Syllabus of 4 + 1 Year Integrated UG and PG Programme

w. e. f 2024-25 Academic Year

GRADUATE SCHOOL

Mahatma Gandhi University

P. D. Hills P O

Kottayam, Kerala

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Schools offering Majors

SL.No	School/Centre
1	School of Bio Sciences
2	School of Chemical Sciences
3	School of Computer Sciences
4	School of Environmental Sciences
5	School of Gandhian Thought and Development Studies
6	School of International Relations and Politics
7	School of Pure and Applied Physics
8	School of Social Sciences

Sl. No.	Major	Intake
SCIENCE		
1	Bio Sciences	6**
2	Chemistry	6
3	Computer Science	6
4	Environmental Science	6
5	Physics	6
SOCIAL SCIENCES		
1	Development Studies	5
2	Gandhian Studies	5
3	History	10
4	International Relations and Politics	10

Majors offered and Intake *1 seat shall be sanctioned over and above the intake in each major in the 3rd semester for students who opt for a change of major after two semesters.

**Progression to PG Shall be based on the specialization selected by students as Biochemistry (2 seats) Biotechnology (2 seats) and Microbiology (2 seats) based on merit.

Schools offering Minors/MDCs/AECs/VACs/SECs

SL.No	School/Centre
1	School of Artificial Intelligence And Robotics
2	School of Behavioural Sciences
3	School of Biosciences
4	School of Chemical Sciences
5	School of Computer Sciences
6	School of Data Analytics
7	School of Energy Materials
8	School of Environmental Sciences
9	School of Food Science And Technology
10	School of Gandhian Thought And Development Studies
11	School of Gender Studies
12	School of Indian Legal Thought
13	School of International Relations And Politics
14	School of Letters
15	School of Mathematics And Statistics
16	School of Nanoscience And Nano Technology
17	School of Pedagogical Sciences
18	School of Polymer Science And Technology
19	School of Pure And Applied Physics
20	School of Social Sciences
21	School of Tourism Studies
22	International and Inter University Centre for Nanoscience and Nanotechnology
23	K N Raj School of Economics

Scheme for 4 + 1 Integrated UG and PG Programme
Graduate School
Mahatma Gandhi University
School of Pure and Applied Physics

Course Code	Title	Credits	Hours per Week		Level	Type
			Theory	Practicals		
SEMESTER I						
MG1DSCUPH101	Principles of Physics	4			Foundation (100-199)	Major
MG1DSCUSP121	Foundations of Physics	4			"	Minor A
MG1DSCUSP141	Elements of Modern Physics	4			"	Minor B
MG1MDCUSP101	Physics of Devices	3			"	MDC
	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER II						
MG2DSCUPH101	Modern Physics	4			"	Major
MG2DSCUSP121	Electricity and Magnetism	4			"	Minor A
MG2DSCUSP141	Condensed Matter Physics	4			"	Minor B
MG2MDCUSP101	Physics and Environment	3			"	MDC
	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER III						
MG3DSCUPH201	Mechanics	4			Intermediate (200-299)	Major
MG3DSCUPH202	Properties of Matter & Thermal Physics	4			"	Major
MG3DSCUPH203	Electromagnetics	4			"	Major
MG3DSCUSP221	Numerical Methods	4			"	Minor

						A
MG3MDCUSP201	Introduction to Astrophysics	3			"	MDC
MG3VACUSP201	Photometric Techniques	3			"	VAC
SEMESTER IV						
MG4DSCUPH201	Electronics	4			"	Major
MG4DSCUPH202	Classical Optics	4			"	Major
MG4DSCUPH203	Mathematical Physics I	4			"	Major
MG4DSCUSP241	Basics of Quantum Mechanics	4			"	Minor B
MG4SECUSP201	Electronic Devices and Circuits	3			"	SEC
MG4VACUSP201	Thin films and Applications	3			"	VAC
MG4INTUPH200	Internship/Fieldwork	2				
SEMESTER V						
MG5DSCUPH301	Classical Mechanics	4			Higher (300-399)	Major
MG5DSCUPH302	Electrodynamics	4			"	Major
MG5DSCUPH303	Statistical Physics	4			"	Major
MG5DSCUPH304	Quantum Mechanics I	4			"	Major
MG5SECUSP301	Crystal Structure Analysis	3			"	SEC
MG5VACUSP301	Solar Cell Technology	3			"	VAC
SEMESTER VI						
MG6DSCUPH301	Mathematical Physics II	4			"	Major
MG6DSCUPH302	Solid State Physics	4			"	Major
MG6DSCUPH303	Quantum Mechanics II	4			"	Major
MG6DSEUPH304	Atomic and Molecular Physics	4			"	Major (E)

MG6DSEUPH305	Physics of Nanomaterials					
MG6DSEUPH306	Laser Physics					
MG6DSEUPH307	Basic Astrophysics	4			"	Major (E)
MG6DSEUPH308	Foundations of Theoretical Physics					
MG6DSEUPH309	Materials Science					
MG6SECUSP301	Instrumentation	3			"	SEC
Total Credits		**133**				

SEMESTER VII						
MG7DSCUPH401	Nuclear and Particle Physics	4			Advanced (400-499)	Major
MG7DSEUPH402	Quantum Field Theory	4			"	Major (E)
MG7DSEUPH403	Materials Physics					
MG7DSEUPH404	Photonics					
MG7DSEUPH405	Solar Physics	4			"	Major (E)
MG7DSEUPH406	Semiconductor Physics					
MG7DSEUPH407	Nanoscience and Nanotechnology					
MG7DSCUSP421	Nuclear and Particle Physics	4			"	Minor A
MG7DSEUSP422	Spectroscopic Characterization Techniques	4			"	Minor A (E)
MG7DSEUSP441	Basic Crystallography	4			"	Minor A/B (E)
SEMESTER VIII						
MG8DSCUPH401	Research Methodology	4			"	Major
MG8DSEUPH402	Introduction to Plasma Physics	4			"	Major (E)

MG8DSEUPH403	General Relativity and Cosmology					
MG8DSEUPH404	Material Characterization Methods					
MG8RPHUPH400	Research Project	12			"	
	Major*	4			"	Major*
	Major*	4			"	Major*
	Major*	4			"	Major*
Total Credits		**44**				
SEMESTER IX						
MG09DSEUPH501	Space Physics	4			PG Level (500-599)	Major (E)
MG09DSEUPH502	Applied Photonics					
MG09DSEUPH503	Nanophotonics					
MG09DSEUPH504	Atmospheric Physics	4			"	Major (E)
MG09DSEUPH505	Nanoscience and Nanotechnology					
MG09DSEUPH506	Semiconductor Devices					
MG09DSEUPH507	Theory of Relativity	4			"	Major (E)
MG09DSEUPH508	Functional Materials					
MG09DSEUPH509	Statistical Field Theory					
MG09DSEUPH510	Computational Methods for Theoretical Physics	4			"	Major (E)
MG09DSEUPH511	Computational Methods for Materials Physics					
MG09DSEUPH512	Elective based Extended Practical	4			"	Major (E)
SEMESTER X						
MG10RPHUPH500	Research Project	20			"	
	Major**	4			"	

	Major**	4			“	
	Major**	4			“	
	Major**	4			“	
	Major**	4			“	
Total Credits		**40**				

*Only for 4-Years Honours Students

**Only for students who opt for theory courses instead of Research Project

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Pure and Applied Physics		
Programme	4 year Integrated UG (Physics Major)		
Course Title	Principles of Physics		
Course Type	Major		
Course Level	100-199		
Course Code	MG1DSCUPH101		
Course Overview	This foundational course provides a comprehensive exploration of fundamental physical theories and phenomena. It covers classical mechanics, including Newton's Laws and central force motion, as well as modern concepts like Special Relativity. Students will delve into thermodynamics, studying energy transformations and statistical mechanics, essential for understanding complex systems. Electromagnetism topics include electrostatics, magnetostatics, and Maxwell's equations, crucial for applications in various technological fields. The course also introduces quantum mechanics, covering wave functions, quantum dynamics, and the Schrödinger equation, offering insights into atomic and molecular behavior. Through theoretical study and practical exercises, students develop a deep understanding of foundational physics principles and their applications in scientific and engineering contexts.		
Semester	1	**Credit**	4

Total Student Learning Time	Instructional hours for theory	Instructional hours for practical/lab work/field work
Prerequisite	None	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Recall and apply Newton's Laws to analyze complex mechanical systems, including central force motion and harmonic oscillators.	R, An, A	1, 2
2	Evaluate the implications of Lorentz transformations in Special Relativity, demonstrating understanding of length contraction and time dilation.	E, U	1, 2
3	Recall and apply the principles of thermodynamics, including the first and second laws, to predict the performance of Carnot engines and analyze entropy changes in various physical systems.	R, A, An	1, 2
4	Analyze electrostatic and magnetostatic phenomena using Maxwell's equations, including solving problems involving charge distributions and magnetic fields.	A, An	1, 2
5	Compare classical and quantum mechanical descriptions of physical phenomena, demonstrating understanding of the probabilistic nature of quantum states and the uncertainty principle.	E, U	1, 2

6	Design experiments to explore quantum mechanical concepts such as wave function solutions and time evolution, applying the Schrödinger equation to different physical scenarios.	C, A	1, 2

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Mechanics and Relativity Kinematics and Dynamics, Newton's Laws, Central force motion - reduction to one-body problem, equations of motion, energy and angular momentum as constants of motion, classification of orbits, Kepler problem, Harmonic oscillator - Equation of motion, solutions, damped oscillator, forced harmonic oscillator, Relativity : Galilean relativity, Special relativity-Lorentz transformation, length contraction, time dilation, velocity addition.		1, 2
Module 2	**Hours**	
Thermodynamics and statistical mechanics Thermodynamics - Zeroth law, first law, second law, Carnot engine, Entropy, thermodynamic potentials, Classical statistical mechanics - microcanonical ensemble, two-level systems, ideal gas, entropy of mixing and Gibbs paradox, canonical ensemble, examples.		3
Module 3	**Hours**	
Electromagnetism Electrostatics - Coulomb's law, Electric field, Continuous charge distribution, divergence and curl of electrostatic fields, electric potential, Poisson's equation and Laplace's equation, Magnetostatics - Lorentz force, Biot-Savart law - divergence and curl of magnetic field		4
Module 4	**Hours**	

Quantum Mechanics Origin: Double slit experiment, Photoelectric effect, Compton effect - Heisenberg uncertainty principle - Wave function : probability in classical and quantum mechanics, mean and uncertainty - Quantization and Measurement : Single-valuedness and quantization of momentum, measurement postulate - States of definite energy : Free particle on a ring, Particle in a well - Quantum dynamics : A solution of time-dependent Schrödinger equation - General solution for time evolution.		5, 6

Mode of Transaction	**Classroom activities:** **Field activities:** **Lab based activities:**
Mode of Assessment	

Learning Resources

1. Fundamentals of Physics - Mechanics, Relativity and Thermodynamics by R. Shankar

2. Fundamentals of Physics - Electromagnetism, Optics and Quantum Mechanics by R. Shankar

3. Kleppner, D., & Kolenkow, R. (2013). An Introduction to Mechanics (2nd ed.). Cambridge: Cambridge University Press.

4. Griffiths, David J. (David Jeffery), Introduction to Electrodynamics. Boston :Pearson, 2013.

5. Griffiths, D. J., Introduction to Quantum Mechanics (3rd ed.). Pearson Prentice Hall, 2nd edition, 2015.

Relevance of Learning the Course/ Employability of the Course

This course is highly relevant in today's world as it equips students with essential analytical and problem-solving skills that are sought after in various industries.
Understanding physics principles is crucial for careers in engineering, technology, and research, where knowledge of mechanics, thermodynamics, electromagnetism, and quantum mechanics is fundamental. Employers value candidates who can apply theoretical concepts to practical situations, making physics graduates highly desirable in fields such as aerospace, renewable energy, and telecommunications. Moreover, the interdisciplinary nature of physics allows graduates to adapt to diverse work environments and tackle complex challenges across different sectors. Overall, mastering the principles of physics enhances employability by fostering critical thinking, innovation, and adaptability,

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Pure and Applied Physics		
Programme	4 year Integrated UG (Physics Minor)		
Course Title	Foundations of Physics		
Course Type	Minor		
Course Level	100-199		
Course Code	MG1DSCUSP121		
Course Overview	This foundational course provides a comprehensive study of essential physical principles across diverse disciplines. It covers mechanics, including kinematics, dynamics, and central force motion, fundamental for understanding motion and forces. Thermodynamics and statistical mechanics are explored, emphasizing the laws of thermodynamics, entropy, and their application in energy transformations and complex systems. Electromagnetism topics include electrostatics, magnetostatics, and Maxwell's equations, crucial for technological and biological applications. Quantum mechanics introduces wave functions, quantization, and the probabilistic nature of quantum states, pivotal for atomic and subatomic phenomena. This course equips students with foundational knowledge and analytical skills relevant to careers in physics, engineering, chemistry, biology, and related scientific fields.		
Semester	1	**Credit**	4
Total Student	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	

Learning Time		
Pre-requisite	None	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	*Upon completion of this course, students will be able to**;***		
1	Apply Newton's Laws to analyze mechanical systems, including central force motion and harmonic oscillators, integrating energy and angular momentum conservation.	R, A, An	1, 5
2	Explain thermodynamic principles and laws, apply them to Carnot engines, and evaluate entropy using statistical mechanics formulations.	U, An, E	1, 5
3	Analyze electrostatic and magnetostatic fields using Coulomb's law and Biot-Savart law, and evaluate electric potentials and magnetic fields with divergence and curl concepts.	An, E	1, 5
4	Compare classical and quantum descriptions of physical phenomena (e.g., double slit experiment, photoelectric effect), understanding the probabilistic nature of quantum states and the Heisenberg uncertainty principle.	E, U	1, 5
5	Apply quantum mechanics to solve problems with wave functions, momentum quantization, and states of definite energy, demonstrating understanding of the measurement postulate and quantum outcomes.	A, C	1, 5

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Mechanics Kinematics and Dynamics, Newton's Laws, Central force motion - reduction to one-body problem, equations of motion, energy and angular momentum as constants of motion, Kepler problem, Harmonic oscillator - Equation of motion, solutions, damped oscillator, forced harmonic oscillator.		1
Module 2	**Hours**	
Thermodynamics and statistical mechanics Thermodynamics - Zeroth law, first law, second law, Carnot engine, Entropy, thermodynamic potentials, Classical statistical mechanics - microcanonical ensemble, two-level systems, ideal gas, entropy of mixing and Gibbs paradox.		2
Module 3	**Hours**	
Electromagnetism Electrostatics - Coulomb's law, Electric field, Continuous charge distribution, divergence and curl of electrostatic fields, electric potential, Magnetostatics - Lorentz force, Biot-Savart law - divergence and curl of magnetic field		3
Module 4	**Hours**	
Quantum Mechanics Origin: Double slit experiment, Photoelectric effect, Compton effect - Heisenberg uncertainty principle - Wave function : probability in classical and quantum mechanics, mean and uncertainty - Quantization and Measurement : Single-valuedness and quantization of momentum, measurement postulate - States of definite energy.		4, 5

Mode of Transaction	**Classroom** **Field** **Lab based**

Mode of Assessment	

Learning Resources

1. Kleppner, D., & Kolenkow, R. (2013). An Introduction to Mechanics (2nd ed.). Cambridge: Cambridge University Press.

2. Griffiths, David J. (David Jeffery), Introduction to Electrodynamics. Boston :Pearson, 2013.

3. Griffiths, D. J., Introduction to Quantum Mechanics (3rd ed.). Pearson Prentice Hall, 2nd edition, 2015.

Relevance of Learning the Course/ Employability of the Course

This course is a basic and foundational offering that can hold enormous value to students interested in various fields such as biology, chemistry, mathematics etc. by offering essential insights into the fundamental physical principles. For chemists, it provides a deep understanding of thermodynamics and quantum mechanics, crucial for studying reaction kinetics, molecular structures, and energy transformations. Biologists benefit from electromagnetism concepts, aiding in the understanding of biological processes like nerve signaling and cellular dynamics. Furthermore, the course enhances mathematical proficiency through applications of calculus, differential equations, and vector analysis in physics contexts, enriching quantitative analysis and modeling skills across disciplines. This interdisciplinary approach equips individuals to tackle complex challenges, innovate in technology and materials science, and contribute to

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Pure and Applied Physics		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	**Elements of Modern Physics**		
Course Type	Major/**Minor**/MDC/AEC/SEC/VAC		
Course Level	**100-199**/200-299/300-399/400-499/500-599		
Course Code	MG1DSCUSP141		
Course Overview	This course mainly involves the descriptions of nature through some theories which are different from classical physics. Modern physics presents the foundations and frontiers of today's physics. It quantum mechanically focusses on the domains of atomic, nuclear, particle, and condensed-matter physics.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	30	
Pre-requisite	Fundamental of Physics		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Understand the particle properties of waves and wave properties of particles.		
2	Understand the comprehensive structure of atoms and related topics.		
3	Understand the basic physics of semiconductor materials		
4	Gain conceptual understanding about the universe		
5	Understand, analyse, evaluate, and interpret the world around in a scientific way		
6	Pursue advanced levels of the subject		

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Quantum theory of light Electromagnetic waves, Blackbody radiation, Photoelectric effect, Nature of light, X-Ray diffraction, Compton effect, Pair production, Photons and gravity, De Broglie waves, Phase and group velocities, Particle diffraction, Particle in a box, Uncertainty principles.		
Module 2	**Hours**	
Atomic physics The Nuclear Atom, Electron Orbits, Atomic Spectra, The Bohr Atom, Energy Levels and Spectra, Correspondence Principle, Nuclear Motion, Atomic Excitation, Electron Spin, Exclusion Principle, Fermions and bosons, Periodic Table, Atomic Structures, Explaining the Periodic Table.		
Module 3	**Hours**	
Semiconductor physics Energy bands, Charge carriers in semiconductors, Intrinsic and extrinsic semiconductors, Energy bands of n-type and p-type semiconductors, Elemental and		

compound semiconductors, Carrier concentration at thermal equilibrium, Fermi level, Temperature dependence of carrier concentration.		
Module 4	**Hours**	
Introductory astrophysics Stellar structure - M-L relation, HR diagram, Physical state, Hydrostatic equilibrium, Stellar evolution – H burning, CNO cycle, Helium burning, Structure of main sequence stars, Qualitative account of pre-main sequence evolution, Early post main sequence evolution.		

Mode of Transaction	**Classroom activities:** **Field activities:** **Lab based activities:**
Mode of Assessment	

Learning Resources

1

2

3

Relevance of Learning the Course / Employability of the Course

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Pure and Applied Physics		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Modern Physics		
Course Type	Major		
Course Level	200-299		
Course Code	MG2DSCUPH101		
Course Overview	This course is a comprehensive study of modern physics which began in 1900 with Max Planck's discovery of energy quantization in black body radiation. This mainly involves the advanced description of nature through some theories which are different from classical physics. Modern physics presents the foundations and frontiers of today's physics. It quantum mechanically focusses on the domains like atomic, nuclear, particle, semiconductor and astro physics.		
Semester	2	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	30	
Pre-requisite	Basic physics, calculus		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Understand the structure of atoms and subsequent developments in the field.		
2	Understand the comprehensive structure of nucleus and fundamentals of particle physics		
3	Understand the basic physics of semiconductor materials and P-N junction		
4	Gain conceptual understanding about the universe		
5	Understand, analyse, evaluate, and interpret the world around in a scientific way		
6	Pursue advanced levels of the subject.		

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1: Atomic structure	**Hours**	**CO No**
Early models of atom, Atomic spectra, Bohr model, Origin of line spectra, Correspondence principle, Quantum mechanics of hydrogen atom, Exclusion principle, Periodic table of elements, X-Ray Spectra, Fluorescence and phosphorescence.	**15**	
Module 2: Nuclear and particle physics	**Hours**	
Structure and properties of the nucleus, Binding energy, Magic numbers, Nuclear forces, Radioactivity– Alpha, beta and gamma decays, Half-life, Radioactive decay law, Nuclear reactions, Nuclear reactors, elementary particles, quarks, fundamental interactions.	**15**	
Module 3: Semiconductor physics	**Hours**	
Energy bands, Charge carriers in semiconductors, Energy bands of n-type and p-type semiconductors, Fermi level, Drift of carriers in electric and magnetic	**15**	

fields, Carrier mobility, Mean free time of carriers, Current density, Conductivity and Resistivity of semiconductors, P-N junction under forward and reverse biases.		
Module 4: Introductory astrophysics Stellar structure - M-L relation, HR diagram, Physical state, Hydrostatic equilibrium, Stellar evolution – H burning, CNO cycle, Helium burning, Structure of main sequence stars, Qualitative account of pre-main sequence evolution, Early post main sequence evolution.	**Hours** **15**	

Mode of Transaction	**Classroom activities:** **Field activities:** **Lab based activities:**
Mode of Assessment	

Learning Resources

1

2

3

Relevance of Learning the Course / Employability of the Course

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	SCHOOL OF PURE & APPLIED PHYSICS		
Programme	**4 + 1 Integrated UG and PG Programme- PHYSICS**		
Course Title	**CONDENSED MATTER PHYSICS**		
Course Type	Major/**Minor**/MDC/AEC/SEC/VAC		
Course Level	**100-199**/200-299/300-399/400-499/500-599		
Course Code	MG2DSCUSP141		
Course Overview	This course explores the fundamental principles governing the behavior of condensed matter, focusing on solids. Topics covered include crystal structures, symmetry operations, different crystal structures, crystal bonding, lattice dynamics, electronic properties of solids, semiconductor, superconductivity, and nanomaterials.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	30	
Pre-requisite			

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Learning Outcomes: By the end of this course, students should be able to:		
1	Understand the basic concepts of crystal structures.		
2	Understand the basic concept of crystal symmetry and type of crystals		
3	Explain the electronic band structure of solids, including metals, insulators, and semiconductors.		
4	Analyze semiconductor properties, such as carrier concentration, mobility, and conductivity.		
5	Apply theoretical models and experimental techniques to study the properties of condensed matter systems.		
6			

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Crystal Structure, Crystalline and amorphous solids, Crystal lattices and unit cells, symmetry operations. Crystallographic notation and crystal systems	**15**	
Module 2	**Hours**	
Bravais lattice in two and three dimensions, miller indices, metallic crystal structures, coordination number, Atomic packing factor, Structure of NaCl, Diamond, Zinc blend etc. Braggs' law. X-ray diffraction and crystal structure determination	**15**	
Module 3	**Hours**	

Bonding in Solids, type of bonding, classification of crystals, ionic bonding, covalent bonding, metallic bonding, Vander Wall bonding and hydrogen bonding.	**15**	
Module 4	**Hours**	
Energy bands and band structure in solids, Metal, insulator, and semiconducting materials, Intrinsic and extrinsic semiconductors, n and p type materials, Semiconductor devices, Diode, transistors and Light emitting diodes.	**15**	

Mode of Transaction	**Classroom activities:** **Lab based activities:**
Mode of Assessment	

Learning Resources

1. Introduction to Solid State Physics, Charles Kittel, Wiley India Edition
2. Solid State Physics, A J Dekker, Pan Macmillon 3.

Relevance of Learning the Course/ Employability of the Course

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	SCHOOL OF PURE & APPLIED PHYSICS		
Programme	**4 + 1 Integrated UG and PG Programme- PHYSICS**		
Course Title	**ELECTRICITY AND MAGNETISM**		
Course Type	Major/**Minor**/MDC/AEC/SEC/VAC		
Course Level	**100-199**/200-299/300-399/400-499/500-599		
Course Code	MG2DSCUSP121		
Course Overview	**Course Description:** This course provides an introduction to the fundamental principles of electricity and magnetism. Topics covered include electrostatics, electric circuits, magnetostatics, electromagnetic induction, Maxwell's equations, and electromagnetic waves. The course emphasizes both theoretical concepts and practical applications.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	**30**	
Pre-requisite			

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Learning Outcomes: By the end of this course, students should be able to:		
1	Understand the fundamental concepts of electrostatics, including Coulomb's law, electric fields, electric potential, and Gauss's law.		
2	Analyze simple electric circuits, including series and parallel circuits, using Ohm's law and Kirchhoff's laws.		
3	Describe the behavior of magnetic fields, including magnetic forces and magnetic materials.		
4	Apply the laws of magnetostatics to analyze simple magnetic systems and devices.		
5	Explain electromagnetic induction and Faraday's law, and analyze the behavior of inductors and transformers.		
6	Apply the principles of electricity and magnetism to solve problems and design simple circuits and devices.		

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S)

COURSE CONTENT

Module 1	**Hours**	**CO No**
Electrostatics:- Coulomb's law, Electric field, distribution of charges, Field lines and Gauss's Law, Electric potential and potential difference, Gauss's law, application of Gauss's law,	**15**	
Module 2	**Hours**	
Work and energy in Electrostatics, Conductors, Electric Circuits, Ohm's law, Series and parallel circuits, Kirchhoff's laws, Capacitors and capacitance.	**15**	
Module 3	**Hours**	
Magnetostatics:- Magnetic fields and magnetic field lines, Magnetic forces on moving charges, Magnetic materials, Electromagnetic Induction, Faraday's law,	**15**	

Lenz's law, Inductors and inductance, Principles of Transformers, Generators.		
Module 4: Thermal and Chemical Effects of Electric Current.	**Hours**	
Thermoelectricity – Seebeck effect, laws of thermo- e.m.f, Measurement of thermo-e.m.f using potentiometer, Peltier effect and Peltier coefficient, Thomson effect and Thomson coefficient, AC and DC circuits, principle of AC/DC motors, Peak, average and RMS values of AC voltage and current, Impedence in an AC Circuit-Inductance in an AC circuit. Capacitance in an AC circuit, AC through an inductance and capacitance in series, AC through capacitance and resistance in series	**15**	

Mode of Transaction	**Classroom activities:** **Field activities:** **Lab based activities:**
Mode of Assessment	

Learning Resources

1. Text book of Electricity and Magnetism, Brij Lal and N Subramanyam. 2.

Relevance of Learning the Course/ Employability of the Course