reference Books Recommended-

1. Fundamentals of Solid State Physics by B.S. Saxena, R.C. Gupta, P.N. Saxena
2. Solid State Physics by S.O. Pillai
3. Semiconductor Physics and Devices by K. Purushothaman
4. Electronic Devices and Circuits by S. Salivahanan, N. Suresh Kumar
5. Optoelectronics and Optical Communication by B.P. Singh, Rekha Singh
6. Basic Electronics and Linear Circuits by N.N. Bhargava, D.C. Kulshreshtha, S.C. Gupta
7. Electronic Devices and Circuits by J.B. Gupta
8. Principles of Electronics by V.K. Mehta, Rohit Mehta

Online Resources (e-books/ learning portals/ other e-resources)

1. https://nptel.ac.in/courses/122106025
2. https://archive.nptel.ac.in/courses/108/101/108101091/
3. http://www.digimat.in/nptel/courses/video/117103063/L31.html
4. https://archive.nptel.ac.in/courses/117/103/117103063/

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Examination (ESE) : 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test/ Quiz (2): **20+20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type, **1 out of 2** from each unit- **4x10 =40 Marks**	

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Degree/ Honors)	Semester: VI	Session: 2024-25

1	Course Code	PHSC- 06 P	
2	Course Title	Solid State Physics and Solid State Devices	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	After the completion of the course, the students are expected to: ➢ Assemble required parts/devices and arrange them to perform experiments. Record/ observe data as required by the experimental objectives. ➢ Analyse recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to theory of semiconductors. ➢ Apply theory and principle of semiconductors for various device applications ➢ Verify various I/P, O/P and other characteristics of various semiconductor (solid state) devices and interpret the phenomena.	
6	Credit Value	01 Credit	1 Credit = 30 Hours Laboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

Total No. of learning-Training/performance Periods - 30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Periods
1	To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150°C) and to determine its band gap.	30
2	To determine the Hall coefficient of a semiconductor sample.	
3	To study V-I characteristics of PN junction diode, and Light emitting diode.	
4	To study the V-I characteristics of a Zener diode and its use as voltage regulator.	
5	Study of V-I & power curves of solar cells, and find maximum power point & efficiency.	
6	To study the characteristics of a Bipolar Junction Transistor in CE configuration.	
7	To study the various biasing configurations of BJT for normal class A operation.	
8	To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.	
9	To study the frequency response of voltage gain of a RC-coupled transistor amplifier.	
10	To design and study a Wien bridge oscillator.	
11	To design a phase shift oscillator of given specifications using BJT.	
12	To study the Colpitt`s oscillator.	

Keywords:	Semiconductor Resistivity, Hall Coefficient, Diode Characteristics, Zener Diode Voltage Regulation, Solar Cell Efficiency, Bipolar Junction Transistor (BJT), BJT Biasing Configurations, Oscillator Design

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
5. Practical Physics B.Sc III : R P Goyal, Shivlal Agrawal Publications

Reference Books Recommended-

1. Semiconductor Physics and Devices by Donald A. Neamen
2. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky
3. Microelectronic Circuits by Adel S. Sedra and Kenneth C. Smith
4. Practical Electronics for Inventors by Paul Scherz and Simon Monk

Online Resources (e-books/ learning portals/ other e-resources)

1. Virtual Lab : https://vlab.amrita.edu/?sub=1&brch=282
2. https://vlab.amrita.edu/index.php?sub=1&brch=282&sim=370&cnt=3
3. https://bop-iitk.vlabs.ac.in/exp/energy-band-gap/simulation.html
4. http://vlabs.iitkgp.ac.in/ssd/index.html#
5. http://vlabs.iitkgp.ac.in/psac/newlabs2020/ssds/#
6. https://ae-iitr.vlabs.ac.in/List%20of%20experiments.html
7. https://da-iitb.vlabs.ac.in/List%20of%20experiments.html

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance – **05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in science *(Honors/Honors with Research)*	Semester: VII	Session: 2024-25

1	Course Code	**PHSC-07**
2	Course Title	**Classical Mechanics**
3	Course Type	**Discipline Specific Course**
4	Pre-requisite (if any)	**As per Program**
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ The ideas and concepts in classical physics ➢ Explain Newtonian Mechanics, Lagrangian, and Hamiltonian formulation ➢ Gain knowledge about central force problems and its application in scattering phenomena ➢ Explain small oscillations and its applications. Apply mechanics to solve various physical problems
6	Credit Value	**04 Credits** | **1 Credit = 15 Hours for Learning & Observation**
7	Total Marks	**Maximum Marks: 100** | **Minimum Pass Marks: 40**

PART – B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics	No. of Period
I	**Preliminaries of classical mechanics** Review of Newtonian Mechanics; Conservation laws; Constraints and their classification; Principle of virtual work; Generalized coordinates and velocities, D' Alembert's principle, Lagrangian and the Euler-Lagrangeequations, Simple applications of Lagrangian formulation, Hamilton's principle, Lagrange's equation from Hamilton's principle; Legendre transformations and Hamilton's equation of motion; Hamilton's equation from Hamilton's principle; The principle of least action simple applications of Hamiltonian formulation; Conservation theorems, cyclic coordinates and symmetry properties	15
II	**Canonical transformations and relativistic mechanics** Canonical transformations; Poisson's Bracket; equation of motion and Conservation theorems in the Poisson Bracket formulation; Hamilton Jacobi (HJ) theory; Harmonic oscillator as an example of HJ method Four vectors; Four velocity and acceleration; Lorentz Covariant form of equation of motion.	15
III	**Central forces** Two-body central force problems and their reduction to the equivalent one-body problem; The equations of motion and first integrals; one-dimensional problems and classification of orbits; The differential equation of the orbit, Closure and stability of orbits; Kepler's laws and planetary motion; Scattering in central force; Rutherford's scattering	15
IV	**Rigid body and Periodic motion** Euler's angles, Euler's theorem on the motion of a rigid body; The Coriolis force; The Euler equations of motion of rigid bodies; Small oscillations; normal modes; Formulation of the problem of small oscillations; Vibrating string; normal vibrations; dispersion; Coupled vibrating systems, free vibration of a linear triatomic molecule.	15

Keywords:	Newtonian Mechanics, Lagrangian formulation, Hamiltonian formulation, Poisson's bracket, central force problems, small oscillations

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Classical Mechanics by Herbert Goldstein, Charles Poole, and John Safko
2. Mechanics by L.D. Landau and E.M. Lifshitz
3. Classical Mechanics: Systems of Particles and Hamiltonian Dynamics by Walter Greiner
4. Introduction to Classical Mechanics: With Problems and Solutions by David Morin
5. Classical Dynamics of Particles and Systems by Jerry B. Marion and Stephen T. Thornton
6. Classical Mechanics by R. Douglas Gregory
7. Analytical Mechanics by Grant R. Fowles and George L. Cassiday

Reference Books Recommended

1. Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGraw Hall.
3. Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press.
4. Classical Mechanics: An Introduction, Dieter Strauch, 2009, Springer.

Online Resources (e-books/ learning portals/ other e-resources)

1. Classical Mechanics-https://archive.nptel.ac.in/courses/115/106/115106123/
2. Classical Mechanics- https://archive.nptel.ac.in/courses/115/105/115105098/
3. Classical Mechanics- https://archive.nptel.ac.in/courses/122/106/122106027/

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**
Continuous Internal Assessment (CIA): **30 Marks**
End Semester Examination (ESE): **70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2):	**20+20**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
	Assignment/ Seminar (1):	**10**	
	Total Marks:	**30**	
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type, **1 out of 2** from each unit- **4 x 10 =40 Marks**		

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science *(Honors/ Honors with Research)*	**Semester: VIII**	**Session: 2024-25**

1	Course Code	**PHSC-08**	
2	Course Title	**Quantum Mechanics**	
3	Course Type	**Discipline Specific Course**	
4	Pre-requisite (if any)	**As per Program**	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ Explore uncertainty relations and states with minimum uncertainty. Learn and apply commutation relationships ➢ Master matrix representation of operators and solve the harmonic oscillator. Comprehend angular momentum in quantum mechanics. ➢ Explore spin angular momentum and Pauli's matrices. Master the concept of Clebsch- Gordon coefficients. ➢ Analyze central force problems and spherically symmetric potentials in 3D. Explore parity, square-well potentials, and hydrogen atom solutions	
6	Credit Value	**04 Credits**	**1 Credit = 15 Hours- Learning & Observation**
7	Total Marks	**Maximum Marks: 100**	**Minimum Pass Marks: 40**

PART – B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 60 Period (60 Hours)

Unit	Topics	No. of Period
I	Super position principle, State with minimum uncertainty product, commutation relationship, completeness and normalization of eigen functions, Dirac-delta function,Bra& Ket notation, matrix representation of an operator, harmonic oscillator and its solutionby matrix method, Heisenberg equation of motion.	15
II	Angular momentum in quantum mechanics, matrix representation of angular momentum, commutation relationships of orbital angular momentum, eigen values and eigen functions of L^2 and L_z, Spin angular momentum: basic introduction, Total angular momentum and its commutation relationship, Pauli`s spin matrices, addition of angular momentum, Clebsch-Gordon coefficients. Applied problem based on momentum and positions.	15
III	Central force problem, spherically symmetric potentials in three dimensions, separation of wave equation, parity, three-dimensional square-well potential and energy levels, the hydrogen atom; solution of the radial equation, energy levels and stationery state wave functions, discussion of bound states, degeneracy.	15
IV	Time- independent perturbation theory, non-degenerate case, first order and second perturbations with the example of an oscillator, degenerate cases, removal of degeneracy in second order, Zeeman effect without electron spin, first-order Stark effect in hydrogen, perturbed energy levels, correct eigen function, occurrence of permanent electric dipole moments.	15

Keywords:	Uncertainty principle, normalization of wavefunction, angular momentum spherically symmetric potential, Time independent perturbation theory, Zeeman effect

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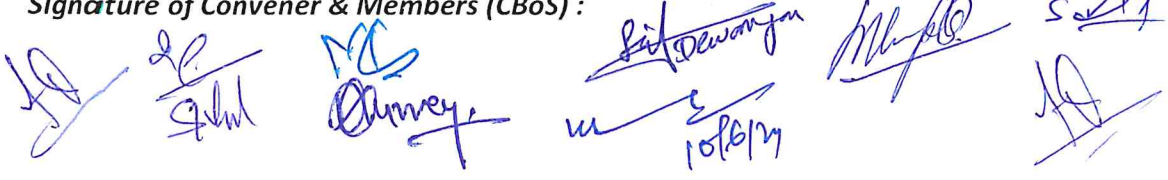

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended -

1. Principles of Quantum Mechanics by R. Shankar
2. Modern Quantum Mechanics" by J. J. Sakurai and Jim Napolitano
3. Introduction to Quantum Mechanics" by David J. Griffiths and Darrell F. Schroeter
4. Quantum Mechanics: A Modern Development" by Leslie E. Ballentine
5. Quantum Mechanics by Leonard I. Schiff

Reference Books Recommended -

1. L. I. Schiff : Quantum mechanics (McGraw-Hill).
2. S. Gasiorowicz, Quantum Physics (Wiley).
3. Landau and Lifshitz : Non-relativistic quantum mechanics.
4. B. Crasemanand Z. D. Powell: Quantum mechanics (Addison Wesley)
5. A. P. Messiah : Quantum Mechanics.
6. J. J. Sakurai : Modern Quantum Mechanics.
7. Mathews and Venkatesa: Quantum Mechanics.
8. G. Aruldhas: Quantum Mechanics (II Edition)

Online Resources (e-books/ learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics textbook in PDF https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. Cambridge University Books for Physics https://www.cambridgeindia.org/
4. Books for solving physics problems https://bookboon.com/en/physics-ebooks
5. NPTEL Online courses: https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. Quantum Mechanics https://archive.nptel.ac.in/courses/115/101/115101107/
7. Quantum Mechanics https://nptel.ac.in/courses/115106066

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**

Continuous Internal Assessment (CIA): **30 Marks**

End Semester Examination (ESE): **70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): Assignment/ Seminar (1): Total Marks:	**20+20** **10** **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type, **1 out of 2** from each unit- **4x10 =40 Marks**		

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION

Program : Bachelor in Science *(Diploma / Degree/Honors)*	Semester - III	Session: 2024-2025

1	Course Code	PHSE-01
2	Course Title	Introduction to Statistical Mechanics
3	Course Type	Discipline Specific Elective
4	Pre-requisite (if, any)	As per Program
5	Course Learning. Outcomes(CLO)	➢ Differentiate between macrostate and microstate and calculate their numbers ➢ Comprehend the concept of ensembles and its requirement in study of physical phenomenon ➢ Correlate and compare the classical and quantum statistical distribution laws. ➢ Apply concepts of statistical distribution laws for different physical systems.
6	Credit Value	4 Credits — *Credit = 15 Hours -learning & Observation*
7	Total Marks	Max. Marks: 100 — Min Passing Marks: 40

PART -B: CONTENT OF THE COURSE

Total No.of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Maxwellian Distribution of Speeds In An Ideal Gas**: Distribution of speeds and velocity, experimental verification, distinction between mean, rms and most probable speeds, Doppler broadening of spectral lines, transport phenomena in gases: molecular collision, collision cross section, estimates of molecular diameter and mean free path; transport of mass , momentum and energy and inter-relationship, dependence on temperature and pressure. **Behaviour of Real Gases :**deviation from ideal gas equation, the Virial equation, Andrew's experiment on CO_2 gas; critical constants.	15
II	**Macrostate & Microstate** Macrostate, Microstate, Number of accessible microstates and Postulate of equal a priori. **Concept of Ensemble:** Concept of Gibb's ensemble, postulate of ensemble average, Micro Canonical, Canonical & Grand Canonical ensembles. Thermodynamic Probability, Postulate of Equilibrium and Boltzmann Entropy relation. Phase space, Phase trajectory, Volume element in phase space, Quantization of phase space and number of accessible microstates for free particle in 1D, free particle in 3D.	15

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III	**Transition to quantum statistics:** *h* as a natural constant and its implications, cases of particle in 1D and 1Dimensional harmonic oscillator, **Quantum Statistical Distribution Laws:** In-distinguishability of particles and its consequences, Bose-Einstein & Fermi Dirac statistics. Comparison of statistical distribution laws and their physical significance. Canonical Distribution Law: Boltzmann's Canonical Distribution Law, Boltzmann's Partition Function, Proof of Equipartition Theorem (Law of Equipartition of energy) and relation between Partition function and Thermodynamic potentials.	**15**
IV	**Bose-Einstein Distribution Law and its Applications:** Bose-Einstein Statistics: Heat capacity, Bose Einstein condensation, Radiation as a photon gas, Quantum Theory of Radiation: Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law **Fermi-Dirac Distribution Law and its Applications:** Free electrons in a metal, Definition of Fermi energy, Determination of Fermi energy at absolute zero, Kinetic energy of Fermi gas at absolute zero and concept of Density of States, Specific Heat of Metals (Density of Orbitals).	**15**
Keywords	Macrostate & Microstate, ensemble, distribution laws, Bose-Einstein Statistics, Fermi-Dirac Statistics	

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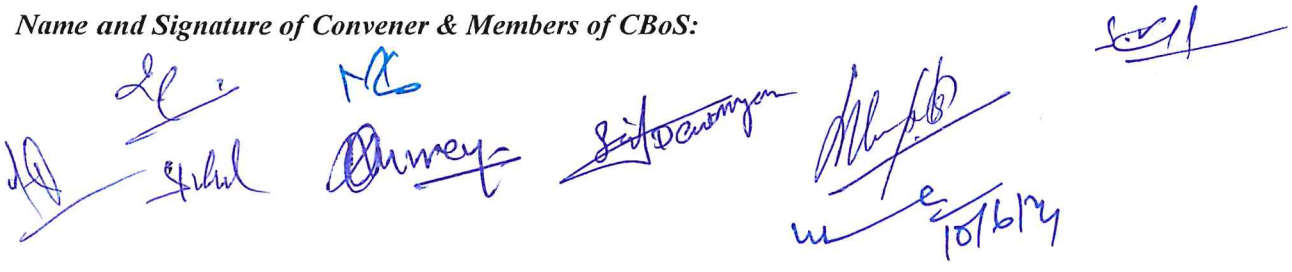

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PART–C:LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Unified Physics –II, R P Goyal, Shivlal Agrawal & Sons Publication
2. Unified Physics-II, Yugbodh Prakashan
3. Unified Physics-II, Navbodh Prakashan

Reference Books Recommended–

1. F. Reif, "Statistical Physics (In SI Units): Berkeley Physics Course Vol 5", McGraw Hill, 2017
2. B.B. Laud, "Fundamentals of Statistical Mechanics", New Age International Private Limited, 2020
3. B.K. Agarwal, M. Eisner, "Statistical Mechanics", New Age International Private Limited, 2007

Online Resources–e-Resources / e-books and e-learning portals

1. MIT Open Learning - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/
2. National Programme on Technology Enhanced Learning (NPTEL), https://archive.nptel.ac.in/courses/115/103/115103113/,
3. https://onlinecourses.nptel.ac.in/noc19_ph10/preview,
4. https://archive.nptel.ac.in/courses/115/106/115106126/
5. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
6. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA): 30 Marks
End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 & 20** Assignment/Seminar- **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40Marks**	

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DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION

Program: Bachelor in Science *(Diploma /Degree/Honors)*	Semester - IV	Session: 2024-2025

1	Course Code	PHSE-02	
2	Course Title	Mathematical Physics-I	
3	Course Type	Discipline Specific Elective	
4	Pre-requisite (if, any)	As per Program	
5	Course Learning Outcomes(CLO)	➢ Revise and apply the knowledge of calculus, vectors, vector calculus, probability and probability distributions in various cases. ➢ Illustrate proficiency in writing and solving Differential equation and solving them for a given physical system. ➢ Apply and interpret the curvilinear coordinates in problems with spherical and cylindrical symmetries. ➢ Use Dirac Delta function for various physical situation, especially in quantum mechanical approaches.	
6	Credit Value	4 Credits	*Credit = 15 Hours -learning & Observation*
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods(01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Calculus:** **Recapitulation:** Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions, Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). **Calculus of functions of more than one variable:** Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. **Origin and Evolution of Mathematical concepts in Ancient India:** Bhaskaracharya, the Inventor of Calculus: some examples on calculus	16
II	**First Order and Second Order Differential equations:** First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems.Particular Integral. **Orthogonal Curvilinear Coordinates:** Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl andLaplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.	16

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III	**Introduction to probability**: Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance. Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing.	**15**
IV	**Dirac Delta function and its properties**: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function. Problems based on dirac-delta function and its application	**13**
Keywords	Calculus, Lagrange Multipliers, Homogeneous Equations, Particular Integral, Probability distribution, Dependent events, Dirac delta function	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
2. Mathematical Physics, Goswami, 1st edition, Cengage Learning
3. Engineering Mathematics, S. Pal and S.C. Bhunia, 2015, Oxford University Press
4. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
5. Essential Mathematical Methods, K. F. Riley & M.P.Hobson, 2011, Cambridge Univ. Press.
6. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company

Reference Books Recommended–

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.

Online Resources–e-Resources / e-books and e-learning portals

1. NPTEL online Courses: https://archive.nptel.ac.in/courses/115/105/115105097/
2. NPTEL online Courses: https://nptel.ac.in/courses/115103036
3. e-gyankosh- https://egyankosh.ac.in/handle/123456789/97951
4. Origin and Evolution of Calculus in India: http://mathematical-forum.org/wp-content/uploads/2021/01/Paper-1.pdf
5. https://iks.iitgn.ac.in/wp-content/uploads/2016/02/Development-of-Calculus-in-India-K-Ramasubramanian-MD-Srinivas-2010.pdf
6. Indian Mathematics: NPTEL Course : https://nptel.ac.in/courses/111101080

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 & 20** Assignment/Seminar- **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40Marks**	

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DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program: Bachelor in Science *(Degree/Honors)*		**Semester - V**	Session: 2024-2025
1	**Course Code**	**PHSE-03**	
2	**Course Title**	**Nuclear Physics**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	***As per Program***	
5	**Course Learning. Outcomes (CLO)**	➢ Describe nuclear constituents and their intrinsic properties.Analyze binding energy variations with mass number and understand the N/Z plot. ➢ Explain and apply nuclear models for clear understanding of stability of nuclei and nuclear processes.Differentiate alpha, beta, and gamma decay and interpret energy spectra. ➢ Apply conservation laws to compute Q-values, and analyze reaction mechanism.Explain significance of scattering and reaction cross section. ➢ Calculate and compare nuclear fission and fusion energy.Describe nuclear detectors and particle accelerators. ➢ Gain insights into cutting-edge research, accelerator technology, and interdisciplinary applications and apprehend the role of accelerators in advancing scientific knowledge and contributing to societal well-being.	
6	**Credit Value**	**4 Credits**	***Credit = 15 Hours - learning & Observation***
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**General Properties of Nuclei:** Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments.	15
II	**Nuclear Models:** Liquid drop model approach, semi empirical mass formula and, significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model, evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field.	15

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III	**Nuclear decay and Reactions:** Alpha, beta, gamma decay, energy spectrum, Geiger-Nuttel law, disintegration energy, quantum theory of alpha decay, types of beta decay and energy spectrum, Pauli's prediction of neutrino. Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering). **Nuclear Energy Reactions:** Nuclear Fission, Calculation of energy released, Nuclear fusion, Energy released in Fusion, Comparison of Fission and fusion energy, Fusion as source of stellar Energy, Nuclear reactors in India, Contribution of nuclear energy in total energy requirement.	**15**
IV	**Nuclear Detector and Particle Accelerators:** Interaction of charge particle through matter, Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation, Detectors and construction of photo-multiplier tube (PMT), Semiconductor Detectors. Accelerator facility available in India: Van-de Graaff generator, Pelletron accelerator, Linear accelerator, Cyclotron accelerator **Nuclear Accelerators in India:** RRCAT, VECC, BARC TIFR Pelletron Facility, IUC : working, evolution and contribution.	**15**
Keywords	Properties of Nucleus, Nuclear forces, Nuclear Models, Decay reaction, detectors and accelerators	

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Introduction to Nuclear and Particle Physics V.K. Mittal, R. C. Verma, S. C. Gupta, Eastern Economy Edition.
2. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, 2004)
3. Nuclear Physics by S.N. Ghoshal, S. Chand Publishing, 2019
4. Unified Physics-III by R P Goyal, Shivlal Agrawal & Sons Publication
5. Nuclear Physics -6Ed by D. C. Tayal, Himalaya Publishing House

Reference Books Recommended –

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mc-Graw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
4. Nuclear Physics An Introduction S. B. Patel New Age International Publishers.

Online Resources– e-Resources / e-books and e-learning portals

1. NPTEL :: Physics - NOC:Nuclear and Particle Physics
2. NPTEL :: Physics - Nuclear Physics: Fundamentals and Applications
3. Fundamentals of Nuclear Power Generation - Course (nptel.ac.in)
4. eGyanKosh: Unit-13 Nuclear Physics
5. eGyanKosh: Block-4 Nuclear Physics
6. NPTEL :: Physics - Nuclear Science & Engineering
7. Official Websites of Raja Ramanna Centre for Advanced Technology (RRCAT),Variable Energy Cyclotron Centre (VECC),BARC–TIFR Pelletron Facility, Inter-University Accelerator Centre (IUAC)

PART -D:vAssessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 & 20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**	

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION

Program : Bachelor in Science *(Degree/Honors)*	Semester - VI	Session: 2024-2025

1	Course Code	PHSE-04 T	
2	Course Title	Numerical Methods and C Programming	
3	Course Type	Discipline Specific Elective	
4	Pre-requisite(if,any)	*As per Program*	
5	Course Learning. Outcomes(CLO)	At the end of this course, the students will be able to: ➢ Analyse the convergence of solutions to numerical methods.Understand the principles of Gaussian elimination, pivoting, and iterative methods to solve linear systems ➢ Use interpolation methods, Perform numerical differentiation and integration using Newton-Cotes formulae ➢ Explain the roles of compilers, interpreters, and operating systems, Learn the basics of C programming	
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*
7	Total Marks	Max. Marks : 100	Min Passing Marks:40

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	Methods for determination of zeroes of linear and nonlinear algebraic equations and transcendental equations, convergence of solutions. Solution of simultaneous linear equations, Gaussian elimination, pivoting, iterative method, matrix inversion, Finite differences, interpolation with equally spaced and unevenly spaced points, curve fitting, polynomial least squares and cubic spline fitting. Numerical differentiation and integration, Newton-Cotes formulae, error estimates, Gauss method.	13
II	Numerical solution of ordinary differential equations, Euler and Runga-Kutta methods, Solution of related problems, Predictor-corrector method, Solution of related problems, Elementary ideas of solutions of partial differential equations	10
III	Problem analysis and solving scheme. Computational procedure, programming outline, flow chart. Branching and looping writing. Character set, constants, (numeric string) variables (numeric string) rules for arithmetic expressions and hierarchy of operators, rational expressions, logical expressions, and operators, library functions. Identifiers, qualifiers, define statements, value Initialized variables, operators, and expressions. Operator precedence and associativity. scanf with specifier, search set arrangements and suppression Character, format specifier for scanf. Control structure, if statement, if else statement, multiway decision, compound statement.	10
IV	Loops: for loop, while loop, do while loop, break statement, compound statement continue statement, go to statement, Function - function main, function accepting more than one parameter, user defined and library function concept associatively with functions, function parameter, return value, recursion comparison. Arrays, strings, multidimensional array, array of strings function in string	12

Keywords	Transcendental equations, Ordinary differential equations, Numerical integration, Numerical differentiation, Flow charts, C - Statement.

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Numerical Methods for Scientists and Engineers by R. W. Hamming
2. Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale
3. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar, and R. K. Jain
4. Programming in ANSI C by E. Balagurusamy
5. Let Us C" by Yashavant Kanetkar
6. Numerical Methods and Programming by P. B. Patil and U. P. Verma
7. Numerical Methods with Programs in C by T. Veerarajan and T. Ramachandran
8. Numerical Methods by B S Grewal

Reference Books Recommended –

1. Sastry: Introductory Methods of Numerical Analysis
2. Rajaraman: Numerical Analysis
3. Numerical Methods by Dr. P. Kandasamy, Dr. K Thilagavathy, Dr. K. Gunvanthi
4. Fundamentals of Numerical Methods by Rajeev K Bansal

Online Resources–

e-Resources / e-books and e-learning portals

1. Numerical methods https://archive.nptel.ac.in/courses/111/107/111107105/
2. Numerical analysis https://archive.nptel.ac.in/courses/111/101/111101165/
3. Numerical Methods for Engineers https://archive.nptel.ac.in/courses/127/106/127106019/
4. Introduction to Numerical Methods https://nptel.ac.in/courses/105105043

PART-D:ASSESSMENT ANDEVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**
Continuous Internal Assessment (CIA): **30 Marks**
End Semester Exam (ESE): **70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): Assignment/Seminar- Total Marks -	**20 +20** **10** **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 = 20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit- **4 x 10=40 Marks**		

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program : Bachelor in Science *(Degree/Honors)*		**Semester - VI**	**Session: 2024-2025**
1	**Course Code**	**PHSE-04 P**	
2	**Course Title**	**Numerical Methods and C Programming**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	**As per Program**	
5	**Course Learning. Outcomes(CLO)**	At the end of this course, the students will be able to: ➢ Get experimental Knowledge of computational methods in physics ➢ Learn C language ➢ Use C programming to solve various equations ➢ Perform Interpolation and curve fittings through various tools.	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max. Marks:50**	**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE

Total No. of learning-Training/performance Periods- 30 Periods (30 Hours)

Module	Topics (Course Contents) **At least 10 of the following or related Experiments**	No. of Period
Lab./ Experiment Contents of Course	Any 8 program from the list given below or similar program. 1. To solve Simultaneous Linear equation by Gauss Elimination Method 2. To calculate the root of Transcendental equation by Newton-Raphsons Method 3. Solving the system of Linear simultaneous equation by Gauss-Serdel Method 4. Numerical Integration by Simposon's 1/3 rule 5. Solving simultaneous Linear equation by Gauss-Jordan method 6. Solution of differential equation by Euler's Method 7. To invert a given Matrix by Gauss-Jordan Method 8. Solution of differential equation by Runge-Kutte Method 9. To fit the given data in straight line by Linear Regression Method (a) Write a program to find the largest of n number of series. (b) To calculate the standard deviation of a given set of data 10. To write a program to compute the complex roots of a given polynomial of Nth degree by Graffe's method 11. To write a program to compute the Eigen Values a given Matrix 12. To integrate a given function by (a) Trapezoidal method or by (b) Gauss quadrature 13. To find solutions of first order, ordinary differential equation by Taylor method	**30**
Keywords	Gauss Elimination, Newton-Raphson, Numerical Integration, Euler's Method, Runge-Kutta, Linear Regression, Eigenvalues, Differential Equations	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Introductory Methods of Numerical Analysis: Sastry:
2. Numerical Analysis : Rajaraman
3. Numerical methods : Antia
4. Numerical Methods by Dr. P. Kandasamy, Dr. K Thilagavathy, Dr. K. Gunvanthi
5. Fundamentals of Numerical Methods by Rajeev K Bansal
6. Numerical Methods in Engineering & Science: with Programs in C, C++, and MATLAB by B S Grewal
7. Raja Raman: FORTRAN programming

Reference Books Recommended –

1. Numerical Methods: Problems and Solutions by M.K. Jain, S. R. K. Iyengar, and R. K. Jain
2. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar, and R. K. Jain
3. Numerical Methods: Principles, Analysis, and Algorithms by A. Singaravelu
4. Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale

Online Resources–

e-Resources / e-books and e-learning portals

1. Numerical methods https://archive.nptel.ac.in/courses/111/107/111107105/
2. Numerical analysis https://archive.nptel.ac.in/courses/111/101/111101165/
3. Numerical Methods for Engineers https://archive.nptel.ac.in/courses/127/106/127106019/
4. Introduction to Numerical Methods https://nptel.ac.in/courses/105105043

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**10 & 10**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
	Assignment/Seminar +Attendance-	**05**	
	Total Marks -	**15**	
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		**Managed by Course teacher as per lab. status**

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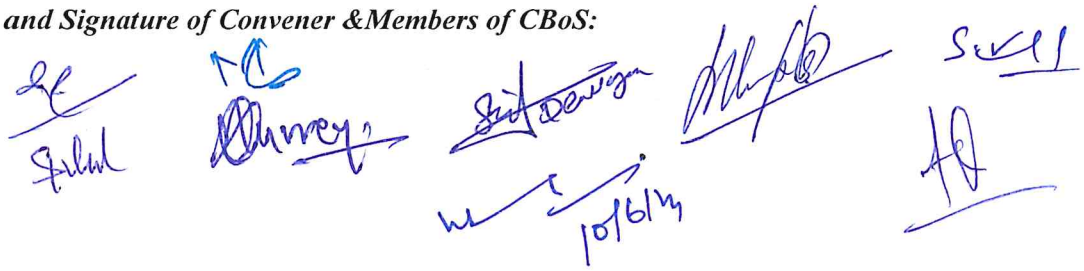

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION				
Program : Bachelor in Science *(Honors/Honors with Research)*		**Semester - VII**		Session: 2024-2025
1	**Course Code**	**PHSE- 05**		
2	**Course Title**	**Mathematical Physics -II**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ Apply Fourier analysis of periodic functions in physical problems such as vibrating strings etc. ➢ Solve the beta, gamma and the error functions and their applications in doing integrations. ➢ Relate basic theory of errors, their analysis, and estimation with examples of simple experiments in Physics. ➢ Solve partial differential equations with the examples of important partial differential equations in Physics		
6	**Credit Value**	**4 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 60 Periods (60 Hours)

Unit	Topics (Course contents)	No. of Period
I	Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. **Partial Differential Equations**: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry	15
II	**Fourier Series:** Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series	15
III	**Frobenius Method and Special Functions**: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite & Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations. **Some Special Integrals:** Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).	15
IV	**Complex Analysis**: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula	15
Keywords	Calculus, Partial derivatives, Differential equations, Periodic function, Singular point, Beta and Gamma function, Complex number, Complex variables.	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Calculus of Several Variables and Partial Differential Equations by M.L. Krasnov, S.G. Miskin, and A.I. Gromova
2. Fourier Series and Boundary Value Problems by James Brown and Ruel Churchill
3. Differential Equations with Boundary Value Problems by Dennis G. Zill and Warren S. Wright
4. Complex Variables and Applications by James Ward Brown and Ruel V. Churchill

Reference Books Recommended–

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. An Introduction to Ordinary Differential Equations, E.A Coddington, 1961, PHI Learning
5. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
6. Partial Differential Equations for Scientists and Engineers, S.J. Farlow, 1993, Dover Publications.
7. Mathematical methods for Scientists & Engineers, D.A. Mc Quarrie, 2003, Viva Books

Online Resources–

e-Resources / e-books and e-learning portals

1. NPTEL Online Courses: Dr Saurabh Basu (Complex analysis) https://nptel.ac.in/courses/115103036
2. NPTEL Online Course: V. Balkrishanan (Fourier Transform) :https://nptel.ac.in/courses/115106086
3. NOC: Mathematical Methods in Physics 1, IISER Bhopal, Prof. Auditya Sharma https://nptel.ac.in/courses/111106148
4. Vector Calculus, egyankosh: https://egyankosh.ac.in/handle/123456789/25388
5. e-PG pathshala: Mathematical Physics, https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=+4mIqRALksfwQH9v8YSMrw==

PART -D:Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): Assignment / Seminar - Total Marks -	**20 +20** **10** **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**		

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program : Bachelor in Science *(Honors/Honors with Research)*		**Semester - VII**	**Session: 2024-2025**
1	**Course Code**	**PHSE- 06**	
2	**Course Title**	**Classical Electrodynamics & Electromagnetic Theory**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	*As per Program*	
5	**Course Learning. Outcomes (CLO)**	➢ Calculate the reflection and transmission of waves at the media interface. ➢ Understand the aspects related to Polarized lights and its generation as the superposition of different waves. ➢ Understanding the plasma state, the concept of Debye screening, and collective behavior	
6	**Credit Value**	**4 Credits**	***Credit = 15 Hours - learning & Observation***
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Maxwell Equations:** Review of Maxwell's equations. Vector and Scalar Potentials. Maxwell's equations in terms of scalar and vector potentials. Concept of Gauge. Gauge Transformations: Lorentz and Coulomb Gauge; four-vectors, mathematical properties of space-time in special relativity; matrix representation of Lorentz transformation; Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density and Momentum Density. Radiation Pressure. **Radiation by moving charges:** Lienard-Wiechert potential and fields for a point charge; total power radiated by an accelerated charge- Larmor's formula and its relativistic generalization	15
II	**EM Wave Propagation in Unbounded :** Transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, skin depth.Propagation of E.M. Waves in Anisotropic Dielectrics. **EM Wave in Bounded Media:** Boundary Conditions at Interface between two Media.Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection& Refraction. Brewster's law. Total internal reflection, Metallic reflection (normal Incidence)	15
III	**Polarization of Electromagnetic Waves:** Description of Linear, Circular and Elliptical Polarization. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extra – ordinary refractive indices. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Optical Rotation. Fresnel's Theory of optical rotation. Specific rotation. Laurent's half-shadepolarimeter	15
IV	**Plasma:** Definition, Debye Shielding phenomena and criteria for plasma, motion of charged particles in electromagnetic field, Uniform E and B fields, electric field drift, non-uniform magneto-static field, Gradient B drift, parallel acceleration and magnetic mirror effect, Elementary concepts of plasma kinetic theory, the Boltzmann equation, the basic plasma phenomena, plasma oscillations; Fundamental equations of magneto - hydrodynamics (MHD); Plasma confinement schemes	15
Keywords	*Maxwell Equations,scalar and vector potentials, Lienard-Wiechert potential, EM wave propagation, Polarization, Debye Shielding phenomena, magnetohydrodynamics*	

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Electromagnetic Theory, Chopra & Agrawal, K. Nath Publishing
5. Classical Electrodynamics J. D. Jackson, Wiley

Reference Books Recommended –

1. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
2. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press
3. Plasma Physics, Bittencourt
4. Plasma Physics, Chen

Online Resources– e-Resources / e-books and e-learning portals

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics textbook in PDF https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. Cambridge University Books for Physics https://www.cambridgeindia.org/
4. Books for solving physics problems https://bookboon.com/en/physics-ebooks
5. NPTEL Online courses: https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. https://archive.nptel.ac.in/courses/115/104/115104088/
7. Classical Electromagnetism - 1 (Electrostatics) https://bsc.hcverma.in/course/cee1
8. Plasma Physics and Applicationshttps://onlinecourses.nptel.ac.in/noc24_ph20/preview

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment(CIA):	**30 Marks**
End Semester Exam(ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 &20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**	

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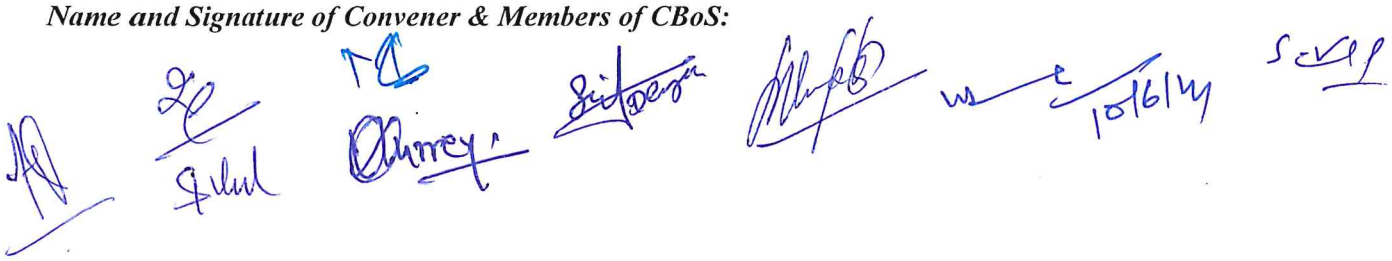

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION

Program : Bachelor in Science *(Honors/Honors with Research)*	Semester - VII	Session: 2024-2025

1	Course Code	PHSE- 07 T	
2	Course Title	DIGITAL ELECTRONICS	
3	Course Type	Discipline Specific Elective	
4	Pre-requisite (if, any)	*As per Program*	
5	Course Learning. Outcomes (CLO)	➢ *Understand basics of logic gates, Boolean algebra, and simplifying complex Boolean functions.* ➢ *Learn about combinational circuits, logic families, and digital ICs.* ➢ *Understand the working of flip-flops and thus memory* ➢ *Capable to know the various sequential circuits an Ads & DAs*	
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Number system:** Decimal, Binary, Octal and Hexadecimal Number System with mutual conversion, Mathematics of number systems (addition, subtraction, multiplication and division), 1's and 2's compliments, addition and subtraction using 1's and 2's compliments. **Binary Codes:** Binary Coded Decimal (BCD), its addition and subtraction, Excess –3 code, its addition and subtraction, Gray code, binary to gray code and gray code to binary code conversion. **Logic gates:** Positive and negative logic, Basic gates, Universal building block. Basic laws of Boolean Algebra, De-Morgan's Theorem	12
II	**Simplification of Boolean Functions:** Simplification of Boolean functions through Boolean laws, Realization through logic gates, Minterms and Maxterms, Two, Three and Four variable Karnough Map (K-Map), and minimization of SOP and POS expressions. **Combinational Logic Circuits:** Half-adder, Full-adder, Binary serial and parallel adders, Half Subtractor, Full Subtractor. Multiplexers (2:1, 4:1 and 16:1), Demultiplexer (1:2, 1:4 and 1:16), Encoders (Octal to Binary encoder, Decimal to BCD), Binary decoders BCD to Decimal, BCD to Seven Segment)	11
III	**Digital logic Families:** Introduction, Basic concepts of RTL, DTL, TTL, ECL and CMOS logic families and their characteristics (Fan-in, Fan-out, Supply voltage range, Power dissipation, Input/ Output logic levels, Noise margin, Speed of operation) **Flip-flop and timing diagram:** RS flip-flop, R-S flip-flop using NOR gate, RS flip-flop using NAND gate, Clocked RS flip-flop, D- latch flip-flop, Flip-flop with Preset and Clearinputs, JK flip-flop, Positive and negative edge triggered flop-flops., JK Master Slave flip-flop	11
IV	**Sequential Circuits: Counters:** Synchronous and Asynchronous counters: Binary ripple counter, up counter, down counter, up-down counter and ring counter with their time diagrams. **Registers:** Shift Register, PIPO, SIPO, PISO, SISO and Bi-directional shift Register, Application of shift register (Serial Adder, Sequence generator) **Digital to analog converter and Analog to Digital converters:** D/A converters using binary weighted resistor network and R-2R ladder Network; Counter type A/D converter, applications of DACs and ADCs	11

Keywords	Number System, Logic gates, Codes, Digital Logic Families, Flip flops, Registers, counters

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended–

1. Digital Design by M. Morris Mano and Michael D. Ciletti
2. Modern Digital Electronics by R.P. Jain
3. Digital Electronics: Principles, Devices and Applications by Anil K. Maini

Reference Books Recommended–

1. Digital and Analogue Technique- Navneet Gokhale and Kale, Kitab Mahal
2. Digital Electronics and Micro-Computers- R K Gaur, Dhanpat Rai Publications
3. Digital electronics- D K Kaushik, Dhanpat Rai Publication Company
4. Digital Electronics: Principles, Devices and Applications- A K Maini, John Wiley & Sons Ltd.
5. Digital Principles and applications – Malvino and Leach, Tata McGraw Hills, New Delhi
6. Hand Book of Electronics – Gupta and Kumar, Pragati Prakashan, Meerut
7. Digital integrated Electronics _ Taub and Schilling, McGraw International Edition
8. Fundamentals of Digital Circuits – A.Anand Kumar, Prentice Hall of India, New Delhi
9. Modern Digital Electronics- R P Jain, Tata McGraw Hill Publication, New Delhi

Online Resources–

e-Resources / e-books and e-learning portals

1. https://www.freebookcentre.net/Electronics/Digital-CircuitsBooks.html#google_vignette
2. https://www.researchgate.net/profile/Dk Kaushik/publication/264005171_Digital_Electronics/links/53fca84a0cf2364ccc04b6dd/Digital-Electronics.pdf
3. https://www.freebookcentre.net/electronics-ebooks-download/Digital-Electronics-Notes.html
4. https://www.academia.edu/40001993/Digital_Electronics
5. https://www.technicalbookspdf.com/electronic-engineering/digital-electronics/
6. https://www.tutorialspoint.com/digital_circuits/digital_circuits_multiplexers.htm
7. https://www.electronics-tutorials.ws/combination/comb_3.html
8. https://www.youtube.com/watch?v=Eb56gaw6JrQ
9. https://www.tutorialspoint.com/computer_logical_organization/digital_counters.htm
10. https://www.youtube.com/watch?v=bAQfPQqKCHs
11. https://www.youtube.com/watch?v=K2wPxfiggAU

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam(ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**20 +20**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall b considered against **30** Marks
	Assignment / Seminar -	**10**	
	Total Marks -	**30**	
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**		

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program : Bachelor in Science *(Honors/Honors with Research)*		**Semester - VII**	Session: 2024-2025
1	**Course Code**	**PHSE- 07 P**	
2	**Course Title**	**DIGITAL ELECTRONICS**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if,any)	**As per Program**	
5	**Course Learning. Outcomes(CLO)**	**After completion of this course a student will be able to-** ➢ Understand the working of logic gates and realization of Functions ➢ Clarify the concept of combinational logic circuits ➢ Understand the differences between MUX, DMUX, Encoder and Decoder and their uses ➢ Familiar with basic memory elements (Flip-flop) ➢ Understand the concept of counters and shift registers, Able to use D/A and A/D convertors.	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE

Total No. of learning-Training/performance Periods:30 Periods (30 Hours)

Module	Topics (Course Contents) At least 10 of the following or related Experiments	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. To study and verify the truth-tables of various logic gates 2. To study the Binary to Gray and Gray to Binary conversion 3. To verify the Boolean Laws with the help of logic gates 4. To realize Half Adder and Full Adder 5. To realize Half and Full subtractor 6. To verify the working and truth table of a Multiplexer 7. To verify the working and truth table of a Demultiplexer 8. To study the Decimal to BCD Encoder 9. To study the BCD to Seven Segment Decoder 10. To verify the truth table of (i) R-S flip-flop, (ii) Data latch and (iii) Edg triggered flip-flop 11. To verify the truth table of (i) J-K flip-flop, (ii) J-K Master-Slave flip-flop an (iii) T flip-flop 12. To understand the working of Ripple counter and verify its truth table 13. To understand the working of Up-Down counter and verify its truth table 14. To understand the working of Left/Right Shift Register and verify its truth table 15. To understand the working of SIPO/ PIPO Shift Register and verify its trut table 16. To understand the working of Sequence generator 17. To study the R-2R ladder Digital to Analog convertor 18. To study Counter type Analog to Digital convertor	**30**
Keywords	***Logic gates, Boolean algebra, Adders, Multiplexer, Flip-flop, Counter, Shift register. Convertors.***	

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PART–C:LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Digital Electronics: Theory and Practical- Virendra Kumar, New Age International Publications
2. Digital Electronics – A Comprehensive Lab Manual- Cherry Bhargava, B S Publication
3. Digital electronics experiment manual- Toger Tokheim, McGraw Hill
4. Handbook of Experiments in Electronics and Communication- B Sasikala & S P Rao, Vikas Publishing
5. Practical Digital Electronics Manual- Nigel P Cook, Prentice Hall

Reference Books Recommended–

1. Digital Design by M. Morris Mano and Michael D. Ciletti
2. Fundamentals of Digital Circuits by A. Anand Kumar
3. Digital Electronics: Principles and Integrated Circuits" by Anil K. Maini
4. Digital Fundamentals by Thomas L. Floyd
5. Modern Digital Electronics by R. P. Jain
6. Digital Logic Design by B. Somanathan Nair

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. https://nationallibraryopac.nvli.in/cgi-bin/koha/opac-detail.pl?biblionumber=15445&query_desc=Provider%3ANew%20Age%20International%2
2. https://books.google.com/books/about/Digital_Electronics.html?id=b7WwzQEACAAJ
3. https://ssit.edu.in/dept/assignment/declabmanual.pdf

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2):	**10 & 10**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
	Assignment/Seminar +Attendance-	**05**	
	Total Marks -	**15**	
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		**Managed by Course teacher as per lab. status**

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DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program : Bachelor in Science *(Honors/Honors with Research)*		**Semester -VII**	Session: 2024-2025
1	**Course Code**	**PHSE- 08 T**	
2	**Course Title**	**Operational Amplifier & Its Applications**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	***As per Program***	
5	**Course Learning. Outcomes (CLO)**	**After completion of the course students will be able to –** ➢ The Idea and concepts of differential amplifier ➢ Basic concepts of Ideal operational amplifier and Practical operational amplifier with its electrical parameters ➢ Gain the knowledge of op-amp with feedback and its effect on different parameters ➢ Understand the concept of various oscillators and their applications ➢ Know the uses of Timer circuits and their applications	
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Differential amplifier:** Basic idea of direct coupled amplifier and its drawbacks, Circuit configurations of Differential amplifier, need for dual power supply, Basics of different configurations, dual input-balanced output differential amplifier, Its DC analysis and AC analysis. Inverting and Non-Inverting inputs, CMRR, need for constant current bias level transistor circuit Level translator	11
II	**Operational Amplifier:** Introduction, Block diagram, Functions of each block, Electrical parameters, Ideal op-amp, it's characteristics and equivalent circuit, **Open-loop configurations:** Differential, Inverting and Non-inverting amplifiers, **Op-Amp with negative feedback:** Block diagrams of feedback configurations, Voltage series feedback and its effect on Input resistance, Output resistance, Bandwidth, Total output offset voltage. Voltage follower, Voltage shunt feedback, Inverting input terminal at virtual ground, its effect on Input resistance, Output resistance, Bandwidth, Total output offset voltage	12
III	**Practical Op-Amp:** Input offset voltage, Input bias current, Input offset current, Total output offset voltage, Thermal drift, Error voltage, Common mode configuration and CMMR, **Linear Applications:** Summing, Scaling and Averaging amplifiers, Basics of Instrumentation amplifier, Instrumentation amplifier using Transducer bridge, Its uses, Voltage to current converter, Theory of Integrator and Differentiator	11
IV	**Active Filters Using Op-Amp:** Idea of active filters and their classification, First order and Second order low-pass Butterworth filter **Op-Amp Oscillators:** Oscillator block diagram and condition for sustained oscillations, Phase Shift oscillator, Wien Bridge oscillator and calculation for their frequency of oscillations. Square-wave generator, Triangular wave generator. **The 555 Timer:** Block diagram of 555, The 555 as a Monostable Multivibrator, Its use as pulse stretcher, 555 as a Stable Multivibrator, Its use as Square-wave oscillator	11
Keywords	***Differential Amplifier, Operational Amplifier, Configuration, Feedback, Practical op-amp, Integrator, differentiator, Filters, Oscillators.***	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Op-amps and Linear Integrated Circuits- Ramakant A Gayakwad, Prentice Hall, India
2. Op-amps and Linear Integrated Circuits- R F Coughlin & F F Driscoll, Prentice Hall, India
3. Op- Amp and Linear Integrated circuits: K. Lal. Kishore, Pearson Education, Delhi
4. Op- Amp with Linear Integrated circuits: William D. Stanly, Pearson Education, Delhi
5. Linear Integrated circuits: D. Roy Choudhury and Shail B. Jain, New Age International Publications, New Delhi.
6. Op- Amp and Linear Integrated circuits: concept and applications- James N Flore, Cengage Learning India Pvt. Ltd

Reference Books Recommended–

1. Microelectronic Circuits by Adel S. Sedra and Kenneth C. Smith
2. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky
3. Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Driscoll
4. Design with Operational Amplifiers and Analog Integrated Circuits by Sergio Franco
5. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad
6. Operational Amplifiers with Linear Integrated Circuits" by William D. Stanley**
7. Analog Filter Design" by M.E. Van Valkenburg\

Online Resources–

e-Resources / e-books and e-learning portals

1. https://www.reddit.com/r/AskElectronics/comments/aevtj1/looking_for_some_books_to_learn_about_opamps/
2. https://open.umn.edu/opentextbooks/textbooks/574
3. https://community.element14.com/learn/publications/ebooks/w/documents/27823/a-quick-beginner-s-introduction-to-op-amps---ebook
4. https://www.analog.com/en/resources/technical-books/op-amp-applications-handbook.html
5. https://mgcub.ac.in/pdf/material/202004041708263c4d2b87a6.pdf
6. https://mrcet.com/downloads/digital_notes/ECE/III%20Year/10082021/LINEAR%20&%20DIGITAL%20IC.pdf
7. https://alan.ece.gatech.edu/ECE3040/Lectures/Lecture28-Operational%20Amplifier.pdf

PART -D:ASSESSMENT ANDEVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**
Continuous Internal Assessment (CIA): **30 Marks**
End Semester Exam (ESE): **70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program: Bachelor in Science *(Honors/ Honors with Research)*		**Semester - VII**	Session: 2024-2025
1	**Course Code**	**PHSE- 08 P**	
2	**Course Title**	**Operational Amplifier & Its Applications**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite (if, any)**	**As per Program**	
5	**Course Learning. Outcomes(CLO)**	**After completion of this course a student will be able to-** ➢ Understand the working of differential amplifier and its inverting and non-inverting configurations. ➢ Know the importance of negative feedback ➢ Know the uses of op-amp IC. Understand the idea of Oscillators ➢ Understand the working of active filters ➢ Have the idea about Multivibrators	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max.Marks:50**	**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE		
Total No. of learning-Training/performance Periods - Periods (30 Hours)		
Module	**Topics(Course Contents)** **At least 10 of the following or related Experiments**	**No. of Period**
Lab./ Experiment Contents of Course	1. To study the differential amplifier and to find the voltage gain 2. To study Inverting and Non-Inverting op-amp 3. To study Voltage series feedback and its effect on Input resistance, Output resistance using op-amp 4. To study Summing op-amp (IC741) and verify their theoretical and practical output 5. To study Subtractor op-amp (IC741) and verify their theoretical and practical output 6. To study Scaling op-amp (IC741) and verify their theoretical and practical output 7. To study the operation of the Integrator & differentiator using op-amp and trace the output wave forms for sine and square wave inputs 8. To study the operation of RC phase shift oscillators using op-amp and trace the output wave forms 9. To study the operation of Wien bridge oscillators using op-amp and trace the output wave forms 10. To study the First order low-pass Butterworth filter 11. To study the Second order low-pass Butterworth filter 12. To study the function of Square wave generator and trace the expected wave form 13. To study the function of Triangular wave generator and trace the expected wave form 14. To use 555 timer as Monostable multivibrator and trace the expected wave form 15. To use 555 timer as Astable multivibrator and trace the expected wave form	**30**
Keywords	Differential amplifier, Feedback, Op-amp, Integrator, Differentiator, Oscillator, Waveforms, Filters, Multivibrators.	

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PART–C:LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Handbook of operational amplifier applications- Bruce Carter and Thomas R. Brown, Texas Instruments
2. Operational Amplifier: Theory and Experiments- Shrikrishna Yawale & Sangita Yawale, Springer
3. Op-Amps for Everyone- Ron Mancini, Texas Instruments

Reference Books Recommended–

1. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad
2. Design with Operational Amplifiers and Analog Integrated Circuits by Sergio Franco
3. Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Driscoll
4. Op Amps for Everyone by Ron Mancini
5. Op Amp Applications Handbook by Analog Devices Inc.
6. Practical Electronics for Inventors by Paul Scherz and Simon Monk
7. Electronic Devices and Circuits by David A. Bell
8. Electronic Principles by Albert Malvino and David J. Bates

Online Resources–

e-Resources / e-books and e-learning portals

1. https://www.scribd.com/document/370796028/Op-Amp-Lab-Manual
2. https://gnindia.dronacharya.info/ECE/Downloads/Labmanuals/EC_%20LAB_(EEC-451)_IVSem_18012013.pdf
3. https://www.researchgate.net/publication/282055366_7_Lab_Experiments_with_Op-amp_A_manual_for_undergrad_students_teaching_staff
4. https://www.utdallas.edu/~rmh072000/EE3101/exp5.pdf
5. https://www.csun.edu/sites/default/files/ECE340%20Lab%20Manual.pdf
6. https://link.springer.com/book/10.1007/978-981-16-4185-5

PART-D:ASSESSMENT ANDEVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**10 & 10**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
	Assignment/Seminar +Attendance-	**05**	
	otal Marks -	**15**	
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		**Managed by Course teacher as per lab. status**

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSE- 09 T**	
2	**Course Title**	**Solid State Physics**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite (if, any)**	***As per Program***	
5	**Course Learning. Outcomes (CLO)**	By course end, students will master: ➢ Energy band concept in solids, including energy gap analysis. ➢ Bloch function, Kronig-Penny model application for electron description. ➢ Hall effect in semiconductors, Fermi-Dirac distribution temperature impact, and free electron gas behavior in 3D. ➢ Zone schemes exploration, Fermi surface construction, and understanding of nearly free electrons, holes, and open orbits.	
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Electrical Properties of solid** Free electron model; Solution of one-dimensional Schrodinger equation in a constant potential; density of states; Fermi energy; Energy bands and origin of energy gap and its magnitude, Bloch function, Kronig-Penny model, Wave equation of electron in periodic potential, crystal moment of an electron, Hall effect **Magnetic properties of solids** Dia, para and ferromagnetism; Langevin's theory of dia and paramagnetism, Curie-Weiss law	11
II	Effect of temperature on F-D distribution, free electron gas in three dimensions. Different zone schemes, reduced and periodic zones, construction of Fermi surfaces, nearly free electrons, electron, hole, open orbits, Calculation of energy bands, Tight binding, Wigner-Seitz, cohesive energy, pseudo potential methods. Experimental methods in Fermi surface studies, quantization of orbits in a magnetic field, de Haas van Alphen Effect, External orbits, Fermi surface of copper	11
III	Lattice dynamics in monoatomic and diatomic lattice: two atoms per primitive basis, optical and acoustic modes, quantization of elastic waves, phonon momentum, inelastic neutron scattering by phonons, Anharmonic crystal interactions-thermal expansion, thermal conductivity, thermal resistivity of phonon gas, umklapp processes, imperfections	11
IV	**Superconductivity** Experimental survey: occurrence of superconductivity, Destruction of superconductivity by magnetic field, Meissner effect, heat capacity, energy gap, MW, and IR properties, isotope effect. Theoretical survey: thermodynamics of superconducting transition, London equation, Coherence length, Cooper pairing due to phonons, BCS theory of superconductivity, BCS ground state, flux quantization of superconducting ring, duration of persistent currents, Type II superconductors, Vortex states, estimation of Hc1 and Hc2, single particle and Josephson superconductor tunneling, DC/AC Josephson effect, Macroscopic quantum interference. High-temperature superconductors, critical fields and currents	12
Keywords	*Free electron model, Kronig Penny Model, Hall effect, Zone schemes, fermi surfaces, optical and acoustic modes, Superconductivity, BCS theory*	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Solid State Physics by Neil W. Ashcroft and N. David Mermin
2. Introduction to Solid State Physic by Charles Kittel
3. Solid State Physics by J. S. Blakemore
4. Quantum Theory of Solids by Charles Kittel
5. Introduction to Superconductivity by Michael Tinkham

Reference Books Recommended–

1. Principles of the Theory of Solids by J. M. Ziman
2. Electronic Properties of Materials by Rolf E. Hummel
3. Solid State Physics: An Introduction by Philip Hofmann
4. Lattice Dynamics by A. A. Maradudin
5. Superconductivity, Second Edition by J. B. Ketterson and S. N. Song
6. Fundamentals of Superconductivity by John Robert Schrieffer
7. The Physics of Solids by Richard Turton
8. Solid State Physics: Structure and Properties of Materials by M. A. Wahab

Online Resources–

e-Resources / e-books and e-learning portals

1. Condensed Matter Physics https://archive.nptel.ac.in/courses/115/106/115106061/
2. Advanced Condensed Matter Physicshttps://archive.nptel.ac.in/courses/115/103/115103102/
3. Introduction to condensed matter physics https://homepages.iitb.ac.in/~kdasgupta/pdf/PH409[Aug2013].pdf
4. Introduction to solid state physics https://archive.nptel.ac.in/courses/115/104/115104109/

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment(CIA):	**30 Marks**
EndSemester Exam(ESE):	**70 Marks**

Continuous Internal Assessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): Assignment / Seminar - Total Marks -	**20 +20** **10** **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**		

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program: Bachelor in Science *(Honors/ Honors with Research)*		**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSC-09 P**	
2	**Course Title**	**Solid State Physics**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite (if, any)**	**As per Program**	
5	**Course Learning. Outcomes(CLO)**	After the completion of the course, the Students are expected to : ➢ Analyse recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to theory of semiconductors. ➢ Apply theory and principle of semiconductors for various device applications ➢ Various electronics experiments and some advanced experiments in Physics	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max. Marks:50**	**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE		
Total No. of learning-Training/performancePeriods:30 Periods (30 Hours)		
Module	**Topics(Course Contents)** **At least 10 of the following or related Experiments**	**No. of Period**
Lab./ Experiment Contents of Course	1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method) 2. To measure the Magnetic susceptibility of Solids 3. To determine the Coupling Coefficient of a Piezoelectric crystal 4. To measure the Dielectric Constant of a dielectric Materials with frequency 5. To study the PE Hysteresis loop of a Ferroelectric Crystal 6. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis 7. Determination of ionization potential of Lithium/Mercury 8. To study I-V characteristics of photovoltaic solar cell and its efficiency 9. Study of optoelectronic devices and verification of inverse square law 10. Determination of 'h' Planck's constant by Photoelectric effect 11. Determination of 'e/m' by Thomson method 12. Determination of Ionization Potential using Thyratron valve 13. Study of absorption coefficient of KMnO4	**30**
Keywords	*Magnetic susceptibility, Dielectric constant, PE hysteresis loop, BH curve, Resistivity, Hall coefficient, Ionization potential, Planck's constant*	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books:

1. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
3. Practical Physics B.Sc III : R P Goyal, Shivlal Agrawal Publications
4. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd.,
5. London, 1962.
6. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015.
7. Indu Prakash: Practical Physics
8. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014

Reference Books:

1. Experimental Methods for Engineers by J.P. Holman
2. Semiconductor Physics and Devices by Donald A. Neamen
3. Optoelectronics and Photonics: Principles and Practices by Safa O. Kasap
4. Piezoelectricity: Evolution and Future of a Technology by Walter Heywang, Karl Lubitz, and Wolfram Wersing

Online Resources–
e-Resources / e-books and e-learning portals

1. Link for e-Books for Physics: Physics Practical:
   https://www.iiserkol.ac.in/~ph324/experiment_list.html
2. Virtual Lab :https://vlab.amrita.edu/?sub=1&brch=282
3. https://vlab.amrita.edu/index.php?sub=1&brch=282&sim=370&cnt=3
4. https://bop-iitk.vlabs.ac.in/exp/energy-band-gap/simulation.html
5. http://vlabs.iitkgp.ac.in/ssd/index.html#
6. http://vlabs.iitkgp.ac.in/psac/newlabs2020/ssds/#
7. https://ae-iitr.vlabs.ac.in/List%20of%20experiments.html
8. https://da-iitb.vlabs.ac.in/List%20of%20experiments.html
9. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**10 &10**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
	Assignment/Seminar +Attendance-	**05**	
	Total Marks -	**15**	
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment**		**Managed by Course teacher as per lab. status**
	A. Performed the Task based on lab. work	**- 20 Marks**	
	B. Spotting based on tools& technology (written) –	**10 Marks**	
	C. Viva-voce (based on principle/technology) -	**05 Marks**	

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DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION				
Program:Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSE- 10**		
2	**Course Title**	**Atomic and Molecular Physics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	**As per Program**		
5	**Course Learning. Outcomes (CLO)**	➢ Explain Vector atom model and use it for analyzing hydrogen spectra. ➢ Analyze various spectra and check for possibility of a given transition ➢ Explain and Apply Raman's effect and spectroscopy for various application. ➢ Appreciate the extraordinary characteristic of lasers and differentiate it from an ordinary light. ➢ Explore more about scientific contribution of Sir C V Raman		
6	**Credit Value**	**4 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course contents)	No. of Period
I	Vector atom model, quantum numbers associated with vector atom model, Spectra of hydrogen, deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules, singlet, triplet fine structure in alkaline earth spectra, L-S and J-J coupling	**15**
II	Different types of Spectra, Discrete set of electronic energies of molecules, quantization of vibrational energies, determination of inter-nuclear distance, Transition rules for vibration and electronic vibration spectra. Pure rotational and rotation vibration spectra, Quantization of States Dissociation limit for the ground and other electronic states, transition rules for pure rotation and electronic- rotation Spectra	**15**
III	Raman effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. Application of Raman Spectroscopy, Resonance Spectroscopy, X-Rays, Production of X-rays, X-ray spectra, Mosley's law, X-Ray Spectroscopy,	**15**
IV	Atom Radiation interactions: Semi-classical description of radiation. Absorption, spontaneous and stimulated emissions, Einstein's A and B coefficients, Coherent and Incoherent emissions, LASERs and MASERs, Line widths, various types of line broadening, two-level atoms in a radiation field	**15**

Keywords	Vector atom model, hydrogen spectra, electronic transitions, vibrational spectra, rotational spectra, Raman effect

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Atomic Physics by J.B. Rajam
2. Molecular Spectroscopy by Ira N. Levine
3. Fundamentals of Molecular Spectroscopy by C.N. Banwell and E.M. McCash
4. Lasers: Theory and Applications by K. Thyagarajan and A.K. Ghatak
5. Spectroscopy by B.P. Straughan and S. Walker
6. Modern Spectroscopy by J. Michael Hollas.

Reference Books Recommended –

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A.Dubson,2009, PHI Learning
3. Modern Physics, R.A. Serway, C.J. Moses, and C. A. Moyer, 2005, Cengage Learning
4. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

Online Resources– e-Resources / e-books and e-learning portals

1. https://archive.nptel.ac.in/courses/115/105/115105100/
2. https://archive.nptel.ac.in/courses/115/101/115101003/#

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**
Continuous Internal Assessment(CIA): **30 Marks**
EndSemester Exam(ESE): **70 Marks**

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 & 20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**	

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DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION				
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester - VIII**		Session: 2024-2025
1	**Course Code**	**PHSE-11**		
2	**Course Title**	**Statistical Mechanics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	At the end of this course, the students will be able to: ➢ Explain the connection between statistics and thermodynamics. Define the phase space of the classical system. ➢ Define three different types of Ensembles and discuss corresponding theories. Define partition functions for different canonical systems. ➢ Explain energy, energy-density fluctuations, and correspondence of various ensembles. Explain statistics of different quantum mechanical ensembles. ➢ Discuss Bose-Einstein (BE) Condensate w.r.t. liquid Helium II, Define and discuss electron gas behavior w.r.t. Fermi Dirac Statistics ➢ Discuss Virial expansion of the equation of state. Discuss Brownian motion and Einstein and Smoluchowski theory		
6	**Credit Value**	**4 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Foundation of Statistical Mechanics** Macroscopic and microscopic states, contact between statistics and thermodynamics, physical significance of Ω (N,V, E), the classical gas, entropy of mixing and Gibb's paradox, phase space of classical system, Liouville`s theorem and its consequences, quantum states and phase space.	15
II	**Elements of ensemble theory** A system in microcanonical, canonical, and grand canonical ensembles, partition functions, physical significance of statistical quantities, example of classical system, energy and energy-density Fluctuations and mutual correspondence of various ensembles	15
III	**Formulation of quantum statistics** Quantum mechanical ensemble theory, density matrix, statistics of various quantum mechanical ensembles, system composed of indistinguishable particles. Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac distributions Thermodynamic behavior of an ideal Bose gas, Bose-Einstein condensation and, elementary excitations in liquid helium II, Thermodynamic behavior of an ideal Fermi gas, the electron gas, non-relativistic and relativistic degenerate electron gas, theory of white dwarf stars.	15
IV	**Statistical Mechanics of interacting systems** The method of cluster expansion for a classical gas, Virial expansion of the equation of state. Theory of phase transition – general remark on the problem of condensation, Fluctuations: thermodynamic fluctuations, Spatial correlation in a fluid Brownian motion: Einstein Smoluchowski's theory of Brownian motion	15
Keywords	*Macro and microstates, ensembles, phase space, partition function, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics, Fluctuations, Brownian motion*	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Reference Books Recommended –

1. L. D. Landau & E. M. Lifshitz (Butter worth and Heinemann Press).
2. Federick Reif, Fundamental of statistical and thermal physics (McGraw-Hill publishers)
3. Kerson Huang, Statistical Mechanics (Wiley Eastern)
4. Charles Kittel, Elemental Statistical Physics

Text Books Recommended –

1. Brij Lal, N. Subrahmanyam, P S Hemne; Heat and Thermodynamics and Statistical Physics
2. R. K. Pathria, Statistical Mechanics (Pergamon Press)
3. Statistical and Thermal Physics an introduction; Michael J R Hoch

Online Resources– e-Resources / e-books and e-learning portals

1. Statistical Mechanicshttps://archive.nptel.ac.in/courses/115/106/115106126/
2. Introduction to Statistical Mechanics https://archive.nptel.ac.in/courses/115/103/115103113/
3. Statistical Mechanics https://archive.nptel.ac.in/courses/115/106/115106111/
4. Statistical mechanics http://www.digimat.in/nptel/courses/video/115106126/L01.html

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment(CIA):	**30 Marks**
EndSemester Exam(ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2):	**20 & 20**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
	Assignment / Seminar -	**10**	
	Total Marks -	**30**	

End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**

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DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program : Bachelor in Science *(Honors/Honors with Research)*		**Semester -VIII**	Session: 2024-2025
1	**Course Code**	**PHSE-12 T**	
2	**Course Title**	**Microprocessor**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	***As per program***	
5	**Course Learning. Outcomes (CLO)**	**After completion of this course a student will be able to-** ➢ *Understand the basics of digital computer, Clarify the concept of memories used in computer system* ➢ *Familiar with buses and registers available in microprocessor* ➢ *Understand the addressing modes, data transfer group, arithmetic group, logical group etc.Know about Assembly Language, High-Level and Area of applications of various languages* ➢ *Able to use Assembly Language for programming of microprocessor*	
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Digital Computer:** Generation of computer, Digital Computer, Its basic components: Input and output devices, Central Processing Unit (CPU) and its organization, **Primary memory:** Introduction, Types of Primary memory - RAM, SDRAM, SGRAM, DDR SDRAM, SIMM, DIMM, ROM, PROM, EPROM, EEPROM, **Secondary memory:** Construction and working principles of Hard Disc, Floppy Disc, Optical Disc, Magnetic Bubble Memory. Cache memory, Real and Virtual Memory. Memory hierarchy	11
II	**Microprocessor:** Introduction and evaluation, Architecture and functional organization of Intel 8085, ALU, Timing and Control unit, **Buses:** Address Bus, Data Bus and Control Bus. Bus architecture: PCI, ISA, USB and AGP. **Registers:** ACC, General purpose register, Stack pointer, Program counter, Instruction register, Temporary register. Processing speed of processor, Types of processors (Basic Idea), Opcode and Operand, Pin Diagram and Pin Configuration of 8085, Intel 8085 instructions, Instruction cycle, Timing diagram	12
III	**Instruction set of 8085:** Addressing modes, Data transfer group, Arithmetic group, Logical group, Branch group, Stack, I/O and Machine control group. **Programming of Microprocessor:** Assembly Language, High-Level languages. Advantages and Disadvantages of high-level languages, Area of applications of various languages, Stack, Subroutines, Modular programing, Structured programing	11
IV	**Assembly Language Programs:** Addition of two 8-bit number; sum 8-bit, Addition of Two 8-bit number; sum 16-bit, 8-bit subtraction, Shift an 8-bit/ 16-bit number left by 1-bit, Shift an 8-bit/ 16-bit number left by 2-bit,Find larger number of two numbers, Find the largest number in a data array, Find smaller number of two numbers, Find the smallest number in a data array, To arrange a series of numbers in Descending order, To arrange a data array in ascending order, 8-bit multiplication; product in 16-bit, 8-bit division	11
Keywords	***CPU, Memory, Microprocessor, Buses, Registers, Opcode, Instructions, Addressing mode, Assembly language, Programming.***	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. MicroprocessorArchitectureProgrammingandapplicationswith8085,R.S.Goankar,2002,PrenticeHall
2. Digital electronics and Microcomputers, R K Gaur, Dhanpat Rai Publications
3. Fundamentals of Microprocessors and Microcontrollers, B Ram, Dhanpat Rai Publications

Reference Books Recommended –

1. Introduction to microprocessor – Aditya Mathur, Tata McGraw Hills, New Delhi
2. Microprocessor8085: Architecture, Programming and interfacing, A.Wadhwa,2010,PHILearning
3. Microprocessors and Interfacing Devices, Rupender Singh & Sunita Jain, CBS Publications

Online Resources–

e-Resources / e-books and e-learning portals

1. https://www.freebookcentre.net/Electronics/MicroProcessors-Books.html
2. https://www.phindia.com/Books/ShoweBooks/MTMyNg/Microprocessors-Microcontrollers
3. https://books.google.co.in/books?id=P-n3kelycHQC&printsec=frontcover&redir_esc=y#v=onepage&q&f=false
4. https://www.youtube.com/watch?v=UjagUR2i_Ok
5. https://www.youtube.com/watch?v=dLGw66gKKkQ
6. https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
7. https://www.youtube.com/watch?v=hwwhsNOqqm8
8. https://www.youtube.com/watch?v=wUmi3roAqmk

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam(ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): Assignment / Seminar - Total Marks -	**20 +20** **10** **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**		

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FOUR YEAR UNDER GRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program : Bachelor in Science *(Honors/Honors with Research)*		**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSE-12 P**	
2	**Course Title**	**Microprocessors**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	**As per Program**	
5	**Course Learning. Outcomes(CLO)**	**After completion of this course a student will be able to-** ➢ *Understand the working of logic gates and realization of Functions* ➢ *Clarify the concept of combinational logic circuits* ➢ *Understand the differences between MUX, DMUX, Encoder and Decoder and their use* ➢ *Familiar with basic memory elements (Flip-flop)*	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max. Marks:50**	**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE

Total No. of learning-Training/performance Periods:30 Periods (30 Hours)

Module	Topics (Course Contents) At least 10 of the following or related Experiments	No. of Period
Lab./ Experiment Contents of Course	1. Write the program using 8085 Microprocessor for Addition and Subtraction of numbers using direct addressing mode 2. Write the program using 8085 Microprocessor for Addition and Subtraction of numbers using indirect addressing mode 3. Write the program using 8085 Microprocessor for Multiplication by repeated addition 4. Write the program using 8085 Microprocessor for Division by repeated subtraction 5. Write the program using 8085 Microprocessor for Handling of 16-bit Numbers 6. Write the program using 8085 Microprocessor to Use of CALL and RETURN Instruction 7. Write the program using 8085 Microprocessor to add two hexa decimal & decimal numbers 8. Write the program using8085Microprocessor to subtract two hexadecimal & decimal numbers 9. Write the program using 8085 Microprocessor for Addition of two 8-bit numbers 10. Writetheprogramusing8085Microprocessor for Addition of two 16-bit numbers 11. Write a program to perform multiplication of two 8-bit numbers using bit addition method 12. Write a program to perform multiplication of two 8-bit numbers using bit rotation method 13. Write a program to perform division of two 8-bit numbers using Repeated Subtraction method 14. Write a program for Finding the largest and smallest number from an array 15. Write a program for Find 1's & 2's complement of a 8 bit number 16. Write a program to Transfer Block of data bytes from one memory location to another 17. Any Similar programming	**30**
Keywords	***Microprocessor, Addressing mode, CALL, RETURN, Programming***	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Microprocessor Architecture, Programming, and Applications with the 8085 by Ramesh S. Gaonkar
2. Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096 by Krishna Kant
3. Fundamentals of Microprocessors and Microcontrollers by B. Ram
4. 8085 Microprocessor and its Applications by A. Nagoor Kani
5. The 8085 Microprocessor: Architecture, Programming and Interfacing by K. Udaya Kumar and B.S. Umashankar

Reference Books Recommended–

1. Digital Electronics: Theory and Practical- Virendra Kumar, New Age International Publications
2. Digital Electronics – A Comprehensive Lab Manual- Cherry Bhargava, B S Publication
3. Digital electronics experiment manual- Toger Tokheim, McGraw Hill
4. Handbook of Experiments in Electronics and Communication- B Sasikala & S P Rao, Vikas Publishing
5. Practical Digital Electronics Manual- Nigel P Cook, Prentice Hall

Online Resources–

e-Resources / e-books and e-learning portals

1. https://www.ssit.edu.in/dept/assignment/8085labmanual.pdf
2. https://gnindia.dronacharya.info/ECE/Downloads/Labmanuals/Microprocessor_Lab_Manual.pdf
3. https://people.iitism.ac.in/~download/lab%20manuals/ece/5.%20ECC211%20Microprocessor%20&%20Microcontroller%20Lab.pdf
4. https://www.technicalsymposium.com/microprocessor_lab.pdf
5. https://mjcollege.ac.in/images/labmannuals/MICROPROCESSORLABMANUALBIT281.pdf

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**10 & 10**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
	Assignment/Seminar +Attendance-	**05**	
	Total Marks -	**15**	
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		**Managed by Course teacher as per lab. status**

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION			
Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)		**Semester: I**	**Session: 2024-25**
1	**Course Code**	**PHGE-01 T**	
2	**Course Title**	**Mechanics**	
3	**Course Type**	**Generic Elective Course**	
4	**Pre-requisite (if any)**	**As per Program**	
5	**Course Learning Outcomes (CLO)**	*After going through the course, the student should be able to:* ➢ *Analyze and apply the laws of motion to various dynamical situations.* ➢ *Explain and demonstrate the principle of conservation of momentum and energy including their application in real-world scenario such as collision and energy transformation.* ➢ *Evaluate and calculate moment of inertia for objects of different shapes and analyze how these properties affect the motion of rotating bodies.* ➢ *Analyze flow of fluids.* ➢ *Describe special relativistic effects and their effects on the mass and energy of a moving object.*	
6	**Credit Value**	**03 Credits**	**1 Credit= 15 Hours for Learning & Observation**
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**

PART – B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Historical Background:** Contribution of Aryabhatta and Varahmihir to science and society, Brief biography of Vikram Sarabhai with his contribution. **Vectors:** Scalar and vector quantities &fields, Scalar & Vector products of two vectors, Derivatives of a vector, Gradient of scalar field and its physical significance. **Laws of Motion:** Review of Newton's Laws of motion, Dynamics of a system of particles, Concept of Center of Mass, Motion of center of mass, Conservation of linear momentum, Motion of Rocket. **Work and Energy:** Work-Energy theorem for conservative forces, Force as a gradient of Potential Energy, Conservation of energy, Elastic and in-elastic Collisions	12
II	**Rotational Dynamics**: Angular momentum, Torque, Conservation of angular momentum, Moment of Inertia, Theorem of parallel and perpendicular axes (statements only), Calculation of Moment of Inertia of discrete and continuous objects (Rectangular lamina, disc, solid cylinder, solid sphere). **Elasticity:** Stress & Strain, Hooke's law, Elastic constants, Poisson's Ratio, Relationship between various elastic modulii (without derivation), Work done in twisting a cylinder. **Fluid Dynamics**: Flow of fluids, Coefficient of viscosity, Derivation of Poiseulli's formula, Motion of a spherical body falling in a viscous fluid, Stoke's law, Expression for terminal velocity.	12
III	**Gravitation**: Newton's Law of Gravitation, Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant), Kepler's Laws (statements only), Satellite in circular orbit and applications, Geosynchronous orbits. **Oscillations**: Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Compound pendulum, Differential equations of damped oscillations and forced oscillations (Conceptual only).	11
IV	**Special Theory of Relativity:** Frame of reference, Galilean Transformations, Inertial and Non-inertial frames, Outcomes of Michelson Morley's Experiment, Postulates of Special Theory of Relativity, Lorentz Transformation, Length contraction, Time dilation, Relativistic transformation of velocity, Relativistic variation of mass, Mass-energy equivalence, Transformation of Energy and Momentum.	10

Keywords:	Aryabhatta, Vectors, Newton's Laws, Angular Momentum, Elasticity, Gravitation, Oscillations, Relativity

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PART – C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books Recommended-

1. Mechanics & Properties of matter, D.C. Tayal & P. Tayal, 2023, Pub. By Authors.
2. Unified Physics I –R. P. Goyal, Shivlal Agrawal Publication
3. Unified Physics I, Navbodh Publication

Reference Books Recommended-

1. Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
2. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
3. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

Online Resources (e-books/ learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics text book in PDF
3. https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
4. Cambridge University Books for Physics https://www.cambridgeindia.org/
5. Books for solving physics problems https://bookboon.com/en/physics-ebooks
6. NPTEL Online courses https://nptel.ac.in/courses/115105098; https://archive.nptel.ac.in/courses/115/106/115106123/;
7. BSc Lectures by Prof. H C Verma: https://bsc.hcverma.in/index.php/course/relativity; https://bsc.hcverma.in/index.php/course/cm1

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2):	**20 + 20**	Better marks out of the two Test / Quiz **+** marks obtained in Assignment shall be considered against **30 Marks**
	Assignment/ Seminar (1):	**10**	
	Total Marks:	**30**	
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 = 20 Marks** Section B: Descriptive answer type,**1 out of 2** from each unit-**4 x 10=40 Marks**		

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)	Semester: I	Session: 2024-25

1	Course Code	PHGE- 01 P	
2	Course Title	Mechanics	
3	Course Type	Generic Elective Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	After the completion of the course, Students are expected to understand working mechanism and laws of classical mechanics. The Students will be able to ➢ Assemble required parts/devices and arrange them to perform experiments. ➢ Record/ observe data as required by the experimental objectives. ➢ Analyze recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to laws of mechanics and its applications	
6	Credit Value	01 Credit	1 Credit = 30 Hours Laboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

Total No. of learning-Training/performance Periods- 30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Period
1	Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.	30
2	To study the random error in observations.	
3	To study the motion of the spring and calculate (a) Spring constant and, (b) g.	
4	To determine the Moment of Inertia of a Flywheel.	
5	To determine g and velocity for a freely falling body using Digital Timing Technique.	
6	To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).	
7	To determine the Young's Modulus of a Wire by Optical Lever Method.	
8	To determine the Modulus of Rigidity of a Wire by Maxwell's needle.	
9	To determine the elastic constants of a wire by Searle's method	
10	To determine the value of g using Bar Pendulum.	
11	To determine the value of g using Kater's Pendulum.	
12	Study of bending of a beam/ cantilever	
13	To determine Moment of Inertia of an irregular body by Inertia Table	
Keywords	Moment of Inertia, Pendulum, Vernier Callipers, Screw Gauge, Travelling microscope, Elastic Constant, Searle's Method, Stoke's Method, Cappilary Rise Method, Viscosity, Surface Tension	

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PART – C: Learning Resources

Text Books, Reference Books and others

Text Books Recommended-

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
2. Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. Practical Physics B.Sc. I : R P Goyal, Shivlal Publications

Reference Books Recommended-

1. Advanced Practical Physics for Students by B.L. Worsnop and H.T. Flint
2. Practical Physics by G.L. Squires
3. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements by John R. Taylor
4. Mechanics and Properties of Matter by J.C. Upadhyaya

Online Resources (e-books/ learning portals/ other e-resources)

1. Link for e-Books for Physics:Physics Practical:
   https://www.uou.ac.in/sites//default/files/slm/BSCPH-104.pdf
2. Virtual Lab :https://vlab.amrita.edu/?sub=1&brch=74
3. https://vlab.amrita.edu/?sub=1&brch=74&sim=571&cnt=1
4. https://www.ae.msstate.edu/vlsm/

PART – D : ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz - (2): **10 & 10** Assignment/Seminar +Attendance – **05** Total Marks - **15**	Better marks out of the two Test/Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work -20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

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DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)	Semester: II	Session: 2024-25

1	Course Code	PHGE-02 T	
2	Course Title	ELECTRICITY AND MAGNETISM	
3	Course Type	Generic Elective Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	After going through the course, the student should be able to: ➢ State various laws related with electrostatics, dielectric, electric current, magnetism and electromagnetic induction. ➢ Apply vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics. ➢ Compare rise and decay of current in LR, CR, LCR circuits. ➢ Apply Biot-Savart law for calculation of magnetic field in simple geographic situations. ➢ Derive and analyze Maxwell's equations.	
6	Credit Value	03 Credits	1 Credit= 15 Hours for Learning & Observation
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks: 40

PART – B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Power plants in Chhattisgarh:** An overview of thermal and hydroelectric power plants in Chhattisgarh. **Vector Analysis**: Divergence & Curl of Vector fields, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors and its application in electrostatics and magnetostatics. **Electrostatics field:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics, Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, plane charged sheet, charged conductor.	12
II	**Electrostatic potential:** Electric potential as line integral of electric field, potential due to a point charge, Calculation of electric field from potential, Capacitance of Parallel plate capacitor, Energy per unit volume in electrostatic field. **Dielectric & Electric Currents:** Dielectric medium, Polarisation, Displacement vector, Gauss's theorem in dielectrics, Parallel plate capacitor completely filled with dielectric. Steady current, current density J, non – steady current and Continuity equation, Rise and decay of current in LR, CR, LCR circuits.	13
III	**Magnetism:** Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law, Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, Brief introduction of dia, para and ferro-magnetic materials.	10
IV	**Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils, Energy stored in magnetic field. **Maxwell`s equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Wave equation in free space.	10

Keywords:	Vector calculus, Electrostatics, Dielectrics and Electric Current, Magnetism, Electromagnetic Induction, Maxwell's Equation and Electromagnetic Wave Propagation

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books

1. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
2. Unified Physics – Part II, R. P. Goyal, Shivlal Agrawal and Sons
3. Unified Physics – Navbodh Publications
4. Introduction to Electrodynamics and Electromagnetism, H. C. Verma,

Reference Books

1. Vector analysis – Schaum's Outline, M.R. Spiegel, S. Lipschutz, D. Spellman, 2nd Edn., 2009, McGraw- Hill Education.
2. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Online Resources (e-books/ learning portals/ other e-resources)

1. *All e-books of physics* https://www.e-booksdirectory.com/listing.php?category=2
2. *Free physics text book in PDF* https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. *Cambridge University Books for Physics* https://www.cambridgeindia.org/
4. *Books for solving physics problems* https://bookboon.com/en/physics-ebooks
5. *NPTEL Online courses:* https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. https://archive.nptel.ac.in/courses/115/104/115104088/
7. *Classical Electromagnetism - 1 (Electrostatics)* https://bsc.hcverma.in/course/cee1
8. *Classical Electromagnetism - 2 (Electrostatics)* https://bsc.hcverma.in/course/cee2

PART – D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**

Continuous Internal Assessment (CIA): **30 Marks**

End Semester Examination (ESE): **70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2):	**20 + 20**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
	Assignment/ Seminar (1):	**10**	
	Total Marks:	**30**	
End Semester Examination (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type,**1 out of 2** from each unit- **4 x 10=40 Marks**		

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DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)	Semester: II	Session: 2024-25

1	Course Code	**PHGE- 02 P**
2	Course Title	**Electricity & Magnetism**
3	Course Type	**Generic Elective Course**
4	Pre-requisite (if any)	**As per program**
5	Course Learning Outcomes (CLO)	*After the completion of the course, Students are expected to understand working laws of Electricity, Magnetism and EMWs. The students will also be able to* ➢ *Verify various circuit laws, network theorems, using simple electric circuits. Assemble required parts/devices and arrange them to perform experiments.* ➢ *Verify various laws in electricity and magnetism such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments* ➢ *Record/ observe data as required by the experimental objectives. Analyze recorded data and formulate it to get desired results.* ➢ *Interpret results and check for attainment of proposed objectives related to laws of Electricity, Magnetism and its applications*
6	Credit Value	**01 Credit** — **1 Credit = 30 Hours Laboratory Work**
7	Total Marks	**Maximum Marks: 50** — **Minimum Pass Marks: 20**

PART – B: CONTENT OF THE COURSE

Total No. of learning-Training/performance Periods - 30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Periods
1	To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages,(c) DC Current, and (d) checking electrical fuses.	30
2	To compare capacitances using De'Sauty's bridge.	
3	Measurement of field strength B and its variation in a Solenoid Determine (dB/dx).	
4	To study the Characteristics of a Series RC Circuit.	
5	To study a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor.	
6	To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.	
7	To determine a Low Resistance by Carey Foster's Bridge.	
8	To verify the Thevenin and Norton theorem.	
9	To verify the Superposition, and Maximum Power Transfer Theorem.	
10	To use a vibration magnetometer and study magnetic field.	
11	Study of magnetic field due to a current loop.	
12	Study of magnetic fields using Deflection Magnetometer	
13	Mini Project: Construction and Study of Solenoid and measurement of its magnetic field	

Keywords:	Multimeter, Capacitance Comparison, Magnetic Field, RC Circuit, Series LCR Circuit, Parallel LCR Circuit, Low Resistance Measurement, Electrical Theorems

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Engineering Practical Physics, S. Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Unified Practical Physics : R P Goyal, Shivlal Agrawal & Sons
4. Unified Practical Physics: Yugbodh Prakashan
5. Unified Practical Physics: Navbodh Prakashan

Reference Books Recommended-

1. Basic Electrical and Electronics Engineering by S. K. Bhattacharya
2. A Textbook of Electrical Technology by B.L. Theraja and A.K. Theraja (Volumes 1 and 2)
3. Engineering Circuit Analysis by William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin
4. Practical Physics by G.L. Squires

Online Resources (e-books/ learning portals/ other e-resources)

1. Link for e-Books for Physics: Physics Practical:
   https://www.uou.ac.in/sites//default/files/slm/BSCPH-104.pdf
2. Virtual Lab :https://vlab.amrita.edu/index.php?sub=1&brch=192
3. http://emv-au.vlabs.ac.in/#
4. https://www.ae.msstate.edu/vlsm/
5. https://nationalmaglab.org/magnet-academy/watch-play/interactive-tutorials
6. https://jigyasa-csir.in/cgcri/n12-t4-a3/

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam(ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance – **05** Total Marks - **15**	Better marks out of the two Test / Quiz **+ Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

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DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)	Semester: I/ III/ V	Session: 2024-25

1	Course Code	PHVAC-01	
2	Course Title	Renewable Energy and Energy Harvesting	
3	Course Type	Value Addition Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	Objective of the course is to impart students; the knowledge of renewable energy and they are expected to learn about: ➢ Energy crisis at national and international scenario. ➢ Renewable sources of energy and their importance. ➢ Availability of renewable energy resources in India. ➢ Knowledge about energy harvesting technology.	
6	Credit Value	02 Credits	1 Credit = 15 Hours- Learning & Observation
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 30 Periods (30 Hours)

Unit	Topics	No. of Period
I	**Fossil fuels and Alternate Sources of energy:** Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. Limitations of non-conventional energy resources. Environmental aspect of energy, World energy status, Energy scenario in India. **Geo thermal Energy**: Geothermal Resources, Geo thermal Technologies.	07
II	**Solar energy:** Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, sun tracking systems. **Hydro Energy**: Hydro power resources, hydro power technologies, environmental impact of hydro power sources.	08
III	**Biomass energy:** Biomass resources, Biomass conversion technology, biogas generation, factors affecting bio-digestion, working of biogas plant (with block diagram), biogas from plant waste, biomass energy programme in India, Biodiesel production from non-edible oil seeds. **Ocean Energy**: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.	08
IV	**Wind Energy harvesting**: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines. grid interconnection topologies. **Piezoelectric Energy harvesting:** Introduction, Physics and characteristics of piezoelectric effect, piezoelectric materials, Piezoelectric Energy harvesting applications.	07
Keywords:	Fossil fuel, Renewable energy sources, Solar energy, Biomass energy, Electromagnetic Energy Harvesting, Piezoelectric Energy harvesting.	

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PART – C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended-

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J. Balfour, M. Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

Reference Books Recommended-

1. Non-Conventional Energy Resources by B.H. Khan
2. Renewable Energy Sources and Emerging Technologies by D.P. Kothari, K.C. Singal, and Rakesh Ranjan
3. Solar Energy: Fundamentals, Design, Modelling and Applications by G.N. Tiwari
4. Hydropower Development in India: A Sector Assessment by Pradeep Chaturvedi
5. Biomass Conversion: The Interface of Biotechnology, Chemistry and Materials Science by Samir K. Khanal, edited by B.C. Meikap and P.K. Bhattacharya
6. Ocean Energy: Technology, Environmental Impact and Renewable Energy by Pranav Kumar and T. Balaji
7. Wind Energy: Theory and Practice by S. Rao and Dr. B.B. Parulekar
8. Piezoelectric Materials and Devices: Applications in Engineering and Medical Sciences by Arun Ghosh

Online Resources (e-books/ learning portals/ other e-resources)

1. http://en.wikipedia.org/wiki/Renewable_energy
2. Renewable Energy Engineering: Solar, Wind And Biomass Energy Systems - Course (nptel.ac.in)
3. Technologies For Clean And Renewable Energy Production – NPTEL+
4. NPTEL :: Mechanical Engineering - NOC:Selection Of Nanomaterials For Energy Harvesting And Storage Application
5. Wind energy Labs : Mechanical Engineering : Amrita Vishwa Vidyapeetham Virtual Lab
6. Virtual Labs (vlabs.ac.in)
7. https://youtu.be/uY3x7Tycyps

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz- (2): **10 + 10** Assignment/ Seminar+ Attendance- **05** Total Marks- **15**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **15** Marks.
End Semester Examination (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **05 x1= 05** Mark; **Q2**. Short answer type- **5x2 =10Marks** Section **B**: Descriptive answer type qts.,**1 out of 2** from each unit- **4x05 =20 Marks**	

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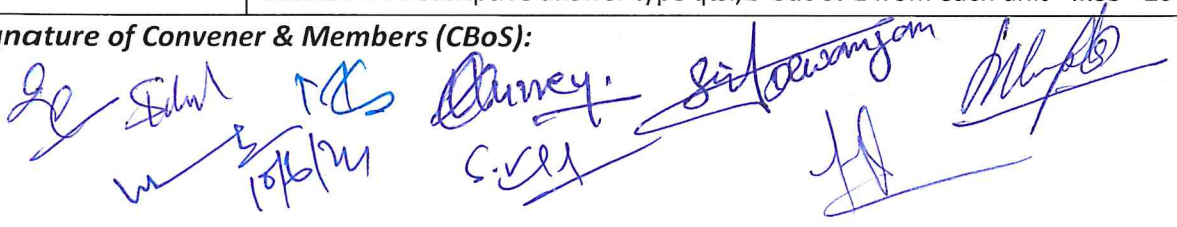

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)		Semester: II/ IV/V/ VI	Session: 2024-25
1	Course Code	PHSEC- 01	
2	Course Title	Basic Electrical Skill	
3	Course Type	Skill Enhancement Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	On successful completion of the course, student is expected to enhance his electrical skill through: ➢ Understanding importance of accuracy in measuring physical quantities. ➢ Using basic mechanical tools. ➢ Using various measuring instruments. ➢ Fault finding and repairing simple domestic appliances	
6	Credit Value	02 Credits (1C+1C)	1 Credit= 15 Hours for Theoretical Learning & = 30 Hours Laboratory or Field learning/ Training
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods:
Theory – 15 Periods (15 Hrs) and Lab. or Field learning/Training 30 Periods (30 Hours)

Module	Topic (Course Contents)	No. of Period
I	**Measurement**: Idea about accuracy in measurement, measuring devices for commonly used physical quantities (Length, Mass, Density, Temperature, Power, Current, Voltage, Resistance, capacitance, inductance, frequency etc). **D.C. Circuit**: Ohms law, Series and parallel resistance circuit, Kirchhoff's law& their application, Primary and secondary cells, maintenance of secondary cells. **A.C. Circuits**: Generation of AC voltage, wave shape, frequency, peak, average, instantaneous & RMS values, idea about R, L, C circiuits **Heating & Lighting effects of current**: Joule's law of electric heating and its domestic applications, idea of commonly used lighting bulb, tube, CFL, LED. **Working:** Working principle of Domestic appliances like electric fan, Cooler, Inverters, Mixer, Electric heater etc **Safety measurements-** Safety measurements in working with mechanical and electrical tools, testing and repair of electrical appliances.	15
II	**Laboratory Work:** **(i)** Use of basic tools: Screwdriver, Pliers, Wrench, Hacksaw, Spanner, Hand and electric drill, Soldering iron etc. **(ii)** Use of Voltmeter, Current meter, electronic balance. **(iii)** Use of Multimeter, CRO. **(iv)** Design & Construction of extension board **(v)** Fan repairing and its study **(vi)** Mixer repairing and its study **(vii)** Electric kettle repairing and its study **(viii)** Electric press repairing and its study **(ix)** Cooler repairing and its study **(x)** Geezer repairing and its study **(xi)** Invertor repairing and its study	30

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Electrical circuits, - M Nahvi and J Edminister, Schaum's outline series, Tata McGraw 2005
3. Circuit Theory, A Chakraborti, Dhanpat Rai & Co.
4. A Text book of electrical technology, - Vol.1, B L Thereja, S. Chand & Co, Delhi
5. A text book of electrical technology- J B Gupta, SK Kalaria & Sons,
6. Principle of electrical engineering- V K Mehta, Rohit Mehta, S. Chand & Co, Delhi
   Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Reference Books Recommended

1. Electrical and Electronic Measurements and Instrumentation by R.K. Rajput
2. Electrical Workshop: Safety, Commissioning, Maintenance & Testing of Electrical Equipment by R.P. Singh
3. Electricity and Magnetism by D.N. Vasudeva

Online Resources (e-books/ learning portals/ other e-resources)

1. National Digital Library- https://ndl.iitkgp.ac.in/
2. https://nptel.ac.in/courses/108/108/108 108076/
3. Basic Instrumentation Skills – Selfstudy Institute
4. physics.iisuniv.ac.in
5. https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/note_1469078786.PDF

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Coordinator)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar + Attendance - **05** Total Marks- **15**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against 15 Marks
End Semester Examination (ESE)	**Laboratory /Skill Performance: On spot Assessment** **A. Performed the Task based on learned skill - 20 Marks** **B. Spotting based on tools (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Evaluation by Coordinator**

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