Sadakathullah Appa College

(Autonomous)

(Reaccredited by NAAC at an 'A' Grade. An ISO 9001:2015 Certified Institution)

Rahmath Nagar, Tirunelveli- 11.

Tamil Nadu.

PG DEPARTMENT OF PHYSICS

MY LORD
VOUCHSAFE ME WISDOM

CBCS SYLLABUS

Learning Outcomes-based Curriculum Framework for

PHYSICS (M.Sc.)

(Applicable for the students admitted from June 2021 as per the Resolutions of the Academic Council Meeting held on 20.03.2021)

CONTENTS

POSTGRADUATE DEPARTMENT OF PHYSICS

CBCS SYLLABUS

M.Sc. Physics (2021-2024)

COURSE STRUCTURE

I SEMESTER				II SEMESTER		
COURSE	**H/W**	**C**		**COURSE**	**H/W**	**C**
DSC –I	5	4		DSC –IV	5	4
DSC – II	5	4		DSC –V	5	4
DSC –III	5	4		DSC –VI	5	4
DSE-I	4	4		DSE-III	4	4
Practical-I	4	2		Practical – III	4	2
Practical-II	4	2		Practical - IV	4	2
IDC – I	2	2		SEC	2	2
Library Hour	1			Library Hour	1	
TOTAL	**30**	**22**		**TOTAL**	**30**	**22**
III SEMESTER				**IV SEMESTER**		
DSC-VII	5	4		DSC –X	5	4
DSC –VIII	5	4		DSC –XI	5	4
DSC –IX	5	4		Project	8	8
DSE –III	4	4		DSE -IV	4	4
Practical-V	4	2		Practical-VII	4	2
Practical-VI	4	2		Practical-VIII	4	2
IDC -II	2	2				
Library Hour	1					
TOTAL	**30**	**22**		**TOTAL**	**30**	**24**

DISTRIBUTION OF HOURS, CREDITS, NO. OF PAPERS & MARKS				
SUBJECT	**HOURS**	**CREDITS**	**NO. OF PAPERS**	**MARKS**
DSC+Project	63	52	12	1250
Practical	32	16	8	400
DSE	16	16	4	400
IDC	4	4	2	100
SEC-SWAYAM-NPTEL Course	2	2	1	50
Library Hour	3			
TOTAL	**120**	**90**	**27**	**2200**

POSTGRADUATE DEPARTMENT OF PHYSICS

M.Sc. Physics (2021-2024)

COURSE STRUCTURE

SEM	Course	Title of the Courses	Sub. Code	H/W	L*	T*	P*	C	Marks		
									I	E	T
I	DSC-I	Mathematical Physics-I	21PCPH11	5	5	-	-	4	40	60	100
	DSC-II	Classical Mechanics	21PCPH12	5	5	-	-	4	40	60	100
	DSC-III	Thermodynamics and Statistical Mechanics	21PCPH13	5	5	-	-	4	40	60	100
	DSE-I	(A) Advanced Electronics	21PEPH11A	4	4	-	-	4	40	60	100
		(B)Python Programming	21PEPH11B								
		(C) Radiological Safety Aspects	21PEPH11C								
	P-I	General Physics Practicals-I	21PCPH1P1	4	-	-	4	2	40	60	100/2
	P-II	Advanced Electronics Practicals-I	21PCPH1P2	4	-	-	4	2	40	60	100/2
	IDC	Basics of Digital Electronics	21PIPH11	2	2	-	-	2	40	60	100/2
		Library Hour		1	-	-	-				
II	DSC-IV	Mathematical Physics-II	21PCPH21	5	5	-	-	4	40	60	100
	DSC-V	Quantum Mechanics -I	21PCPH22	5	5	-	-	4	40	60	100
	DSC-VI	Atomic and Molecular Spectroscopy	21PCPH23	5	5	-	-	4	40	60	100
	DSE-II	(A) Advanced Microprocessors and Microcontroller	21PEPH21A	4	4	-	-	4	40	60	100
		(B) Material Physics and Processing Techniques	21PEPH21B								
		(C) Plasma Physics	21PEPH21C								
	P-III	General Physics Practicals-II	21PCPH2P1	4			4	2	40	60	100/2
	P-IV	Advanced Electronics Practicals-II	21PCPH2P2	4	-	-	4	2	40	60	100/2
	SEC	SWAYAM-NPTEL Course	21PSPH21	2	-	2	-	2	40	60	100/2
		Library Hour		1	-	-	-	-	-	-	-

III	DSC-VII	Electromagnetic Theory	21PCPH31	5	5	-	-	4	40	60	100
	DSC-VIII	Quantum mechanics -II	21PCPH32	5	5	-	-	4	40	60	100
	DSC-IX	Research Methodology	21PCPH33	5	5	-	-	4	40	60	100
	DSE-III	(A) Non-Linear Physics	21PEPH31A	4	4	-	-	4	40	60	100
		(B) Physics of Nano Materials	21PEPH31B								
		(C) Density Functional Theory	21PEPH31C								
	P–V	Advanced Physics Practicals-I	21PCPH3P1	4	-	-	4	2	40	60	100/2
	P-VI	Microprocessor and Microcontroller-Practicals	21PCPH3P2	4	-	-	4	2	40	60	100/2
	IDC-II	Energy Physics	21PIPH31	2	2	-	-	2	40	60	100/2
		Library Hour		1	-	-	-	-			
IV	DSC-X	Advanced Solid State Physics	21PCPH41	5	5	-	-	4	40	60	100
	DSC-XI	Nuclear and Elementary Particle Physics	21PCPH42	5	5	-	-	4	40	60	100
	P	Project	21PPPH41	8	-	8	-	8	-	-	150
	DSE-IV	(A) Applied Optics and Laser Physics	21PEPH41A	4	4	-	-	4	40	60	100
		(B) Elementary Numerical Analysis	21PEPH41B								
		(C) Quantum field Theory	21PEPH41C								
	P-VII	Advanced Physics Practicals-II	21PCPH4P1	4	-	-	4	2	40	60	100/2
	P-VIII	Numerical methods and C++ Programming in Physics	21PCPH4P2	4	-	-	4	2	40	60	100/2
			Total	**120**				**90**			**2200**

*** L–Lecture Hours * T–Tutorial Hours * P–Practical Hours**

M.Sc. Physics

Programme Learning Outcomes

PLO	Upon completion of M.Sc. Degree Programmes, the graduates will be able to:
PLO 1	**Disciplinary Knowledge** • Acquire in-depth scientific knowledge in the core areas of study.
PLO 2	**Creative Thinking and Practical Skills / Problem Solving Skills** • Enrich skills of observation to draw logical inferences from scientific experiments /programming and skills of creative thinking to develop novel ideas. • Hone problem solving skills in theoretical, experimental and computational areas and to apply them in real life situations.
PLO 3	**Sense of inquiry and Skilled Communicator / Research, Innovation and Entrepreneurship** • Develop the capability for raising appropriate questions relating to the current/emerging issues encountered in the scientific field and to plan, execute and express the results of experiments / investigations through technical writings as well as through oral presentations. • Design innovations for exploring the unexplored areas in diverse fields to accomplish socially relevant and economically beneficial innovative research projects. • Become a skilled entrepreneur for launching start-up / business ventures to improve the economy of the nation.
PLO 4	**Ethical Awareness / Team Work / Environmental Conservation and Sustainability** • Equip them for conducting work as an individual / as a member, or as a leader in diverse teams upholding values such as honesty and precision, and thus preventing unethical behaviours such as fabrication, falsification, misrepresentation of data, plagiarism etc. to ensure academic integrity. • Realise that environment and humans are dependent on one another and to know about the responsible management of our ecosystem for survival, and for the well-being of the future generation as well.
PLO 5	**Digital Literacy/Self-Directed Learning/Usage of ICT/Lifelong Learning** • Get access to digital resources, to use them judiciously for updation of knowledge and also to engage in remote/ independent learning. • Inculcate the habit of learning continuously through the effective adoption of ICT to update knowledge in the emerging areas in Sciences for inventions/discoveries so that the knowledge transferred from laboratory to land would yield fruitful results for the betterment of global society.

Programme Specific Outcomes (PSO)

PSO NO.	Upon Completion of M.Sc Physics Degree Programme, the Graduates will be able to:	PLOs mapped
PSO-1	Acquire knowledge in analytic and critical thinking skills in major branches of Physics.	PLO - 1,2
PSO-2	Familiarize themselves with contemporary research in various fields of Physics by enhancing pedagogical and scientific writing skills for Projects through modern methods.	PLO -3,4
PSO-3	Develop leadership skill and find ways to apply their knowledge of Physics with advancement in higher education and career besides the desire to remain lifelong learners.	PLO -1,4,5
PSO-4	Solve issues concerned in the society with the help of Physics and its principles.	PLO -3,4,5
PSO-5	Demonstrate the various concepts of Physics through the practical courses which are framed in relevance to that of the theory courses.	PLO -1,2,3

SEMESTER- I

Course Title	**MATHEMATICAL PHYSICS – I**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCPH11**
Course Type	**DSC-I**
Credits	**4**
Marks	**100**

General Objective:

Mathematical Physics provides firm foundation in various mathematical methods developed and used in understanding different physical phenomena.

Course Objectives:

CO No.	The learners will be able to
CO-1	Comprehend knowledge in Mathematical Physics and its applications.
CO-2	Build expertise in mathematical techniques required in Physics.
CO-3	Develop problem solving skill in Fourier and Laplace transforms.
CO-4	Classify and draw inferences from mathematical solutions based on Group Theory.
CO-5	Familiarize themselves with theorems on representation and solving problems in various fields of Physics.

UNIT – I LINEAR VECTOR SPACE & MATRICES (15 Hours)

Gauss Divergence Theorem - Stoke's theorem-Green's Theorem-Orthogonal curvilinear co-ordinates - Differential operators in terms of orthogonal curvilinear co-ordinates- Cylindrical and spherical polar co-ordinates - Differential operators in terms of cylindrical and spherical polar co-ordinates – Linearly dependent and independent sets of vectors – Dimensions, Basis and Inner product – Schmidt orthogonalization Process – Eigen value and Eigenvectors of matrix.

UNIT – II SPECIAL FUNCTIONS - I (15 Hours)

Dirac delta function – Properties and representation of Dirac delta function- Legendre differential equation and its polynomial – Generation function – Rodrigue's formula –

Orthogonal property – Recurrence formulae – Hermite differential equation and Hermite polynomial – Generating function - Orthogonal property – Recurrence formulae – Rodrigue's formula.

UNIT- III INTEGRAL TRANSFORMS (15 Hours)

Fourier Transform - Properties of Fourier transform - Fourier sine and cosine transform -Fourier transform of a derivative - Laplace transform – properties of Laplace transform- Laplace transform of the derivative of a function - Inverse Laplace transform: Fourier mellin theorem -solution of linear differential equations with constants coefficients

UNIT – IV GROUP THEORY (15 Hours)

Concept of a Group – Group Postulates - Abelian group – Genetrators of Finite group - Cyclic group –Group multiplication table –Subgroups – Cosets – Conjugate elements and classes -Isomorphism and Homomorphism –Cayley's theorem - Group symmetry of a equilateral triangle - Group symmetry of a equilateral square.

UNIT- V REPRESENTATION OF GROUPS (15 Hours)

Reducible and irreducible representations – Theorems on representation -Theorem1- Theorem 2(Schur's lemma) - Theorem 3 - Orthogonality Theorem –Character of a representation - character tables – Construction of Character tables – Character tables for simple molecular types (C_{2V} & C_{3V} point group molecules).

TEXT BOOKS

1. Satya Prakash–"Mathematical Physics", Sulthan Chand & Sons, New Delhi (2005).
2. H.K.Dass and Rama Verma, " Mathematical Physics" - Chand and company Ltd. (2010)
3. A W. Joshi, "Matrices and Tensors in Physics" – Third edition – New Age International (Pvt.) Ltd (1995).

REFERENCE BOOKS

1. George B. Arfken and Hans J. Weber, "Mathematical Methods for Physicists", Academic Press, Sixth Edition (2005).
2. Frank Ayers -Matrices "Schaum's Series", TMH edition McGraw-Hill, New Delhi (1984).
3. Murray R. Spiegel, Seymour Lipschutz and Dennis Spellman, "Vector Analysis Schaum's Outline series", Tata McGraw-Hill, Second Edition (2009).
4. Michael Tinkham, "Group theory and Quantum Mechanics", TMH edition new Delhi (1974).
5. Murray R. Spigel, "Theory and Problems of Laplace transforms", International edition, Mcgraw hill, (1986).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Summarize vector operations in orthogonal curvilinear co-ordinates.	1, 3	Understanding
CO-2	Apply special functions such as Legendre and Hermite polynomials in various fields of Physics.	1, 2, 3	Applying
CO-3	Solve problems in Physics using Fourier and Laplace Transforms.	2, 3	Creating
CO-4	Explain the concept of Group Theory.	1, 2, 3	Analyzing
CO-5	Construct the character table and know the importance of group theorems.	1, 2,4	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
I	21PCPH11		MATHEMATICAL PHYSICS-I			75			4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓		✓	✓	✓		✓		
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓		✓	✓	✓		✓	✓		
CO-5	✓	✓	✓	✓	✓	✓	✓		✓	
	Number of matches (✓) = 36 Relationship = **High** Low (If the No. of matches are less than 25) Medium (If the No. of matches are between 25 and 33) High (If the No. of matches are more than 33)									

SEMESTER- I

Course Title	**CLASSICAL MECHANICS**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCPH12**
Course Type	**DSC-II**
Credits	**4**
Marks	**100**

General Objective:

To understand the motion of particles through Lagrangian and Hamiltonian formulations

Course Objectives:

CO	The learners will be able to
CO-1	Understand the concept of Lagrangian formulation.
CO-2	Illustrate the two body central force problem and its dynamics.
CO-3	Examine mathematical techniques for solving rigid body motion.
CO-4	Explain the foundations of Hamiltonian formulation and canonical transformation.
CO-5	Evaluate the mathematical skills in solving small oscillations and relativity problems.

UNIT- I LAGRANGIAN FORMULATION (15 Hours)

Mechanics of a particle and system of particles – Conservation laws: conservation of linear and angular momentum– Constraints and degrees of freedom – Generalised co-ordinates - D' Alembert's principle of virtual work – Lagrange's equations of motion – non-holonomic system- application of Lagrange's equations of motion: simple pendulum, Atwood's machine, free particle in space - velocity dependent potential.

UNIT – II TWO BODY CENTRAL FORCE PROBLEM (15 Hours)

Reduction to the equivalent one body central force problem – Equations of motion and first integrals – Virial theorem – The equivalent one dimensional problem and classification of orbits – Differential equation for the orbit - Kepler's problem: Inverse square law of force – Scattering in a central force field – Transformation of scattering problems to laboratory coordinates.

UNIT – III KINEMATICS OF RIGID BODY MOTION (15 Hours)

Independent coordinates of a rigid body – Orthogonal transformation- Euler's angles – Coriolis force-Angular momentum and Kinetic energy of motion about a point – Inertia tensor and Moment of inertia- Euler's equations of motion (Newtonian & Lagrangian Method) – Torque free motion of a rigid body – heavy symmetrical top.

UNIT-IV HAMILTONIAN FORMULATION AND CANONICAL TRANSFORMATION (15 Hours)

Calculus of variation - Principle of least action – Other forms of action Principles – Hamilton's principle-Lagrange's equation from Hamilton's principle- Canonical transformation – Generating Functions – Poisson's brackets and its properties – Hamilton's-Jacobi equation for Hamilton's principal function – Example: Harmonic Oscillator problem – Hamilton's characteristic Function – Action angle variables.

UNIT -V SMALL OSCILLATIONS AND THEORY OF RELATIVITY (15 Hours)

Stable and unstable Equilibrium - Lagrange's equation of motion for small oscillations - Normal Co-ordinates and normal frequencies of vibration - Free vibrations of linear tri atomic molecule- Basic Postulates of Special theory of Relativity - Lorentz transformation- Force and energy equations in relativistic Mechanics- Lagrangian and Hamiltonian formulation of relativistic mechanics.

TEXT BOOKS

1. H.Goldstein , *Classical Mechanics*, Addition Wesley, III Edition, (2000).
2. Gupta, Kumar, Sharma, "Classical Mechanics", Pragati Prakasan Publication, 27+th Edition(2021).
3. J.C. Upadhyaya, *Classical Mechanics*, Himalaya Publishing House", 2nd Revised Edition.

REFERENCE BOOKS

1. V.B. Bhatia , *Classical Mechanics,* Narosa Publishing house, New Delhi, (1997).
2. N.C. Rana and P.S. Joag, "Classical Mechanics", Tata McGraw-Hill, I Edition, (1991).
3. John R. Taylor, *Classical Mechanics*, Edwards Brothers, Inc, (2005).
4. R. G. Takwale and P. S. Puranik – *Introduction to Classical Mechanics* - *Tata McGraw* - Hill Publishing Company Ltd. (1989).
5. B. D. Gupta, Satya Prakash and Kedarnath Ramnath, *Classical Mechanics*, New Delhi, (2012).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the principle and importance of Lagrangian formulations.	1,2, 3	Understanding
CO-2	Identify the essential features of a problem such as motion under central force, rigid body dynamics, and periodic motions by using appropriate mathematical equations.	2, 3	Applying
CO-3	Analyze rigid body dynamics and normal mode analysis.	1, 2, 3	Analyzing
CO-4	Explain Hamilton Jacobi equation for Hamilton's principle function and analyze the mechanical problem through canonical transformation.	2, 3,4	Evaluating
CO-5	Evaluate the concepts of small oscillations and relativistic mechanics.	1, 3	Evaluating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
I	21PCPH12		CLASSICAL MECHANICS			75			4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓		
CO-2	✓		✓	✓	✓		✓	✓		
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓		✓	✓	✓		✓	✓	✓	
CO-5	✓	✓		✓		✓		✓		
	Number of matches (✓) = 35 Relationship = **High**									

SEMESTER- I

Course Title	**THERMODYNAMICS AND STATISTICAL MECHANICS**
Total Hrs.	**5**
Hrs./Week	**75**
Sub.Code	**21PCPH13**
Course Type	**DSC-III**
Credits	**4**
Marks	**100**

General Objective:

The objective of the course is to understand the statistical basis of Thermodynamics

Course Objectives:

CO	The learners will be able to
CO-1	Understand the general concepts of Statistical Mechanics and statistical basis of thermodynamics
CO-2	Explore the field of ensembles and partition function.
CO-3	Explain the principles of Bose Einstein and Fermi Dirac Theory.
CO-4	Formulate the applications of Bose and Fermi Statistics in various problems in Physics.
CO-5	Comprehend the concept of the phase transitions.

UNIT –I STATISTICAL BASIS OF THERMODYNAMICS (15 Hours)

Basic postulates of thermodynamics –Phase space–Fundamental relations and definition of intensive variables-Intensive variables in the entropy formulation-Thermodynamic potentials – Maxwell relations-Thermodynamic relations- Microstates and Macrostates –Ideal gas –Entropy of Ideal gas - Microstates and Macrostates in classical and Quantum systems –Density of states – and volume occupied by a quantum state – Liouville's theorem .

UNIT –II METHOD OF ENSEMBLES AND PARTITION FUNCTIONS (15 Hours)

Canonical and Grand Canonical Ensembles - Ideal gas in canonical ensemble – Maxwell velocity distribution – Equipartition of energy – Grand canonical ensemble – Ideal gas in grand canonical ensemble – Comparison of various ensembles – Quantum distributions using other ensembles – Photons –- Partition Function - Canonical partition function –

Molecular partition function – Translational partition function – Rotational partition function – Vibrational partition function.

UNIT - III QUANTUM STATISTICAL MECHANICS (15 Hours)

Postulates of Quantum Statistical Mechanics- Density operator and matrix- applications to electron in a magnetic field- free particle- harmonic oscillator, and to multiparticle systems- Ideal Bose and Fermi gases in canonical and Grand canonical ensembles- Bose-Einstein and Fermi-Dirac distributions- equations of state.

UNIT- IV APPLICATIONS OF BOSE AND FERMI STATISTICS (15 Hours)

Degenerate Fermi gas- low temperature expansion of electronic specific heat- Pauli's theory of paramagnetism-Landau's theory of diamagnetism- Applications of Bose Statistics : Black body radiation- Debye theory for specific heat- Bose Einstein condensation

UNIT – V PHASE TRANSITIONS (15 Hours)

Phase transition-Phase transition of first and second kind –critical exponent – Yang and Lee theory – Phase transition of the second kind –The Ising model – Bragg-William's approximation –one dimensional Ising model-Landau's theory of phase transition

TEXT BOOKS

1. Satya Prakash, "Statistical Mechanics", Kedar Nath Ram Publications, Delhi, (2015).
2. Dr. S.L.Gupta and Dr. V. Kumar, "Statistical Mechanics", Pragati Prakasam Publications, Meerut, 28th Edition, (2015).
3. F.W. Sears and G. L. Salinger, "Thermodynamics, Kinetic Theory and Statistical Thermodynamics", 3rd Ed, Narosa, New Delhi, (1998).

REFERENCE BOOKS

1. F. Reif, "Fundamentals of Statistical and Thermal Physics", Mac Graw-Hill, New York, (1965).
2. R. K. Pathria, "Statistical Mechanics", 2nd Ed, Butter Worth-Heinmann, New Delhi, (1996).
3. F.W. and M.W. Sears and Zymanski, "Statistical Mechanics", McGraw Hill Book Company, New York, (2011).
4. Surekha Tomar, CSIR-UGC NET/ JRF/ SET Physical Science, 3rd Edition.
5. S.P. Kuila, " Fundamentals of Quantum Mechanics Statistical Mechanics and Solid State Physics", Books and Allied Pvt. Ltd., Second Edition, (2018).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the fundamental knowledge of Statistical Mechanics and statistical basis of thermodynamics.	1,3	Understanding
CO2	Identify the various types of ensembles.	1,3	Applying
CO-3	Analyze the importance of Quantum Statistical Mechanics.	1,2,4	Analyzing
CO-4	Explain the applications of Fermi statistics.	1,2,3	Evaluating
CO-5	Estimate the formulation and theory of phase transition.	2,3,4	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
I	21PCPH13		THERMODYNAMICS AND STATISTICAL MECHANICS			75			4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓		✓	✓	✓		✓		
CO-2	✓	✓		✓	✓	✓		✓		
CO-3	✓	✓	✓	✓	✓	✓	✓		✓	
CO-4	✓	✓	✓	✓	✓	✓	✓	✓		
CO-5	✓		✓	✓	✓		✓	✓	✓	
	Number of matches (✓) = 35 Relationship = **High**									

SEMESTER- I

Course Title	**ADVANCED ELECTRONICS**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH11A**
Course Type	**DSE-IA**
Credits	**4**
Marks	**75**

General Objective:

To introduce the students the theoretical concepts of Advanced Electronics

Course Objectives:

CO	The learners will be able to
CO-1	Understand the physical construction, working, operational characteristics, and applications of semiconductor devices.
CO-2	Explain the detailed analysis of IC 741 op-amp.
CO-3	Discuss the various wave form generators and wave shaping circuits.
CO-4	Impart the knowledge of digital circuits.
CO-5	Develop their understanding of the fundamentals and importance of very large scale integrated systems.

UNIT – I SEMICONDUCTOR DEVICES (12 Hours)

Field effect transistor: The ideal voltage controlled current source – the Junction Field Effect transistor – the JFET volt – ampere characteristics – JFET transfer characteristics – The MOSFET – The enhancement MOSFET – volt – ampere characteristics – The depletion MOSFET – MOSFET circuit symbols – The DC analysis of FETS – The MOSFET as a resistance – switch – amplifier – small – signal FET models – CMOS devices.

UNIT – AMPLIFIER SYSTEMS (12 Hours)

Operational amplifier – architectures – The gain stage with active load – The differential stage – DC level shifting – output stages – offset voltages and currents – Measurements of op – amp parameters – Frequency response and compensation – slew rate – BIFET and BIMOS circuits - Three stage Op.amp – MOS Op amp.

UNIT – III WAVE FORM GENERATORS AND WAVESHAPING (12 Hours)

Wave form Generators and waveshaping : Sinusoidal oscillators – Phase shift: oscillator – Wien bridge oscillator – General form of oscillator configuration – crystal oscillators – multivibrators – comparator – square - wave generation from a sinusoid – Regenerative comparator – Square and triangle - wave generators – pulse generators – NE 555timer and applications.

UNIT – IV DIGITAL CIRCUITS (12 Hours)

Binary - Decimal – Octal and Hexadecimal numbers – 8421 Excess–3 - Gray Codes – Logic gates – Laws Boolean algebra - Logic gates - Half and Full adder – Comparators – Decoders – Multiplexers – Demultiplexers - Design of combinational circuits - Sequential circuits - Flip Flops – Counters – Registers - A/D and D/A converter circuits.

UNIT – V VERY LARGE SCALE INTEGRATED SYSTEMS (12 Hours)

Dynamic MOS shift registers – CMOS Domino logic - Random Access Memory (RAM) – Read - write memory cells – Bipolar RAM cells – Charge coupled device (CCD) – CCD structures – Integrated - Injection logic(I2L) – Microprocessors and Micro computers.

TEXT BOOKS

1. Salivahanan, " Electronic devices and circuits", Tata McGraw Hill Publications, New Delhi (1998).
2. Albert Malvino & David J Bates, "Electronic Principles", Tata McGraw Hill Publications, 7th Edition, New Delhi, (2007).
3. A.P.Godse & U.A.Bakshi, "Electronic Devices and Circuits", Technical Publications, Second Edition, Pune (2015).

REFERENCE BOOKS

1. SM.Sze, "Semiconductor devices – Physics and technology", Wiley, New York (1985).
2. Ajay Ghatak and Thyagarajan, "Opto electronics", Cambridge University Press, New Delhi, (1989).
3. Millman, J & Grabel, A. "Micro Electronics", Tata McGraw Hill, Second edition, ISBN 0-07- 463736-3., (2002).
4. H.S.Kalsi, "Electronic Instrumentation", The McGraw-Hill Companies, Second edition, New Delhi, (2004).
5. K.V. Ramanan, "Functional Electronics", Tata McGraw-Hill, New Delhi, (1995).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the importance and applications of semiconductor devices.	1,2,4	Understanding
CO-2	Categorize the various uses of operational amplifier.	1,3	Analyzing
CO-3	Estimate the operational details of very large scale integrated systems.	4,5	Evaluating
CO4	Develop the ability to analyze and design different digital circuits.	2,4,5	Creating
CO-5	Construct the wave form generators and wave shaping circuits.	1,2,4	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
I	21PEPH11A		ADVANCED ELECTRONICS			60			4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓	✓		✓	
CO-2	✓	✓		✓	✓	✓		✓		
CO-3	✓	✓	✓	✓	✓	✓	✓		✓	
CO-4	✓	✓	✓	✓	✓		✓		✓	✓
CO-5	✓	✓	✓	✓	✓				✓	✓
	Number of matches (✓) = 37 Relationship = **High**									

SEMESTER- I

Course Title	**PYTHON PROGRAMMING**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH11B**
Course Type	**DSE-IB**
Credits	**4**
Marks	**75**

General Objective:

To educate the students about the Python programming for general purposes

Course Objectives:

CO	The learners will be able to
CO-1	Introduce the concepts of algorithms and develop them.
CO-2	Summarize the different types of statements in Python programming.
CO-3	Explain the aspects of control flow and functions in Python programming.
CO-4	Discuss the concepts of lists, tuples and dictionaries.
CO-5	Build confidence in Python programming to use the files, modules and packages.

UNIT I ALGORITHMIC PROBLEM SOLVING (12 Hours)

Algorithms- building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language)- algorithmic problem solving- simple strategies for developing algorithms (iteration, recursion). Illustrative problems:-find minimum in a list- insert a card in a list of sorted cards- guess an integer number in a range- Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS (12 Hours)

Python interpreter and interactive mode- values and types- int, float, boolean, string, and list- variables, expressions, statements - tuple assignment- precedence of operators- comments- modules and functions- function definition and use- flow of execution- parameters and arguments- Illustrative Programs: exchange the values of two variables- circulate the values of n variables- distance between two Points.

UNIT III CONTROL FLOW, FUNCTIONS (12 Hours)

Conditionals- Boolean values and operators-conditional (if)- alternative (if-else), chained conditional (if-elif-else)- Iteration: state, while, for, break, continue, pass; Fruitful functions- return values, parameters- local and global scope-function composition- recursion-Strings- string slices-immutability, string functions and methods- string module- Lists as arrays. Illustrative programs-square root, gcd, exponentiation- sum an array of numbers-linear search- binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES (12 Hours)

Lists: list operations- list slices- list methods- list loop- mutability- aliasing, cloning lists, list parameters- Tuples- tuple assignment- tuple as return value- Dictionaries- operations and methods-advanced list processing - list comprehension-Illustrative programs- selection sort- insertion sort-mergesort- histogram.

UNIT V FILES, MODULES, PACKAGES (12 Hours)

Files and exception- text files- reading and writing files-format operator- command line arguments-errors and exceptions-handling exceptions-modules-packages- Illustrative programs- word count- copy file.

TEXT BOOKS

1. David Beazley, "Python Cookbook", O'Reilly Media Inc., Third edition, Canada.
2. Allen B. Downey, "Think Python", O'Reilly Media Inc., Second edition, USA, (2016).
3. Mark Lutz, "Learning Python", O'Reilly Media, (2013).

REFERENCE BOOKS

1. Kenneth Lambert, "Fundamentals of Python: First Programms",. Cengage Learning, (2012).
2. Charles R. Severance, "Python for Everybody" Exploring Dta in Python 3", Amazon Digital Services, (2016).
3. Eric Matthes, " Python Crash Course", No Starch Press, (2015).
4. R.Nageswara Rao, "Core Python Programming", Dreamtech Press, (2018).
5. Yuxi Liu, " Python Machine Learning by Example", Packt Publishing Ltd., (2017).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the knowledge to develop algorithm in Python to solve various problems pertaining to Physics.	2,3	Understanding
CO-2	Apply the different types of data, expressions and statements in Python programming.	1,3	Applying
CO-3	Analyze the control flow and functions of Python environment.	1,3	Analyzing
CO-4	Measure the use of lists, tuples and dictionaries in Python programming.	1,2,3	Evaluating
CO-5	Develop the knowledge to use files, modules and packages in Python programming.	2,3,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
I	21PEPH11B	ELECTIVE PAPER II PYTHON PROGRAMMING	60	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓		✓	✓	✓		✓	✓		
CO-2	✓	✓		✓	✓	✓		✓		
CO-3	✓	✓		✓	✓	✓		✓		
CO-4	✓	✓	✓	✓	✓	✓	✓	✓		
CO-5	✓	✓	✓	✓	✓		✓	✓		✓
	Number of matches (✓) =34 Relationship = **High**									

SEMESTER- I

Course Title	**RADIOLOGICAL SAFETY ASPECTS**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH11C**
Course Type	**DSE-IC**
Credits	**4**
Marks	**100**

General Objective:

To create awareness among the students to gain knowledge on the safety aspects of radioactivity

Course Objectives:

CO	The learners will be able to
CO-1	Understand the fundamentals of radioactivity.
CO-2	Study the basics of radiation detectors.
CO-3	Explain the sources of radiation and their applications in the environment.
CO-4	Classify the Radioactive wastes and know to dispose them in a proper way.
CO-5	Experiment with the planning of isotope laboratories and transport of isotopes.

UNIT-I RADIATION PHYSICS (12 Hours)

Introduction to Radioactivity – Radioactive disintegration – Properties of nuclear radiation – Decay & half-life – type of decay - Interaction of Ionizing radiation with Matter – interaction of charge particles – Electromagnetic interactions – Photoelectric absorption – Compton scattering - Attenuation of Gamma radiation in matter – Biological effects: Radiation damage - Molecular level & Cellular level – Deterministic effects – Stochastic effects.

UNIT-II RADIATION DETECTION (12 Hours)

Detectors & Monitoring Instruments: Gas Filled Detectors: GM counter & Proportional Counter - Scintillation Detectors – Semiconductor Detectors - Radiation survey meters – Beta & Gamma detection - Neutron detector - Thermo-Luminescent dosimeters.

UNIT-III PRINCIPLES OF RADIOLOGICAL PROTECTION, HAZARDS EVALUATION & CONTROL (12 Hours)

Radiation Quantities and Units - Dose, equivalent dose and effective dose – ALI & DAC Radiological protection – Optimization of protection – Dose limits for radiation workers – internal exposure, Occupational exposure and members of public - Occupational exposure levels - Radiation hazards evaluation - Specific Gamma constant - Principles to control external hazards - Radiation shield – half-value thickness – Tenth value thickness.

UNIT-IV REGULATORY ASPECTS & WASTE DISPOSAL (12 Hours)

Regulatory document - Monitoring of external radiation - Area monitoring – Role of Radiological Safety Officers - Emergency procedures and spill control - Radioactive Waste management - Types of radioactive waste - Classification of radioactive waste - Disposal of radioactive waste – Solid - Liquid.

UNIT-V PLANNING OF ISOTOPE LABORATORIES & TRANSPORT OF ISOTOPES (12 Hours)

Calcification of radioisotopes – Types of radioisotope laboratories – Design of radioisotope lab. - Specifications & requirements - types of operations – Transport of radioisotopes – Condition for transport – selection of package & design requirements – types of package - safety aspects of transport.

TEXT BOOKS

1. K Thayalan, "Textbook Of Radiological Safety", Jaypee Brothers Medical Publishers Private Limited, (2010).P
2. K.M. Varier, "Nuclear Radiation Detection, Measurements and Analysis", Alpha Science Publication, (2009).
3. Nicolas Tsoulfanidis, Sheldon Landsberger, "Measurement and Detection of Radiation", CRC Press, Fourth Edition, (2015).

REFERENCE BOOKS

1. Govinda Rajan, "Advanced Medical Radiation Dosimetry" Prentice hall of India Pvt.Ltd., New Delhi, (1992).
2. AERB Radiation Production Rules (2004).
3. Glenn F. Knoll, "Radiation Detection and Measurement", John wiley& sons Inc.
4. K. Muraleedhara varier, "Nuclear radiation detection, measurements and analysis", Narosa.
5. S. S. Kapoor and V.S. Ramamurthy- "Nuclear Radiation Detectors", Wiley Eastern Ltd.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the various absorption mechanisms of radiation and particles.	1,2,4	Understanding
CO-2	Apply the knowledge of basic radiation detection mechanisms in various types of detectors.	2,3,5	Applying
CO-3	Examine the principles of radiological protection, hazards evaluation and control.	3,4	Analyzing
CO-4	Explain radioactive waste disposal.	1,4	Evaluating
CO-5	Create the planning of isotope laboratories and transport of isotopes.	4	Creating

Relationship Matrix

Semester	Course Code		Title of the Course					Hours		Credits
I	21PEPH11C		RADIOLOGICAL SAFETY ASPECTS					60		4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓	✓		✓	
CO-2	✓	✓	✓	✓	✓		✓	✓		✓
CO-3	✓		✓	✓	✓			✓	✓	
CO-4	✓	✓	✓	✓	✓	✓			✓	
CO-5			✓	✓	✓				✓	
	Number of matches (✓) =33 Relationship = **Medium**									

SEMESTER- I

Course Title	**GENERAL PHYSICS PRACTICALS - I**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCPH1P1**
Course Type	**PRACTICAL-I**
Credits	**2**
Marks	**100/2**

General Objective:

To train the students with advanced experimental techniques in Physics and to handle sophisticated equipments and analyze the data.

Course Objectives:

CO	The learners will be able to
CO-1	Demonstrate how to handle the equipment.
CO-2	Expose to a hands-on training to use the He-Ne laser source.
CO-3	Experiment the characteristics of lasers.
CO-4	Identify the various parameters in photovoltaic cell, ESR spectrometer and Ultrasonic interferometer experiments.
CO-5	Facilitate the concepts behind various physics experiments such as Quinke's Method, Dielectric constants of solids and thermistor.

(Any Eight)

1. Magnetic Susceptibility - Quinke's Method.
2. Ultrasonic interferometer – velocity and compressibility of any two liquids.
3. Cauchy's constants by least square fit (Experimental method).
4. Temperature coefficient of a thermistor.
5. ESR Spectrometer – Determination of Lande's g-factor.
6. Experiments based on He-Ne laser.
7. Force constant calculation from vibration spectrum.
8. Anderson's Bridge - Determination of self inductance of the given coil - (different turns/coil).
9. Characteristics of photovoltaic cell.
10. Dielectric constants and Dielectric loss of solids.
11. Study of Characteristics of LASER
    (i) Determination of Gaussian nature of laser source and evaluation of beam spot size.
    (ii) Measurement of Laser beam divergence.
    (iii) Absorption of light on various fibers.

12. Hysteresis loop Tracer.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO1	Understand the experiments independently with variety of scientific equipment.	1,3,5	Understanding
CO-2	Construct the working of Ultrasonic interferometer and estimate the velocity and compressibility of any liquids.	2,4,5	Applying
CO-3	Categorize the magnetic susceptibility of paramagnetic substance.	1,5	Analyzing
CO-4	Measure the temperature coefficient of Thermistor and self inductance of a coil.	2,4,5	Evaluating
CO-5	Speculate the wavelength of light emitted by He-Ne Laser and Lande 'g' factor for an electron using ESR spectrometer	2,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
I	21PCPH1P1	GENERAL PHYSICS PRACTICAL-I	60	2

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓		✓		✓
CO-2	✓	✓	✓			✓				✓
CO-3	✓	✓	✓	✓	✓		✓		✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-5	✓	✓	✓	✓			✓			✓
	Number of matches (✓) =36 Relationship = **High**									

SEMESTER- I

Course Title	**ADVANCED ELECTRONICS PRACTICALS-I**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCPH1P2**
Course Type	**PRACTICAL-II**
Credits	**2**
Marks	**100/2**

General Objective:

To educate the students in electronics so that they can verify and develop confidence to handle sophisticated equipments.

Course Objectives:

CO	The learners will be able to
CO-1	Understand the experimental techniques in electronics.
CO-2	Simulate themselves to handle various electronic circuits.
CO-3	Analyze the characteristics of op-amp and transistor.
CO-4	Develop the knowledge of multivibrators and IC circuits.
CO-5	Assemble the circuits of digital to analog and analog to digital conversion, use of logic gates.

(Any Eight)

1. Regulated power supply with 7805 & 7812.
2. Characteristics of Optoelectronic devices –LDR-Photodiode-LED-Photovoltaic cell.
3. Construction of Square wave and Triangular wave generator using OP-Amp.
4. OP-Amp Characteristics – Inverting and Noninverting amplifiers.
5. D/ A Converters using IC 741.
6. UP / Down Counters using IC 7476 / 7473.
7. Schmitt Trigger – using Op-Amp and Transistor.
8. Transistor characteristics.
9. Determination of Planck's constant.
10. 555 multivibrators.
11. Arithmetic operations using IC741.
12. Solve simultaneous equation (Two variables only) using IC 741.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the I-V characteristics of various optoelectronic devices like LDR, LED, photodiode and photovoltaic cell.	1,4,5	Understanding
CO-2	Develop an active expertise in using and constructing electronic circuits	1,3,5	Applying
CO-3	Analyze square and triangular wave using Op-amp and find the solutions of simultaneous equation.	3,5	Analyzing
CO-4	Design Up – Down counter using IC's	2,5	Creating
CO-5	Invent the characteristics of regulated power supply using IC 7805 &7812 and find solutions for Arithmetic operations using IC 7483	1,3,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours				Credits
I	21PCPH1P2	ADVANCED ELECTRONICS PRACTICALS-I					60				2
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓		✓		✓
CO-2	✓	✓	✓	✓	✓	✓			✓	✓
CO-3	✓	✓	✓	✓	✓			✓		✓
CO-4	✓	✓	✓	✓			✓			✓
CO-5	✓	✓	✓	✓	✓	✓		✓		✓
	Number of matches (✓) = 37 Relationship = **High**									

SEMESTER- I

Course Title	**BASICS OF DIGITAL ELECTRONICS**
Total Hrs.	**30**
Hrs./Week	**2**
Sub.Code	**21PIPH11**
Course Type	**IDC-I**
Credits	**2**
Marks	**100/2**

General Objective:

Digital techniques are helpful because it is a lot easier to get an electronic device to switch into one of a number of known states than to accurately reproduce a continuous range of values.

Course Objectives:

CO	The learners will be able to
CO-1	Acquire knowledge about analog and digital electronic devices and circuits.
CO-2	Use the knowledge of Boolean algebra for logical functions.
CO-3	Explain the combinational circuits of encoder and decoder.
CO-4	Compare the flip flop, registers and its applications.
CO-5	Express the concepts of Counter and Converters.

UNIT - I Number system (6 Hours)

Binary numbers – Decimal to Binary conversion – Octal numbers – Octal to Binary conversion –Hexadecimal numbers – Hexadecimal to Binary conversions – Binary Arithmetic – 1's complement subtraction – 2's complement subtraction – BCD addition.

UNIT - II Boolean algebra (6 Hours)

Laws of Boolean algebra – De Morgan's theorem – Algebraic simplification of logical expressions – Logic gates – Combinational logic design – Karnaugh map representation of logical functions – K-map simplification using minterm (2, 3 and 4 variables) – K-map simplification using max terms (2, 3 and 4 variables) – incomplete specified functions.

UNIT- III Combinational circuits (6 Hours)

Half adder – Full adder – Half subtractor – Full subtractor – Multiplexer – Demultiplexer – Encoder – Decimal to BCD encoder– Decoder – BCD to seven segment decoder – Application of combinational circuits.

UNIT - IV Sequential circuits (6 Hours)

Sequential circuits – RS flip flop using NOR gates – clocked RS flip flop – D flipflop – JK flip flop – Master Slave JK flip flop – T flip flop – Register and shift register – Types of registers – Application of sequential circuits.

UNIT - V Counters, Converters and Logic families (6 Hours)

Counters – asynchronous counter – synchronous counter – Decade counter – Application of counters – D/A converter: Ladder type – A/D converter – Application of converters – Diode Transistor Logic (DTL) – Transistor Transistor Logic (TTL).

TEXT BOOKS

1. V. Vijayendran, Digital fundamentals. S. Viswanathan Printers and Publishers Pvt. Ltd., (2009).
2. Virendra Kumar, Digital electronics, New Age International Publishers (2007).
3. R. Muthusubramanian, Salivahanan, Basic Electrical and Electronics Engineering, Tata MCGraw Hill Education Pvt. Ltd., (2011).

REFERENCE BOOKS :

1. Avinashi Kapoor and L. K. Maheswari, Digital Electronics - Principles and Practice, Macmillan India Limited (2004).
2. D. A. Godse and A.P. Godse, Digital electronics, Technical Publlsher, Pune (2008).
3. Morris Mano, Digital Logic and Computer Design, Pearson Education (2004).
4. Don Leach, Albert Malvino, Digital principles and applications, McGraw-Hill Inc., US (1994).
5. P.S. Manoharan, “Digital Electronics and Microprocessors”, Charulatha Publications. Chennai (2013).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Comprehend the concept of analog and digital code conversion techniques of number system.	1,3	Understanding
CO-2	Apply the knowledge of Boolean algebra and simplify the logical expressions using Karnaugh map.	1,3	Applying
CO-3	Categorize the combinational circuits of multiplexer and demultiplexer.	1,3	Analyzing
CO-4	Explain the flip flops using sequential circuits and interpret the function of shift registers.	3,4	Evaluating
CO-5	Design, analyse and evaluate physical operation of A/D and D/A conveters and its real world application	2,4,5	Creating

Relationship Matrix

Semester	Course Code			Title of the Course				Hours	Credits
I	21PIPH11			BASICS OF DIGITAL ELECTRONICS				30	2
CourseOutcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO2	PLO3	PLO4	PLO5	PSO 1	PSO2	PSO3	PSO4	PSO 5
CO-1	✓	✓		✓	✓	✓		✓		
CO-2	✓	✓		✓	✓	✓		✓		
CO-3	✓	✓		✓	✓	✓		✓		
CO-4	✓		✓	✓	✓			✓	✓	
CO-5	✓	✓	✓	✓	✓		✓		✓	✓
	Number of matches (✓) = 32 Relationship = **Medium**									

SEMESTER- II

Course Title	**MATHEMATICAL PHYSICS – II**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCPH21**
Course Type	**DSC-IV**
Credits	**4**
Marks	**100**

General Objective:

Improving student comfort with some mathematical techniques and highlighting the applications of mathematical methods to physics systems.

Course Objectives:

CO	The learners will be able to
CO-1	Grasp knowledge in function of a complex variable.
CO-2	Build expertise in evaluating the definite and infinite integrals using complex variables.
CO-3	Develop problem-solving skills using a variety of specialized functions such as Green, Bessel and Laguerre.
CO-4	Competently use tensor algebra as a tool in the field of applied sciences and related fields.
CO-5	Discriminate the solution of heat flow, vibrating string and membrane problems.

UNIT – I COMPLEX VARIABLES-I (15 Hours)

Function of a complex variable-analytic functions-Necessary and sufficient condition for a function to be analytic (CR equations) – Laplace's equation: Harmonic functions – Line integral of a complex function – Cauchy's integral theorem– Cauchy's Integral formula – Derivatives of an analytic function – Taylors series – Laurent's series.

UNIT – II COMPLEX VARIABLES-II (15 Hours)

Singularities of an analytic function – Residues and their evaluation – Cauchy's residue theorem – Evaluation of definite integrals: Definite integrals of trigonometric functions of $\cos\theta$ and $\sin\theta$ – Evaluation of improper real integrals – evaluation of infinite integrals by Jordan's lemma – evaluation of infinite integrals when the integrand has poles on real axis.

UNIT – III SPECIAL FUNCTIONS II (15 Hours)

Green's functions-An introduction - Green's functions for one - dimensional problems – Green's functions for Poisson's equation -Bessel differential equation and Bessel's function of I, II and III kind – Recurrence formulae – Generating function - Orthonormality of Bessel's functions – Laguerre's Differential equation and Laguerre's polynomials – Generating function – Recurrence relations – Orthogonal property

UNIT – IV PARTIAL DIFFERENTIAL EQUATIONS (15 Hours)

Method of seperation of variables - Heat flow equation - solution of heat flow equation in one - dimension - Two dimentional heat flow - Three dimentional heat flow – Heat flow in circular plate – Heat flow in rectangular plate - Equation of motion for the vibrating string – Vibrations of a rectangular membrane - Vibrations of a circular membrane

UNIT – V TENSORS (15 Hours)

Scalar, Vector and Tensors – Difference between a tensor and a transformation matrix – Tensors of second rank - Contravariant, Covariant & mixed tensors– Addition, subtraction, Equality and null tensors – Inner and outer product – Contraction of tensor – Quotient law– Metric tensor - Tensors in electromagnetic theory - Invariance of Maxwell's equations

TEXT BOOKS

1. Satya Prakash, "Mathematical Physics", Sulthan Chand & Sons, New Delhi, (2005).
2. V. Balakrishnan, " Mathematical Physics with Applications, Problems and solutions", Ane Books Publishers, (2017).
3. H.K.Dass and Rama Verma, "Mathematical Physics", Chand and company Ltd. (2010).

REFERENCE BOOKS

1. George B. Arfken and Hans J. Weber, "Mathematical Methods for Physicists", Academic Press, Sixth Edition (2005).
2. Murray R. Spiegel, "Theory and Problem of complex variables - Schaum's series", Mc Graw - Hill, New delhi (1988).
3. Erwin Kreyszig, "Advanced Engineering Mathematic"s, John wiley and sons (Asia), 8th Edition, (2005).
4. Pipes and Harvill, "Applied Mathematics for Engineers and Physicists," Mc-Graw Hill. Third Edition, New Delhi, (2014).
5. Murray R. Spigel, "Theory and Problems of Laplace transforms", International edition, Mcgraw hill, New Delhi, (1986).

Course outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the various functions of complex variables and line integrals of complex function	1,3	Understanding
CO-2	Apply the complex variables concept to find the solution of definite and infinite integrals	1,2,3	Applying
CO-3	Examine the solution of various Physics problems using the functions such as Green, Bessel and Laguerre.	3,4	Analyzing
CO-4	Construct the solution of heat flow equation, vibrating string and membrane problems using the method of separation of variables.	1,3	Creating
CO-5	Assess the important features of tensors and its applications in various fields of Physics.	3,4,5	Evaluating

Relationship Matrix

Semester	Course Code		Title of the Course					Hours		Credits
II	21PCPH21		MATHEMATICAL PHYSICS – II					75		4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓		✓	✓	✓		✓		
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		
CO-3	✓		✓		✓			✓	✓	
CO-4	✓	✓		✓	✓	✓		✓		
CO-5	✓	✓	✓	✓	✓			✓	✓	✓
	Number of matches (✓) =34 Relationship = **High**									

SEMESTER- II

Course Title	**QUANTUM MECHANICS - I**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCPH22**
Course Type	**DSC-V**
Credits	**4**
Marks	**75**

General Objective:

To develop the knowledge about atoms dual nature of particle and wave functions and its applications

Course Objectives

CO	The learners will be able to
CO-1	Recall the fundamentals of quantum mechanics.
CO-2	Make use of the basic principles of quantum mechanics to find the solution of bound state problems.
CO-3	Develop expertise in the matrix formulation of quantum mechanics.
CO-4	Sort out the various types of angular momentum and its properties.
CO-5	Review the kinematics of scattering process.

UNIT –I FOUNDATION OF WAVE MECHANICS (15 Hours)

Postulates of wave mechanics-degeneracy-eigen value, eigen function-Hermitian operator-parity-uncertainity principle.

Matter waves- Equation of motion - Physical interpretation of wave function- Normalised and orthogonal wave functions-Stationary state solution of schrodinger wave equation- Expectation values - Probability current density- Ehrensfest's theorem – Uncertainty principle- Mathematical proof of Uncertainty principle for one dimensional wave packet.

UNIT - II BOUND STATE PROBLEM (15 Hours)

Bound State Problems – Particle in a box – One dimensional square well potential – Finite potential step – Linear harmonic oscillator – Schrodinger equation- eigen values, energy eigen function- Rigid rotator- wave equation- eigen values and eigenfunction for the rotator- Hydrogen atom -solution of radial equation- energy levels.

UNIT - III EQUATION OF MOTION AND MATRIX FORMULATION (15 Hours)

Equations of motion - Schrödinger picture - Heisenberg picture – Interaction picture – Quantum state vectors and functions- Hilbert space – Operators as Matrices – Matrices form of Wave Function – Unitary Transformations – Eigen value Problem – Projection Operator - Dirac's Bra-ket notation- Matrix theory of Harmonic oscillator.

UNIT – IV ANGULAR MOMENTUM (15 Hours)

Angular momentum operator in position representation-Spin angular momentum-commutation relation of total angular momentum with components- Eigen values and matrix representation of J^2 , J_z and J_+J_-- Addition of angular momenta- Clebsch Gordan coefficients-calculation of Clebsch Gordan coefficients for $j_1=1/2$, $j_2=1/2$.

UNIT – V SCATTERING THEORY (15 Hours)

Kinematics of scattering process- Scattering amplitude and scattering cross section - Green's functions for scattering amplitude - Born approximation and its validity - Partial wave analysis –Scattering by a spherically symmetric potential- phase shift-differential and total cross sections- optical theorem- scattering by square well potential.

TEXT BOOKS

1. Satyaprakash, "Advanced Quantum Mechanics", KedarNath Ram Nath Publication, New Delhi, (2009).
2. P.M. Mathews and Venkatesan, "A Text Book of Quantum Mechanics", Tata McGraw-Hill, New Delhi, (1976).
3. Thangappan. V.K., "Quantum Mechanics", Wiley Eastern Ltd., New Delhi, Second Edition, (1995).

REFERENCE BOOKS

1. V. Devanathan, "Quantum Mechanics", Narosa Publishing House Pvt. Ltd., Chennai, (2005).
2. S. Rajasekar and R. Velusamy, "Quantum Mechanics-Fundamentals-I & II", CRC Press, New York, (2005).
3. L.I. Schiff, "Quantum Mechanics", McGraw Hill Book Company, New York, Third Edition, (2002).
4. Nouredine Zettili, "Quantum Mechanics-Concepts and Applications", Wiley Publications, USA, 2nd Edition, (2009).
5. R. Shankar, "Principles of Quantum Mechanics", Plenum Press, New York and London, Second Edition. (1994).

Course Outcome

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the fundamentals and origin of quantum mechanics and know the concept of uncertainty principle.	1,3,4	Understanding
CO-2	Solve the bound state problems such as particle in a box, rigid rotator, potential well and Hydrogen atom.	1,3	Applying
CO-3	Examine the various pictures and the usage of matrix theory in quantum mechanics.	1,2,3	Analyzing
CO-4	Assess the Eigen values and matrix representation of J^2 and J_z and J_+,$J_-$and Addition of angular momentum.	2,3	Evaluating
CO-5	Formulate the scattering amplitude and cross-section for the scattering of particles using Born approximation and partial wave analysis.	2,3,4	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
II	21PCPH22		QUANTUM MECHANICS - I			75			4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓		✓	✓	
CO-2	✓	✓		✓	✓	✓		✓		
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓		✓		✓		✓	✓		
CO-5	✓		✓	✓	✓		✓	✓	✓	
	Number of matches (✓) = 35 Relationship = **High**									

SEMESTER- II

Course Title	**ATOMIC AND MOLECULAR SPECTROSCOPY**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCPH23**
Course Type	**DSC-VI**
Credits	**4**
Marks	**100**

General Objective:

To have in depth understanding of various techniques of spectroscopy and to study its applications to modern science

Course Objectives:

CO	The learners will be able to
CO-1	Review the spectral analysis in atomic level.
CO-2	Discuss the atoms in an external field and resonance spectroscopy
CO-3	Explore the fields of rotational and vibrational Spectroscopy.
CO-4	Recognize the important features of Raman spectroscopy
CO-5	Highlight the significance of electronic spectroscopy.

UNIT-I ATOMIC SPECTRA (15 Hours)

Quantum states of Electron in atoms- Hydrogen atom spectrum- Electron spin-Spin Orbit interaction- Lande interval rule- Two electron system- LS – JJ coupling Schemes- Fine structure- Spectroscopic terms and selection rules- Hyperfine structure- Isotopic shift- Width of spectral lines- Exchange symmetry of wave function- Pauli's exclusion principle- Spectrum of Helium and Alkali atom.

UNIT-II ATOMS IN EXTERNAL FIELDS AND RESONANCE SPECTROSCOPY (15 Hours)

Zeeman and Paschen Back Effect of one and two electron systems- Stark effect- X-ray – Auger transitions- Compton Effect- NMR – Basic principles- Classical and Quantum

mechanical description- Magnetic dipole coupling-Chemical shift- Knight shift- ESR – Basic principles- Nuclear interaction and Hyperfine Structure- g-factor- Zero field splitting.

UNIT-III MICROWAVE SPECTROSCOPY AND IR SPECTROSCOPY (15 Hours)

Rotational spectra of diatomic molecules- Rigid rotator - Effect of isotropic substitution- Non rigid rotator – Rotation spectra of polyatomic molecules- Linear, symmetric top and asymmetric top molecules- Experimental Techniques- Diatomic vibrating rotator- Linear, Symmetric top molecule- Analysis by infrared techniques.

UNIT-IV RAMAN SPECTROSCOPY (15 Hours)

Raman Effect-Quantum theory of Raman effect- Electronic, rotational, vibrational and Raman spectra of diatomic molecules- Raman spectra of polyatomic molecules- Raman Spectrometer- Hyper Raman effect- Experimental techniques – Laser Raman Spectroscopy.

UNIT-V ELECTRONIC SPECTROSCOPY (15 Hours)

Electronic spectra of diatomic molecules- Frank-Condon principle- Dissociation energy and dissociation products- Rotational fine structure of electronic vibration transitions- Fortrat Diagram- Pre-dissociation.

TEXT BOOKS

1. C.N. Banwell and E.M. McCash, "Fundamentals of Molecular Spectroscopy", IV ed., Tata Mcgraw- Hill Education (India) Private Limited, New Delhi.
2. G. Aruldhas, "Molecular Structure and Spectroscopy", Prentice-Hall of India private Limited, New Delhi.
3. G.M. Barrow, " Introduction to Molecular Spectroscopy", McGraw-Hill Kogakusha Ltd, Tokyo.

REFERENCE BOOKS

1. P.S. Sindhu, "Molecular Spectroscopy", Tata McGraw-Hill publishing company Limited, New Delhi.
2. John Brown and Alan Carrington, "Rotational Spectroscopy of Diatomic Molecules", Cambridge University Press, USA, (2003).
3. C.H.Townes, and A.L. Schawlow, "Microwave Spectroscopy", Dover Publications, New York, (2012).
4. Web Resource-Rotational Spectroscopy of Diatomic Molecules Physics Today 57, 68 (2004); https://doi.org/10.1063/1.1878342
5. Web Resource -Spectroscopy, quantum chemistry and molecular physics Physics Today 21, 52 (1968); https://doi.org/10.1063/1.303492

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the various coupling schemes and spectrum of Helium and Alkali atom.	1,3	Understanding
CO-2	Identify the features of atom in external fields using X-ray, NMR and ESR.	2,3,4	Applying
CO-3	Distinguish the rotational and vibrational spectrum of diatomic molecules.	1,3	Analyzing
CO-4	Explain the classical and quantum theory of linear and nonlinear Raman spectroscopy.	1,2,3	Evaluating
CO-5	Design the important features of electronic spectra of diatomic molecules and dissociation of molecules	2,3	Creating

Relationship Matrix

Semester	Course Code		Title of the Course					Hours		Credits
II	21PCPH23		ATOMIC AND MOLECULAR SPECTROSCOPY					75		4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓		✓	✓	✓		✓		
CO-2	✓		✓	✓	✓		✓	✓	✓	
CO-3	✓	✓			✓	✓		✓		
CO-4	✓	✓	✓	✓	✓	✓	✓	✓		
CO-5	✓		✓	✓	✓		✓	✓		
	Number of matches (✓) =32 Relationship = **Medium**									

SEMESTER- II

Course Title	**ADVANCED MICROPROCESSORS AND MICROCONTROLLERS**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH21A**
Course Type	**DSE-IIA**
Credits	**4**
Marks	**100**

General Objective:

Microprocessor and microcontroller have become important building blocks in digital electronics design. 8086 microprocessor architecture, programming, and interfacing is dealt in detail in this course.

Course Objectives:

CO	The learners will be able to
CO-1	Promote an idea about the architecture and working of 8-bit and 16-bit Intel 8085 microprocessors.
CO-2	Know the addressing modes od instruction sets of Intel 8085 μP.
CO-3	Build expertise in the architecture and instruction set of Intel 8051 microcontroller.
CO-4	Familiarize themselves with the various interfacing schemes
CO-5	Design the working details of micro processor based systems

UNIT – I 8 BIT AND 16 BIT MICROPROCESSORS (12 Hours)

Introduction - Intel 8085 microprocessor (Pin configurations and their functions) - Architecture (ALU, Registers, Timing control unit, Bus system, Flag and interrupts) - opcode and operands - Instruction word size - 8086 Internal Architecture - Internal registers – Bus Cycles and Timing Diagram – Format of 8086 Instructions.

UNIT - II INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING (12 Hours)

Addressing modes of 8085(Register addressing, Direct Addressing, register indirect addressing, Immediate addressing and Implied Addressing). Instruction sets of Intel 8085 (Data transfer, Arithmetic, logical, branch, stack, I/o and machine control group)- Simple assembly language programs (8 bit addition, subtraction, multiplication, division, largest and smallest numbers).

UNIT - III 8 BIT MICROCONTROLLERS (12 Hours)

Introduction of 8051 microcontroller - Architecture - Addressing modes (Immediate, Direct, Register, Register indirect, Implied and Relative) - Instruction set of 8051 (Data transfer, Arithmetic, logical, program branching and Boolean variable).

UNIT - IV PERIPHERAL INTERFACE (12Hours)

Introduction- Interfacing scheme (Memory, I/O, memory &I/O mapped) - Data transfer scheme (Programmed & DMA) - Intel 8255 (Programmable Peripheral Interface) - Intel 8279 - Keyboard and display interface.

UNIT - V MICROPROCESSOR BASED SYSTEMS (12 Hours)

Introduction – Specifications – Peripheral Devices - Microprocessor based system: Temperature control system, Motor speed control system and Traffic light control system – Stepper Motor Control System.

TEXT BOOKS

1. Ramesh Gaonkar, "Microprocessor Architechture, Programming and Applications with the 8085", Penram International Publishing (India) Private Limited, Fifth edition, (2012).
2. B. Ram, "Fundamentals of Microprocessors and microcontrollers", Dhanpat Rai publications , , New Delhi , (2005).
3. Microprocessors and microcontrollers– A.Nagoor Kani, Tata McGraw-Hill Education Pvt. Ltd., 2nd Edition, New Delhi, (2012).

REFERENCE BOOKS

1. Kenneth J Ayala, "The 8051 microcontroller", 3rd Edition, Cengage learning, New York, (2010).
2. A.K. Ray and K M Bhurchandani, "Advanced Microprocessors and Peripherals", Tata McGraw-Hill Ltd., New Delhi, (2007).
3. P.S. Manoharan, "Digital Electronics and Microprocessors", Charulatha Publications.Chennai (2013).
4. Mathur, "Introduction to Microprocessors, Tata Mcgraw Hill Publications, Third Edition.
5. Amar K. Ganguly and Anuva Ganguly, "Microprocessors and Microcontrollers 8085, 8086 and 8051", Narosa Publications, New Delhi, (2012).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Explain the organization and internal architecture of the Intel 8085 and Intel 8086 microprocessors.	1,3	Understanding
CO-2	Apply the various addressing modes, instruction sets and simple assembly language programs	1,2,3	Aplying
CO-3	Summarize the important techniques of various interfacing schemes	1,2,3	Analyzing
CO-4	Estimates the constructional details of Intel 8051 microcontroller	1,3	Evaluating
CO-5	Construct the Microprocessor based system such as Temperature control system, Motor speed control system and Traffic light control system.	2,4,5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
II	21PEPH21A		ADVANCED MICROPROCESSORS AND MICROCONTROLLERS			60			4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓		✓	✓	✓		✓		
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		
CO-3	✓	✓		✓	✓	✓		✓		
CO-4	✓	✓	✓	✓	✓	✓	✓	✓		
CO-5	✓	✓	✓	✓	✓		✓		✓	✓
	Number of matches (✓) = 36 Relationship = **High**									

SEMESTER- II

Course Title	**MATERIALS PHYSICS AND PROCESSING TECHNIQUES**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH21B**
Course Type	**DSE-IIB**
Credits	**4**
Marks	**100**

General Objective:

This course involves investigating the relationships that exist between processing, structure, property and performance of materials.

Course Objectives:

CO	The learners will be able to
CO-1	Classify the techniques of crystal growth and methods.
CO-2	Utilize the important features of plasma processing.
CO-3	Recognize the classification of pumps and pressure gauges.
CO-4	Explore the fields of thin film and nano technology.
CO-5	Develop expertise in handling on various characterizing techniques.

UNIT-I CRYSTAL GROWTH (12 Hours)

Introduction to crystal growth - Naturally occurring crystal growth processes-Crystal growth processes in laboratory and industrial scale - Classification of methods - Growth from solutions - Nucleation - Homogeneous and heterogeneous –Saturation - Supersaturation - Slow evaporation and slow cooling methods - Growth from gel - Growth from flux - Growth from melt - Bridgeman - Stockbarger method - Czochralski pulling method - Growth from vapour- Sublimation method.

UNIT-II PLASMA PROCESSING (12 Hours)

Introduction to plasma- Types of plasma- Properties of plasma- V-I characteristics- Advantages of plasma processing- Thermal plasma- Principles of plasma Structure of sprayed deposits- Plasma decomposition- Treatment of hazardous wastes - Synthesis of ultrafine nanopowders- Plasma melting and remelting- Glow discharge plasma- Plasma reactors for surface treatment.

UNIT-III VACUUM TECHNIQUES (12 Hours)

Qualitative description of pumping process - Surface processes - Gas flow mechanism - Classification of pumps - Positive displacement pumps - Kinetic pumps - Entrapment pumps - Classification of pressure gauges - Total pressure gauges - Hydrostatic pressure gauges - Thermal conductivity gauges - Ionization guages - Vacuum system- simple rotary-diffusion - turbo molecular - ultra high vacuum and cryo-pumped systems.

UNIT-IV THIN FILMS AND NANOMATERIALS (12 Hours)

Plasma arc discharge - sputtering - chemical vapour deposition - pulsed laser deposition - molecular beam epitaxy - Electrochemical deposition - SILAR method - Solid-State Reaction - Sol - Gel Technique - Hydrothermal growth - Ball Milling - Combustion synthesis - Sonochemical method - Microwave synthesis - Coprecipitation

UNIT-V CHARACTERIZATION TOOLS (12 Hours)

Working principles and instrumentation - X-Ray Diffraction (XRD) - X-ray Photoelectron Spectroscopy (XPS) - Atomic Emission Spectroscopy (AES) - Scanning Electron Microscopy - Energy Dispersive X-Ray Analysis (SEM-EDAX) - UV-Visible Spectroscopy - Photoluminescence (PL) - Atomic Force Microscopy (AFM).

TEXT BOOKS

1. William Calister, "Materials Sciece and Engineering", Willey, USA, (1985).
2. Santhanaraghavan and Ramasamy, " Crystal Growth Processes and Methods", Kru Publications, (2000).
3. K. L. Chopra, Thin Films Phenomena, McGraw Hill, First Edition (1969).

REFERENCE BOOKS

1. D. K. Avasthi, A. Tripathi, A. C. Gupta, Ultra High Vacuum Technology, Allied Publishers Private Limited (2002).
2. Kasturi Lal Chopra, Suhit Ranjan Das, Thin Film Solar Cells, Plenum Press, New York (1983).
3. A.Chambers, R.K.Fitch and B.S.Halliday, Basic Vacuum Technology, IOP Publishing Ltd., 2nd Edition (1998).
4. Pipko A, Pliskosky V, Fundamentals of Vacuum Techniques, MIR Publishers First Edition, (1984).
5. Roth, Vacuum Technology, North Holland, Third Edition (1990).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Explain the basic concepts of crystal and its growth technique.	1,3	Understanding
CO-2	Identify the importance of plasma synthesis and processing techniques.	1,3,4	Applying
CO-3	Analyze the suitable pumping systems to obtain the required level of vacuum	2,4	Analyzing
CO-4	Assess the various growth processes of thin film and nanomaterials.	2,3,4	Evaluating
CO-5	Construct the working principles and instrumentation of various characterizing tools such as XRD, SEM, XPS,AES, PL and AFM.	2,3,4	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
II	21PEPH21B	ELECTIVE PAPER II MATERIALS PHYSICS AND PROCESSING TECHNIQUES	60	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓		✓	✓	✓		✓		
CO-2	✓	✓	✓	✓	✓	✓		✓	✓	
CO-3			✓	✓	✓		✓		✓	
CO-4	✓		✓	✓	✓		✓	✓	✓	
CO-5	✓		✓	✓	✓		✓	✓	✓	
	Number of matches (✓) = 33 Relationship = **High**									

SEMESTER- II

Course Title	**PLASMA PHYSICS**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH21C**
Course Type	**DSE-IIC**
Credits	**4**
Marks	**100**

General Objective:

This course focuses on plasma physics, plasma diagnostics techniques and its application to various generators.

Course Objectives:

CO	The learners will be able to
CO-1	Understand the basic concepts and properties of plasma.
CO-2	Impart the knowledge of motion of charged particles in electric, magnetic fields.
CO-3	Explain the theory of plasma oscillations and waves.
CO-4	Develop their understanding of various probe technique for measurement of Plasma parameters.
CO-5	Formulate the applications of plasma physics.

UNIT – I FUNDAMENTAL CONCEPTS ABOUT PLASMA (12 Hours)

Kinetic pressure in a partially ionized - mean free path and collision cross section- mobility of charged particles - Effect of magnetic field on the mobility of ions and electrons- Thermal conductivity- Effect of magnetic field- Quasi- neutrality of plasma Debye shielding distance - Optical properties of plasma.

UNIT – II MOTION OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELD (12 Hours)

Particle description of plasma- Motion of charged particle in electrostatic field- Motion of charged particle in uniform magnetic field - Motion of charged particle in electric and magnetic fields- Motion of charged particle in inhomogeneous magnetic field - Motion of charged particle in magnetic mirror confinement - motion of an electron in a time varying electric field- Magneto- hydrodynamics - Magneto-hydrodynamic equations - Condition for magneto hydrodynamic behavior.

UNIT – III PLASMA OSCILLATIONS AND WAVES (12 Hours)

Introduction, theory of simple oscillations - electron oscillation in a plasma - Derivations of plasma oscillations by using Maxwell's equation - Ion oscillation and waves in a magnetic field - thermal effects on plasma oscillations - Landau damping - Hydro magnetic waves -Oscillations in an electron beam.

UNIT – IV PLASMA DIAGNOSTICS TECHNIQUES (12 Hours)

Single probe method - Double probe method - Use of probe technique for measurement of plasma parameters in magnetic field - microwave method - spectroscopic method - -laser as a tool for plasma diagnostics-X-ray diagnostics of plasma - acoustic method - conclusion.

UNIT - V APPLICATIONS OF PLASMA PHYSICS (12 Hours)

Magneto hydrodynamic Generator - Basic theory - Principle of Working -Fuel in MHD Generator - Generation of Microwaves Utilizing High Density Plasma - Plasma Diode.

TEXT BOOKS

1. S.N.Sen, PragatiPrakashan, Meerut, Plasma Physics- Plasma State of Matter.
2. M. Uman, Introduction to Plasma Physics.
3. I.H. Hutchinson, Principles of Plasma Diagnostics

REFERENCE BOOKS

1. F.F.Chen, Introduction to Plasma Physics, Plenum Press, London
2. Krall &Trivelpiece, Principles of Plasma Physics.
3. D.R. Nicholson, Introduction to Plasma Theory.
4. J.L. Shohet, The Plasma State.
5. R.H. Huddlestone& S.L. Leonard, Plasma Diagnostic Techniques.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the basic concepts and properties of plasma.	1,3	Understanding
CO-2	Apply the knowledge on motion of charged particles in electric and magnetic fields	2,3	Applying
CO-3	Compare the simple theory of oscillation and electron oscillation in Plasma.	2,3	Analyzing
CO-4	Estimate the various plasma phenomena from various diagnostic techniques.	2,4	Evaluating
CO-5	Formulate the important applications of plasma physics.	3,4	Creating

Relationship Matrix

Semester	Course Code			Title of the Course			Hours		Credits	
II	21PEPH21C			PLASMA PHYSICS			60		4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓		✓	✓	✓		✓		
CO-2	✓		✓	✓	✓		✓	✓		
CO-3	✓	✓		✓	✓	✓		✓		
CO-4			✓	✓	✓		✓		✓	
CO-5	✓		✓	✓	✓			✓	✓	
	Number of matches (✓) = 29 Relationship = **Medium**									

SEMESTER- II

Course Title	**GENERAL PHYSICS PRACTICALS - II**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCPH2P1**
Course Type	**PRACTICAL-III**
Credits	**2**
Marks	**100/2**

General Objective:

The course aims at exposing the students to the intricacies of handling sophisticated equipments and analysis of results.

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Course Objectives:

CO	The learners will be able to
CO-1	Expose the students to offer experiments based on the concepts of physics in optics, electrical properties, magnetic properties, mechanical properties etc..
CO-2	Provide hands on experience to handle scientific equipment, measure and analyze the data.
CO-3	Experiment the Optical and Electrical characteristics of a given LED.
CO-4	Make the students understand the concepts behind various physics experiments such as dielectric loss of liquids, laser and solar basee experiments.
CO-5	Identify various physical parameters in arc spectrum, Forbe,s method, and spectrometer experiments.

(Any Eight)

1. Hyperbolic fringes – Determination of elastic constants.
2. Optical fibre – Determination of Numerical Aperture, acceptance angle, power loss and attenuation co efficient.
3. Particle size determination using He-Ne laser.
4. Determination of the wavelength of the laser using grating and determination of the thickness of the wire.
5. Optical and Electrical characteristics of a given LED.
6. Experiment using spectrometer.
7. Mutual inductance – coupling co efficient as a function of distance and angle.
8. GM Counter- Characteristics / B-H Curve.
9. Dielectric constant and loss of liquids.`
10. Solar based Experiments.
11. Arc spectrum - constant deviation spectrograph.
12. Thermal conductivity and Lorentz number determination – Forbe's method.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand experiments independently with variety of scientific equipment.	1,3,5	Understanding
CO-2	Analyze the characteristics of B-H curve and GM counter.	3,4,5	Analyzing
CO-3	Determine the Numerical Aperture, acceptance angle, power loss and attenuation co efficient of a given Optical fibre.	3,4,5	Evaluating
CO-4	Estimate the various physical parameters in arc spectrum and Forbe,s method.	3,5	Evaluating
CO-5	Find the Optical and Electrical characteristics of a given LED and measure particle size using He-Ne laser.	4,5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours		Credits		
II	21PCPH2P1		GENERAL PHYSICS PRACTICALS - II			60		2		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓		✓		✓
CO-2	✓	✓	✓	✓	✓			✓	✓	✓
CO-3	✓	✓	✓	✓	✓				✓	✓
CO-4	✓	✓	✓	✓	✓			✓	✓	✓
CO-5	✓	✓	✓	✓	✓			✓		✓
	Number of matches (✓) = 38 Relationship = **High**									

SEMESTER- II

Course Title	**ADVANCED ELECTRONICS PRACTICALS-II**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCPH2P2**
Course Type	**PRACTICAL-IV**
Credits	**2**
Marks	**100/2**

General Objective:

The course aims at exposing the students to the intricacies of handling sophisticated equipments, designing electronic circuits, trouble shooting and analysis of results

Course Objectives:

CO NO	The learners will be able to
CO-1	Develop the confidence for handling sophisticated equipment.
CO-2	Educate themselves to a hands -on training in the construction of simple electronics circuits.
CO-3	Recognize various components such as resistor, capacitor, IC's, voltmeter, ammeter, LED, switches etc., and its usage in circuit designs.
CO-4	Make the students understand practically the characteristics of transistors, amplifiers, oscillators and filters.
CO-5	Provide an exposure on analog to digital conversion, BCD to seven segment display and adder circuits

(Any Eight)

1. IC 555 Timer – Square wave generation
2. Active filters –Low, High and band pass filters
3. Half adder and Full adder circuits using IC's
4. BCD to seven segment display.
5. A/D Converters using IC 741
6. Ring counter
7. UJT relaxation oscillator / SCR Characteristics
8. Shift Register (SISO, PIPO)
9. Study of JK Flip-Flop.
10. FET Amplifier
11. Two Stage Amplifier with feedback and without feedback
12. Oscillators (Hartley and Colpitt).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand complex simple practical circuits using the electronic components	2,3,5	Understanding
CO-2	Construct Active filter circuit such as low pass, high pass and band pass filters using IC 741.	3,5	Applying
CO-3	Analyse FET, UJT and SCR circuit and study their I–V characteristics.	1,3,5	Analyzing
CO-4	Experiment the circuit with various types of oscillators and amplifiers.	3,4,5	Analyzing
CO-5	Design BCD to seven segment display, adder and A/D converter circuits using IC's	2,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PCPH2P2**	**CORE PRACTICAL – II ADVANCED ELECTRONICS PRACTICALS-II**	**60**	**2**

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO-1	✓	✓	✓	✓	✓		✓	✓		✓
CO-2	✓	✓	✓	✓	✓			✓		✓
CO-3	✓	✓	✓	✓	✓	✓		✓		✓
CO-4	✓	✓	✓	✓	✓			✓	✓	✓
CO-5	✓	✓	✓	✓	✓		✓		✓	✓
	Number of matches (✓) = 39 Relationship = **High**									

SEMESTER- II

Course Title	**SWAYAM-NPTEL ONLINE CERTIFICATION COURSE**
Total Hrs.	**30**
Hrs./Week	**2**
Sub.Code	**21PSPH21**
Course Type	**SEC**
Credits	**2**
Marks	**100/2**

SWAYAM-NPTEL ONLINE CERTIFICATION COURSES

GUIDELINES AND INSTRUCTIONS

1. National Programme on Technology Enhanced Learning (NPTEL) provides e-learning through online web and video courses in Engineering, Science and Humanities streams through its portal https://swayam.gov.in/ncdetails/NPTEL.
2. Enrollment to all the courses is FREE.
3. Enrollment to courses and Examination Registration can be done ONLINE only. The link is available on NPTEL Website http://nptel.ac.in/
4. SWAYAM– NPTEL Online Certification Courses are mandated for the students in the PG Programmes from the Academic year 2021-2022.
5. Candidates must have completed Examination Registration successfully within the prescribed time to receive hall tickets and to write examinations.
6. Any Eight – Week, Two-Credit Course in any discipline to offer for two hours a week be chosen by the respective Departments in the second semester of the Postgraduate Programmes.
7. The SWAYAM–NPTEL Online Certification Courses offered during the December – April Semester be chosen by the Departments. The courses may be handled by the Department Mentor or by any teacher in the respective Departments.

8. The allocation of marks for the online examination conducted by the respective IITs is 25:75 for each course.
9. A candidate should obtain a minimum of 40 marks on 100 marks (a minimum of 10 marks for Assignment and 30 marks in the final examination) to pass the Online Courses.
10. If a student fails in the Online Examination conducted by the respective IITs he/she would be permitted to write a Supplementary Examination for 75 marks by the Controller of Examinations of our College.
11. Those who registered for the Online Courses, obtained Assignment marks, appeared for the Online Examination and failed in the courses alone are eligible to apply for the Supplementary Examinations conducted by the College.
12. If a candidate fails in the Supplemenary Examinations conducted by the College, the norms followed for taking an Arrear Examination will be adopted.
13. A provision is given to candidates to reappear for Supplementary/Arrear Examinations in the same semester to facilitate them to receive their Degrees.
14. The Question paper in Multiple Choice Question Pattern for 75 marks shall be framed by the respective faculty/ by an External Examiner for conducting the Supplementary Examinations.
15. The Supplementary Examinations would be conducted for three hours.
16. Course Completion Certificate will not be issued by the respective IITs for the candidates who clear the Online Courses through the Supplementary Examinations conducted by the College. The two credits the candidate earns, if passed, would be added in the Consolidated Statement of Marks issued by the Controller of Examinations.

SEMESTER- III

Course Title	**ELECTROMAGNETIC THEORY**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCPH31**
Course Type	**DSC-VII**
Credits	**4**
Marks	**100**

General Objective:

To expose the students to use the Electromagnetic theory in the field of Electrical Sciences and Physics

Course Objectives:

CO No.	The learners will be able to
CO-1	Comprehend the knowledge in principles of electrostatics.
CO-2	Explore the field of Magnetostatics.
CO-3	Discuss the Maxwell's equations and gauge transformation
CO-4	Impart the knowledge of electromagnetic waves
CO-5	Develop the understanding of the fundamental formulation of electromagnetic radiation.

UNIT - I ELECTROSTATICS (15 Hours)

Coloumb's law- Gauss law- Poisson's equation and laplace's equation–Work done to move a point charge - Energy of a point charge and continuous change distribution-Methods of images- Electric field in dielectric materials-Induced dipoles and polarizability- Clausius – Mossotti relation -susceptibility, permittivity and dielectric constant of linear dielectrics.

UNIT - II MAGNETOSTATICS (15 Hours)

Lorentz force law-Biot-Savart's law and Ampere's law-Magnetic vector potential - Multipole expansion of the vector potential- Effects of a magnetic field on atomic orbits- Bound current and its physical interpretations - Magnetic susceptibility and permeability in linear and non linear media.

UNIT - III ELECTRODYNAMICS, CONSERVATION LAWS, POTENTIALS AND FIELDS (15 Hours)

Electromagnetic Induction: Faraday's law- Induced Electric field - Electrodynamics before Maxwell - Ampere's law with Maxwell's correction - Maxwell's equations - Maxwell's equations in matter - Boundary conditions - Continuity equation - Poynting vector and Poynting's theorem- Maxwell's stress tensors - Scalar and Vector potentials - Gauge transformations- Lorentz Gauge and Coulomb Gauge - Retarded Potential- Lienard - wiechart potential.

UNIT - IV ELECTROMAGNETIC WAVES (15 Hours)

Monochromatic plane waves- Energy and momentum in EM waves - Reflection and Transmission at normal incidence-Reflection and Transmission at oblique incidence - EM waves in conductors - wave guides - TE waves in rectangular wave guide - The coaxial transmission line.

UNIT - V ELECTROMAGNETIC RADIATION (15 Hours)

Radiation - Electric dipole radiation - Magnetic dipole radiation - Radiation from an arbitrary source - Power radiated by a point charge- Larmor's formula -Abraham lorentz formula for the radiation reaction - Physical origin of radiation reaction

TEXT BOOKS

1. David J. Griffiths, Introduction to Electrodynamics, Printice-Hall India, New Delhi, Third Edition, 2006.
2. J.D. Jackson, Classical Electrodynamics, John Wiley & Sons Inc., Singapore, Third Edition, 1998.
3. J.R. Reitz, E.J. Milford and R.W.Chris Foundations of electromagnectic Theory, Pearson publication, New York. (1967).

REFERENCE BOOKS

1. P.Lorrain and D.corson Introduction to Electromagnetic fields and waves LLC publishers (2013) New York.
2. B.P Laud, Electrodynamics –New Age International Pvt. Ltd (1987), New Delhi.
3. U.A. Bakshi and A.V.Bakshi, Transmission lines and waveguides, 5th Revised Edition, Technical Publication, 2009.
4. D.Fleisch, "A Students Guide to Maxwell's Equations", Cambridge University Press, (2008).
5. Edward C. Jordan & Keith G. Balmain, "Electromagnetic waves and radioactive systems", Second Edition, Prentice Hall of India, New Delhi, (2015).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the various concepts of electrostatics	1,3,4	Understanding
CO-2	Analyze the Magnetic susceptibility and permeability in linear and non linear media using Magnetostatics concept.	2,3,4	Analyzing
CO-3	Explain the covariance of the electrodynamical equations in four dimensional vector space under relativistic limits and the propagation of a relativistically charged particle.	1,3,4	Evaluating
CO-4	Apply Maxwell's equations to physical situations and propagation of electromagnetic waves in conducting media.	1,3	Applying
CO-5	Develop knowledge on fundamentals of radiation and radiation reaction.	1,3	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours		Credits		
III	21PCPH31		ELECTROMAGNETIC THEORY			75		4		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓		✓	✓	
CO-2	✓	✓	✓	✓	✓		✓	✓	✓	
CO-3	✓	✓	✓		✓	✓		✓		
CO-4	✓	✓	✓	✓	✓	✓		✓	✓	
CO-5	✓	✓	✓		✓	✓		✓		
	Number of matches (✓) = 36 Relationship = **High**									

SEMESTER- III

Course Title	**QUANTUM MECHANICS II**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCPH32**
Course Type	**DSC-VIII**
Credits	**4**
Marks	**100**

General Objective:

To educate the students about the perturbation theory, scattering theory and relativistic theory.

Course Objectives:

CO No.	The learners will be able to
CO-1	Comprehend time independent perturbation theory using Schrodinger equation.
CO-2	Know about the various time dependent perturbation theory and approximation methods.
CO-3	Summarize the approximation methods
CO-4	Discuss the concepts of relativistic quantum theory.
CO-5	Develop the knowledge about the quantum theory of atomic structure.

UNIT - I TIME INDEPENDENT PERTURBATION THEORY (15 Hours)

Introduction- Theory for non degenerate case- First and second orders - Theory for degenerate case- Removal of degeneracy- Applications– Linear harmonic oscillator - First order Stark effect in Hydrogen atom- Variation method – Expectation value of the energy- Application to excited state-ground state of helium atom.

UNIT – II TIME DEPENDENT PERTURBATION THEORY (15 Hours)

Introduction- Perturbative solution for transition amplitude - constant perturbation- Transition probability per unit time (Fermi-golden rule) - Harmonic perturbation- adiabatic approximation- sudden approximation- Zeeman effect.

UNIT - III APPROXIMATION METHODS (15 Hours)

Wentzel-Kramers-Brillouin (WKB) approximation method- Application of W.K.B method: Probability of penetrating of a barrier - Semi classical theory of radiation- Electric

dipole approximation- Einstein transition probabilities for absorption and emission-Transition probability per unit time for spontaneous emission of a photon.

UNIT - IV RELATIVISTIC QUANTUM THEORY (15 Hours)

Schrödinger relativistic equation –Klein gorden equation-Charge and current densities- Difficulties-Dirac's relativistic equation – Dirac equation in an electromagnetic field- Probability and current density for dirac equation – Dirac matrices and their properties-Magnetic moment of the electron.

UNIT - V QUANTUM THEORY OF ATOMIC STRUCTURE (15 Hours)

Central field approximation: residual electrostatic interaction-spin - orbit interaction - Determination of central field: Thomas Fermistatistical method - Hartree and Hartree - Fock approximations (self consistent fields) - Atomic structure and Hund's rule.

Molecules: Born-Oppenheimer approximation - An application: the hydrogen molecule Ion (H2+) - Molecular orbital theory: LCAO - Hydrogen molecule.

TEXT BOOKS

1. Sathya Prakash, "Quantum Mechanics", Kendarnath Publiations, UP, (2015).
2. P.M. Mathews and Venkatesan, "A Text Book of Quantum Mechanics", Tata McGraw-Hill, New Delhi, (1976).
3. Jasprit Singh, "Modern Physics for Engineers", Willey Publications, (1999).

REFERENCE BOOKS

1. Powell J.L. and Craseman B., "Quantum Mechanics", Narosa Publishing, Madras, (1995).
2. V. Devanathan, "Quantum Mechanics", Narosa Publishing House Pvt. Ltd., Chennai, (2005).
3. S. Rajasekar and R. Velusamy, "Quantum Mechanics-Fundamentals-I & II", CRC Press, New York, (2005).
4. G. Aruldhas, "Quantum Mechanics", Prentice, Hall of India, New Delhi, (2002).
5. L.I. Schiff, "Quantum Mechanics", Mc Graw Hill Book Company, New York, Third Edition, (2002).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the approximation methods such as time independent and time dependent perturbation theories, variation methods etc.	2,3,4	Understanding
CO-2	Explore the theory of Centre field approximation and Molecular orbital theory.	1,2,4	Applying
CO-3	Analyze the approximate solutions to linear differential equation with spatially varying coefficients.	2,3	Analyzing
CO-4	Explain the behaviour of spinless particles with relativistic energy using Schrodinger equation.	1,3	Evaluating
CO-5	Build knowledge about the Perturbative solution for	3,4	Creating

	transition amplitude in Transition probability per unit time of Fermi-golden rule.		

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
III	21PCPH32	CORE PAPER VIII QUANTUM MECHANICS II	75	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓		✓	✓	✓	
CO-2	✓	✓	✓	✓	✓			✓	✓	
CO-3	✓	✓	✓	✓	✓		✓	✓		
CO-4	✓	✓	✓	✓	✓	✓		✓		
CO-5	✓	✓	✓	✓	✓	✓	✓		✓	
	Number of matches (✓) = 37 Relationship = **High**									

SEMESTER- III

Course Title	**RESEARCH METHODOLOGY**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCPH33**
Course Type	**DSC-IX**
Credits	**4**
Marks	**100**

General Objective:

To expose the students to propose new research project.

Course Objectives:

CO No.	The learners will be able to
CO-1	Understand the steps involved in the research process.
CO-2	Summarize the various types and methods of research.
CO-3	Organize the planning of research.
CO-4	Explain the art of report writing.
CO-5	Develop knowledge about the tools for research.

UNIT - I FOUNDATION OF RESEARCH (15 Hours)

Meaning of Research- Objectives of Research- characteristics of Research- Motivation in research – Research method versus Research methodology – Research and scientific method - Research process – steps involved in the research in the research process -Criteria for good research - Importance of research methodology in scientific research

UNIT – II TYPES AND METHODS OF RESEARCH (15 Hours)

Classification of Research- Pure and Applied Research- Exploring or Formulative Research-Descriptive Research- Diagnostic Research/Study- Evaluation research/Studies-Action Research- Experimental Research- Analytical Study of Statistical Method-Historical Research- Surveys Case Study- Field Studies.

UNIIT - III REVIEW OF LITERATURE AND PLANNING OF RESEARCH (15 Hours)

Need for Reviewing Literature- Literature Search Procedure- Sources of Literature-Planning of Review work- Note Taking- Library and documentation-The planning process-Selection of a Problem for Research- Formulation of the Selected Problems- Research

Design-meaning of research design –Need for research design-Features of good design-Different research design.

UNIT – IV REPORT WRITING (15 Hours)

Types of Reports-Planning of Report Writing-Research Report Format-Principles of Writing Documentation- Data and Data Analysis Reporting in a Thesis- Writing of Report-Typing of Report- Art of writing a scientific paper-Format synopsis writing – Roles of research supervisor and scholar

UNIT – V TOOLS FOR RESEARCH (15 Hours)

Internet and its applications – inflibnet - e-journals - e-books - Technology Tools for Researchers-Zotero-Scopus- QuickCalcs-Zenodo-EndNote-google scholar- Research gate-arXiv-SJ Finder-F100Prime-Power Point Presentation - Multimedia techniques in presenting a scientific paper in a seminar.

TEXT BOOKS

1. C. R. Kothari, "Research Methodology: Methods and Techniques", New Age International Publishers, ISBN:81-224-1522-9.
2. S.Rajasekar, P.Philominathan and V. Chinnathambi, "Research Methodology", RPC Publications, Tirunelveli-11, 2016.
3. Yavuz Orug, " Handbook of Scientific Proposal Writing", CRC Press, USA, (2012).

REFERENCE BOOKS

1. Dr S.L. Gupta and Hitesh Gupta, "Research Methodology – Text and Cases with SPSS Applications", International Book House Pvt Ltd.
2. T N Srivastava and Shailaja Rego, "Business Research Methodology", Tata Mcgraw Hill Education Private Limited, New Delhi.
3. O.R. Krishnaswami, "Methodology of Research in Social Sciences", Himalaya Publishing House, New Delhi.
4. Dr S. K Khandelwal, "Business Statistics", International Book House Pvt Ltd, New Delhi.
5. Dr S. K Khandelwal, "Quantitative Techniques", International Book House Pvt Ltd, New Delhi.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Comprehend the foundation of research, objectives and various criteria in research field.	1,2,3	Understanding
CO-2	Identify the research leading to a Master thesis.	2,3	Applying
CO-3	Analyse the Literature Review procedure, sources of literature and planning of review work.	1,2,3	Analyzing
CO-4	Explain the various types and methods of research	1,2,4	Evaluating
CO-5	Develop knowledge to use various tools for research	1,2	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
III	21PCPH33	CORE PAPER IX RESEARCH METHODOLGY	75	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓		
CO-2	✓	✓	✓	✓	✓	✓	✓		✓	
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓	✓	✓	✓		✓	✓		
CO-5	✓	✓	✓	✓	✓	✓	✓			
	Number of matches (✓) = 38 Relationship = **High**									

SEMESTER- III

Course Title	**NON-LINEAR PHYSICS**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH31A**
Course Type	**DSE-IIIA**
Credits	**4**
Marks	**100**

General Objective:

To educate the students with the basic ideas of nonlinear dynamics and chaos in classical systems modelled by ordinary differential equations and iterated maps.

Course Objectives

CO	The learners will be able to
CO-1	Understand dynamical systems, dissipative systems and Hamiltonian systems.
CO-2	Explain the concept of bifurcations and chaos.
CO-3	Discuss chaos in nonlinear electronic circuits.
CO-4	Develop the knowledge of Fractal geometry with an emphasis on the physical aspects.
CO-5	Elaborate the properties of soliton.

UNIT – I LINEAR AND NONLINEAR SYSTEMS (12 Hours)

Dynamical Systems – Classification of dynamical systems -Linear and Nonlinear systems – Mathematical models examples – Mathematical Implications of Nonlinearity-superposition principle – Effects of nonlinearity - Linear oscillators & Predictability – Nonlinear oscillators – Resonance and Hysteresis-Autonomous and Non-autonomous systems-Dissipative and conservative systems

UNIT- II BIFURCATIONS AND ONSET OF CHAOS (12 Hours)

Equilibrium point – Classification of equilibrium points (- Two dimensional case)-Limit cycle motion – Simple bifurcations –the saddle node – the pitchfork-the transcritical-Hopf bifurcations Logistic map - Period doubling phenomenon –Onset of chaos – Route to chaos – Lorenz system – Sensitive dependence on initial condition – controlling of chaos.

UNIT- III CHAOS IN NONLINEAR ELECTRONIC CIRCUITS (12 Hours)

Linear and Nonlinear circuit elements – Linear circuits: The resonant RLC circuit – Nonlinear circuits:Chua's diode (-Autonomous case) – Practical implementation of Chua's diode –Bifurcation and chaos –Chaotic dynamics of MLC circuit – RL Diode circuit – Colpitt's oscillator – Transmission line systems-Discrete chaotic circuits –Time delay systems.

UNIT – IV FRACTALS AND CELLULAR AUTOMATA (12 Hours)

Introduction to Fractals – Self similarity-Properties and examples of fractals – Construction and properties of some artificial fractals – Cantor set- Koch curve – Sierpinski gasket-Julia set- Mandlebrot set – Applications of fractals – Cellular automata – Basics - Implementation – Conways' game of life – Applications of cellular automata

UNIT – V SOLITON THEORY (12 Hours)

Linear wave propagation (nondispersive and dispersive) –wave packet and dispersion – Nonlinear Dispersive system – Scott Russel`s phenomenon – derivation of Korteweg-de Vries equation – Fermi Pasta Ulam phenomenon-Numerical experiments of Zabusky and Kruskal – birth of solitons.– Inverse scattering trnsform method – Soliton solutions of KdV equation – Hirota's bilinear method.

TEXT BOOKS

1. M. Lakshmanan and S. Rajasekar, "Nonlinear Dynamics: Integrability", Chaos and Patterns, Berlin, (2003). (Unit-I,II,V)
2. M. Lakshmanan and K. Murali, "Chaos in Nonlinear Oscillator, Controlling and Synchronization", World Scientific, Singapore, (1997). (Unit-III)
3. M..J. Ablowitz and PA Clarkson, "Solitons, Nonlinear Evolution Equations and Inverse Scattering", (Cambridge University Press, Cambridge 1991).(Unit-V)

REFERENCE BOOKS

1. H.G. Schuster, "Deterministic Chaos", Verlag, Weinheim, (1998).
2. J. Lichenberg and M.A. Lieberman, "Regular and Stochastic motion", Verlag, Weinheim, (1998).
3. Stephen Wolfram, "A New kind of Science", First Edition, (2002).
4. H.O. Peitgen, Hartmut Jürgens and Dietmar Saupe, "Chaos and Fractals: New Frontiers of Science", Springer, USA, (2004).
5. Weisstein, Eric W. "Elementary Cellular Automaton." From MathWorld--A Wolfram Web Resource. https://mathworld.wolfram.com / ElementaryCellularAutomaton.html.(Unit-IV)

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the basic concepts of dynamical systems, linear and nonlinear systems	1,3	Understanding
CO-2	Categorize various types bifurcations and routes to chaos.	1,2,3	Analyzing
CO-3	Develop the knowledge of nonlinear electronic circuits.	1,3	Applying
CO-4	Explain the applications of fractals and cellular automata.	1,4	Evaluating
CO-5	Discuss the concepts of nonlinear waves and solitons.	1,2,4	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours		Credits		
III	21PEPH31A		NON-LINEAR PHYSICS			60		4		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓		✓	✓		✓		
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		
CO-3	✓	✓	✓		✓	✓		✓		
CO-4	✓	✓	✓		✓	✓			✓	
CO-5	✓	✓	✓	✓	✓	✓	✓		✓	
	Number of matches (✓) = 34 Relationship = **High**									

SEMESTER- III

Course Title	**PHYSICS OF NANOMATERIALS**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH31B**
Course Type	**DSE-III B**
Credits	**4**
Marks	**100**

General Objective:

To introduce the basic ideas of nanomaterials and its applications in research field.

Course Objectives

CO	The learners will be able to
CO-1	Explore the theoretical understanding of nanomaterials and its classifications.
CO-2	Categorize the types of Carbon fullerenes and Carbon Nanotubes.
CO-3	Explain the properties of nanomaterials.
CO-4	Elaborate the synthesis of nanomaterials.
CO-5	Discuss the characterization techniques of nanomaterials and its applications.

UNIT – I NANOSTRUCTURES (12 Hours)

Introduction – Fundamentals of nano – significance of nanomaterials and impact- Classification of nanomaterials– Zero, one and two dimension nano structures –Classification of synthesis methods- Surface energy- Electrostatic stabilization - Steric stabilization – DLVO theory.

UNIT – II FUNCTIONAL NANOMATERIALS (12 Hours)

Carbon fullerenes- Fullerene derived crystals- Carbon nanotubes- Micro and Mesoporous Materials- Ordered mesoporous structures- Random mesoporous structures- crystalline microporous materials- Core-shell structures- Metal-oxide structures- Metal-polymer structures- Oxide-polymer structures– Nanocomposites.

UNIT – III PROPERTIES (12 Hours)

Physical properties of nanomaterials- Melting points, Specific heat capacity– chemical properties- Mechanical properties – Optical properties– Electrical and electronic property- redox properties- Ferroelectrics and dielectrics – Magnetic properties- Variation of magnetism with size-Super para magnetism-Diluted magnetic semi conductor.

UNIT – IV SYNTHESIS (12 Hours)

Top-Down and Bottom-Up approaches- Physical vapour deposition - Chemical vapour deposition- Sol gel - Ball milling technique – Hydrothermal synthesis - Electro deposition- Synthesis of Semiconductors- Nanostructures fabrication by physical techniques – Nano lithography – Nanomanipulator.

UNIT – V CHARACTERIZATION AND APPLICATIONS (12 Hours)

X-Ray diffraction – Scanning Electron Microscopy – Transmission Electron Microscopy –Optical spectroscopy- UV spectroscopy- photoluminescence spectroscopy- Applications- Molecular electronics- Nano electronics, Nano electromechanical systems- DNA chips – DNA array devices – Drug delivery systems.

TEXT BOOKS

1. Kenneth F. Klablunde, "Nanoscale Materials in Chemistry", John wiley and sons, Inc.(2001).
2. Pradeep T, "Nano:The Essentials", Tata MC Graw-Hill publishing company limited (2007).
3. Christof M. Niemeyer, Chad A. Mirkin, "Nanobiotechnology: Concepts, Applications and Perspective", (2004).

REFERENCE BOOKS

1. Wilson M, K Kannangara, G. Smilt, M. Simmons, "Nanotechnology", Boguse-Overseas Press (2005).
2. Freitas R A, Landes, "Nanomedicine", TX publication (1996).
3. Viswanathan B, "Nano Materials", Narosa publishing house (2010).
4. G. Mohan Kumar, "Nanotechnology: Nanomaterials and Nanodevice", Narosa Publishing House Pvt. Ltd., (2016).
5. Bandeyo padhyay.A.K., "Nanomaterials", New Age Science, (2010).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the fundamentals, significance and classification of nanomaterials.	1,3,4	Understanding
CO-2	Analyze different nano structures.	2,4	Analyzing
CO-3	Classify the properties of nanomaterials through various techniques.	1,2,3	Analyzing
CO-4	Discuss the effect of particle size reduction on specific heat, melting point and chemical properties.	2,4	Evaluating
CO-5	Elaborate the characterization techniques and its application.	2,3,4	Creating

Relationship Matrix

Semester	Course Code		Title of the Course					Hours	Credits	
III	21PEPH31B		PHYSICS OF NANOMATERIALS					60	4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓		✓	✓		✓	✓	
CO-2	✓	✓	✓	✓	✓		✓		✓	
CO-3	✓	✓	✓		✓	✓	✓	✓		
CO-4	✓	✓	✓	✓	✓		✓		✓	
CO-5	✓	✓	✓	✓	✓		✓	✓	✓	
	Number of matches (✓) = 35 Relationship = **High**									

SEMESTER- III

Course Title	**DENSITY FUNCTIONAL THEORY**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH31C**
Course Type	**DSE-III C**
Credits	**4**
Marks	**100**

General Objective:

To educate the students with the many electron problems and foundation of DFT.

Course Objectives:

CO	The learners will be able to
CO-1	Comprehend the background of Density Functional Theory (DFT).
CO-2	Explain the difference between DFT and other many body approaches.
CO-3	Discuss how electron correlations are approximated within DFT.
CO-4	Elaborate the difference between different functionals such as LDA, GGA.
CO-5	Develop the knowledge of various methods of DFT.

UNIT- I INTRODUCTION TO MANY ELECTRON PROBLEMS (12 Hours)

Introduction– Hartree-Fock (HF) theory - Configuration Interaction (CI) – Fundamental concept – Variational theorem – Variational theorem for ground state – reducing the CI space – Determinant CI.

UNIT- II FOUNDATION OF DFT (12 Hours)

The Thomas-Fermi model: precursor to modern DFT - Functional and functional derivatives, Euler Lagrange equation – Hohenberg-Kohn Theorem – degenerate ground state - N and υ representability of densities – Current Density Functional Theory.

UNIT- III KOHN-SHAM (KS) EQUATION (12 Hours)

Introduction– Effective exact single particle method to the many body problem – Exchange and correlation energies – Interpretation of KS eigenvalues: Koopman's theorem, Ionization energy, Fermi surface, band gap

UNIT- IV APPROXIMATION TO FUNCTIONALS (12 Hours)

Introduction – Local approximation: local density approximation (LDA) – Semi-local approximation: generalized gradient approximation (GGA) - Non- local approximation: hybrid functional – Self interaction Correction.

UNIT- V INTRODUCTION TO TIME DEPENDENT DFT (12 Hours)

Introduction – Runge - Gross Theorem - Time-Dependent Kohn- Sham Equations - Practical implementation of DFT methods- General scheme for solving Kohn-Sham - Full potential and pseudo potential methods - Basis functions: Gaussian, LAPW equation.

TEXT BOOKS

1. Eberhard Engel and Reiner M. ,"Density Functional Theory: An Advanced Course" Dreizler, Springer-Verlag, (2011).
2. June Gunn Lee,"Computational Materials Science: An Introduction", Second Edition,

CRC Press, Taylor and Francis Group, (2017).
3. Viraht Sahni, "Quantal Density Functional Theory", Springer-Verlag Berlin Heidelberg Publisher, (2004).

REFERENCE BOOKS

1. J. M. Thijssen, "Computational Physics", Cambridge University Press, (1999).
2. Frank Jensen, "Introduction to Computational Chemistry", John Wiley and Sons, (2017).
3. http://vergil.chemistry.gatech.edu/notes/ci.pdf
4. Nazmul Islam, Savaskaya, "Conceptual Density Functional Theory and its Application in the Chemical Domain", Apple Academic Press, Canada, (2018).
5. http://www.lct.jussieu.fr/pagesperso/toulouse/enseignement/introduction_dft.pdf

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the basic concepts of density functional theory.	1,2,3	Understanding
CO-2	Analyze the various types of DFT.	1,3	Analyzing
CO-3	Estimate the Hohenberg–Kohn theorems and the Kohn–Sham approach.	1,2	Evaluating
CO-4	Discuss about the implementations of density functional theory.	1,3,4	Evaluating
CO-5	Build knowledge of the significance approximations of DFT.	1,3	Creating

Relationship Matrix

Semester	Course Code		Title of the Course					Hours		Credits
III	21PEPH31C		DENSITY FUNCTIONAL THEORY					60		4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓		✓	✓	✓	✓		
CO-2	✓	✓	✓		✓	✓		✓		
CO-3	✓	✓	✓		✓	✓	✓			
CO-4	✓	✓	✓		✓	✓		✓		
CO-5	✓	✓	✓		✓	✓		✓	✓	
	Number of matches (✓) = 33 Relationship = **Medium**									

SEMESTER-III

Course Title	**ADVANCED PHYSICS PRACTICALS - I**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCPH3P1**
Course Type	**PRACTICAL-V**
Credits	**2**
Marks	**100/2**

General Objective:

To expose the students to perform some experiments in advanced level of physics.

Course Objectives:

CO No.	The learners will be able to
CO-1	Educate themselves to a hands on training to do advanced physics experiments.
CO-2	Understand the concepts behind various physics experiments such as polarizability of liquids, ultrasonic wave velocity of liquids, young's modulus of materials etc.
CO-3	Build knowledge to measure some of the physical parameters with maximum accuracy.
CO-4	Explore the resistivity and the band-gap of the given semiconductor sample using four probe technique.
CO-5	Discuss the temperature coefficient of the given semiconducting material.

(Any Eight)

1. Determination of hall coefficients and carrier type of given semiconducting material using Hall Effect apparatus.
2. Cornu's method of determination of elastic constant-Young's modulus and Poisson's ratio of a transparent beam by forming Elliptical fringes.
3. Susceptibility determination of solid sample by Gouy's method.
4. Temperature variation of forward bias voltage for Ge and Silicon.
5. Iodine absorption spectrum-Spectroscopic constants.
6. Young's Double slit experiment.
7. Determination of dielectric constant of a given specimen.
8. Determination of lattice parameters, particle size of different powder samples of bulk/nano systems using X-ray diffractometer.
9. Determination of Planck's constant.
10. Hartmann's formula: Determination of wavelength of spectral lines.
11. Study of FTIR spectrum and TGDTA.
12. Determination of Stefan's constant
13. Thickness of wire by Airwedge and diffraction.
14. Determination of specific charge of an electron e/m by –Millikan's oil drop experiment.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Explain the Young's double slit experiment and the wave character of light.	1,5	Understanding
CO-2	Identify the Hall voltage, hall coefficient and carrier concentration of the sample material.	2,5	Applying
CO-3	Analyze the thickness of the Enamel coating on a wire.	2,4,5	Analyzing
CO-4	Analyze the functional groups present in a sample using FTIR spectrum and thermal stability of TG-DTA.	1,3,5	Analyzing
CO-5	Explain the value of Planck's constant,and analyse the reason for error.	2,5	Evaluating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours				Credits
III	21PCPH3P1		ADVANCED PHYSICS PRACTICALS - I			60				2
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓		✓			✓
CO-2	✓	✓	✓	✓	✓	✓				✓
CO-3	✓	✓	✓	✓	✓		✓		✓	✓
CO-4	✓	✓	✓	✓	✓		✓			✓
CO-5	✓	✓	✓	✓	✓	✓		✓		✓
	Number of matches (✓) = 37 Relationship = **High**									

SEMESTER- III

Course Title	**MICROPROCESSOR AND MICROCONTROLLER PRACTICALS**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCPH3P2**
Course Type	**PRACTICAL-VI**
Credits	**2**
Marks	**100/2**

General Objective:

To expose the students to perform some experiments in Microprocessor and Microcontroller Programming

Course Objectives:

CO No.	The learners will be able to
CO-1	Comprehend the applications of Microprocessor.
CO-2	Show the usefulness and limitations of various optimization techniques.
CO-3	Record observations and analyses in a scientific manner.
CO-4	Build theoretical knowledge and develop practical skill in digital systems, logic systems and Microprocessor, electronic systems and microprocessor.
CO-5	Discuss the functioning of Microprocessor and microcontrollers.

(**Any Eight**)

1. Arithmetic Operations

(a) Addition of any two 8 bit numbers using Direct, Indirect and Immediate addressing Modes.

(b) Subtraction of any two 8 bit numbers using Direct, Indirect and Immediate addressing modes.

(c) Multiplication of any two 8 bit numbers using Direct, Indirect and Immediate addressing modes.

(d) Division of any two 8 bit numbers using Direct, Indirect and Immediate addressing modes.

2. Logical Operations

(a) Logical AND operation using Direct, Indirect and Immediate addressing modes.

(b) Logical OR operation using Direct, Indirect and Immediate addressing modes.

(c)Logical NOT operation using Direct, Indirect and Immediate addressing modes.

3. Temperature Conversions (F to C and C to F).
4. Data Manipulation
   (a)Arrange the given data items in ascending or descending order.
   (b) Finding the minimum and maximum value in the given data set.
   (c)Search of an given character in an array.
5. Block move and series generation
   (a) Fibonacci series generation.
   (b)Tribonacci series generation.
   (c)Moving a block of data from memory xxxx to yyyy.
6. Determination of factorial of the given number and sum of the n numbers.
7. Waveform generation
   (a) Square wave with specified period.
   (b) Rectangular wave with specified period.
   (c)Ramp wave with specified period.
   (d) Triangular wave with specified period.
8. Square and square root of the given number.
9. System call and rolling character
   (a) Display a character on the 7 segment display.
   (b)Roll a given character from left to right / right to left.
10. ADC and DAC conversion
    (a) Interfacing ADC with 8085 and conversion of analog input to digital.
    (b) Interfacing ADC with 8085 and conversion of analog input to digital.
11. Stepper motor Interfacing.
12. Traffic light controller.
13. DC motor control.
14. Temperature controller measurements (Digital thermometer).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the ALP program of microprocessors/microcontrollers-based systems such as code conversion, arranging numbers in ascending and descending orders.	2,3,5	Understanding
CO-2	Build knowledge about A/D and D/A conversion and wave form generation.	1,4,5	Applying
CO-3	Evaluate Arithmetic and logical operations and Generate Fibonacci and tribonacci series.	1,3,5	Evaluating
CO-4	Make up stepper motor and DC motor control using Microcontroller.	2,4,5	Creating
CO-5	Construct Assembly language programme for counters.	2,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
III	21PCPH3P2	MICROPROCESSOR AND MICROCONTROLLER PRACTICALS				60	2			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓		✓	✓		✓
CO-2	✓	✓	✓	✓	✓	✓		✓		✓
CO-3	✓	✓	✓	✓	✓		✓			✓
CO-4	✓	✓	✓	✓	✓		✓		✓	✓
CO-5	✓	✓	✓	✓	✓	✓			✓	✓
	Number of matches (✓) = 39 Relationship = **High**									

SEMESTER- III

Course Title	**ENERGY PHYSICS**
Total Hrs.	**30**
Hrs./Week	**2**
Sub.Code	**21PIPH31**
Course Type	**IDC-II**
Credits	**2**
Marks	**100/2**

General Objective:

To introduce the concept of how various sources of energy is collected from renewable resources.

Course Objectives:

CO No.	The learners will be able to
CO-1	Understand and classify energy sources.
CO-2	Study the different techniques of solar collector and its applications.
CO-3	Explain the principles, types and applications of wind energy.
CO-4	Build the knowledge of biomass conversion energy process.
CO-5	Develop and design the fuel cells for energy consumption.

UNIT – I ENERGY SOURCES (6 Hours)

Energy sources and their availability – Classification of energy sources – Conventional energy sources – Nonconventional energy sources – World energy futures – Merits and demerits of energy sources.

UNIT – II SOLAR ENERGY (6 Hours)

Solar radiation at the Earth's Surface – Solar energy measuring equipments – Physical principles of the conversion of solar radiation into heat – Types of air heaters – Application of solar air heaters – Merits and demerits of solar energy.

UNIT - III WIND ENERGY (6 Hours)

Wind energy – The power from the wind – Basic components of Wind Energy Conversion System – Horizontal Axis Wind mills – Vertical Axis Wind mills – Merits and demerits of wind energy.

UNIT - IV BIOMASS ENERGY (6 Hours)

Introduction – Wet and dry process – Photosynthesis – Biogas generation – Materials for Biogas and Biomass – Advantages and disadvantages of Biological conversion of solar energy – Application of Biogas.

UNIT - V FUEL CELLS (6 Hours)

Introduction to fuel cells – Design and principle of operation of a fuel cell (with special reference to H_2, O_2 cell) – Hydrogen fuel cells – Classification of fuel cells – Types of fuel cells –Advantages and disadvantages of fuel cells – Applications of fuel cells.

TEXT BOOKS

1. G.D.Rai, "Non-Conventional Energy Sources", Khana Publiation, New Delhi (2018).
2. G.D.Rai "Solar Energy Utilisation", Khana Publiation, New Delhi (2009).
3. T.N.Veziroglu , "Alternate energy sources" Vol.5 and 6, MGraw-Hill (1978).

REFERENCE BOOKS

1. S.P.Sukhatme , "Solar Energy", Tata Mc. Graw Hill.
2. A.Duffie and W.A.Becjmann, "Solar energies of Thermal processes", John-wily (1980).
3. F.Krith and J.F.K. Krcider, "Principle of Solar engineering", McGraw-Hill (1978).
4. S.Rao and Dr. B.B. Parulekar, "Energy Technology", 2nd Edition, (1997).
5. Bent Sorensen, Giuseppe Spazzafumo, "Hydrogen and Fuel Cells-Emerging Technologies and Applications", Third Edition, (2018).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the types of energy source in their day-to-day life and their primary applications in the world.	1,3,4	Understanding
CO-2	Apply the knowledge in the principle of solar energy and conversion technology.	2,4	Applying
CO-3	Analyze the fundamental concept to utilize the wind energy at low expense.	1,2,4	Analysing
CO-4	Explain the features of biomass energy and its applications.	2,4	Evaluating
CO-5	Design the principle and types of fuel cell to generate usable energy.	2,3,4	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours		Credits		
III	21PIPH31		INTERDISCIPLINARY CORE-II ENERGY PHYSICS			30		2		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓			✓		✓	✓	
CO-2	✓	✓	✓	✓	✓		✓		✓	
CO-3	✓	✓	✓			✓	✓		✓	
CO-4	✓	✓	✓	✓			✓		✓	
CO-5	✓	✓	✓				✓	✓	✓	
	Number of matches (✓) = 31 Relationship = **Medium**									

SEMESTER- IV

Course Title	**ADVANCED SOLID STATE PHYSICS**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCPH41**
Course Type	**DSC-X**
Credits	**4**
Marks	**100**

General Objective:

This Course makes the Students to understand Reciprocal Lattice and Energy Bands, Vibration of crystals, Free electron gas, Dia, Para and Ferromagnetism**.**

Course Objectives:

CO	The learners will be able to
CO-1	Understand the basic knowledge of crystal structures and crystal systems.
CO-2	Determine the behaviour of crystal vibration and its density of states.
CO-3	Distinguish the dimension of Fermi energy level.
CO-4	Differentiate the behaviour of Magnetic properties and its applications.
CO-5	Investigate the dielectric and superconductivity properties and its application.

UNIT - I RECIPROCAL LATTICE AND ENERGY BANDS (15 Hours)

Diffraction of waves by Crystals – Bragg's law – Scattered wave amplitude – reciprocal lattice vectors – Brillouin zones – Fourier analysis of the basis –Bloch function – Kronig penney model – Wave equation of electron in a periodic potential – Number of orbits in a band.

UNIT- II CRYSTAL VIBRATIONS (15 Hours)

Vibration of crystals with mono atomic basis – Two atoms per primitive basis – Quantization of elastic waves – Phonon momentum – Inelastic scattering by phonons – Phonon heat capacity – Density of states in one and three dimensions – Debye model for density of states – Einstein model of the density of states – Thermal conductivity – Thermal resistivity of phonon gas.

UNIT - III FREE ELECTRON FERMI GAS AND FERMI SURFACES (15 Hours)

Energy levels in one dimension – Effect of temperature on the Fermi Dirac distribution – Free electron gas in three dimension – Heat capacity of the electron gas – Electrical conductivity and ohm's law – Motion in magnetic fields – Fermi surface and its Construction - de - Haas - Van Alphen effect.

UNIT - IV DIA, PARA AND FERROMAGNETISM (15 Hours)

Langevin's diamagnetic equation – Quantum theory of diamagnetism and paramagnetism – Hund's rule – Paramagnetic susceptibility of conduction electrons – Ferromagnetic order – Magnons – Ferrimagnetic order –Ferromagnetic domains.

UNIT - V DIELECTRICS, FERROELECTRICS AND SUPER CONDUCTIVITY (15 Hours)

Macroscopic electric field - Local field at an atom - Dielectric constant and polarizability - Ferroelectric crystals -Ferroelectric domains - Piezoelectricity - occurrence of superconductivity -Meissner effect - Type I and Type II superconductors - thermodynamics of superconducting transition - London equation - coherence length - BCS theory of superconductivity - single particle tunneling - DC Josepson and AC Josepson effects.

TEXT BOOKS

1. Charles Kittel, "Introduction to Solid State Physics", 7th Edition, John Wiley & Sons, New York, (1996).
2. S.O.Pillai, "Solid State Physics", Revised 6th Edition, New Age International Publishers, New Delhi, (2007).
3. Wahab. M. A, "Solid State physics", Second edition, Narosa, (2010).

REFERENCE BOOKS

1. M.Ali Omar, "Elementary Solids State Physics", Pearson Education, New Delhi, (1999).
2. H.P.Myres, "Introductory Solids State Physics", 2nd Edition, Taylor and Francis Ltd, London (2001).
3. Surekha Tomar, CSIR- UGC/JRF/SET Physical Sciences, 3rd edition
4. M. S. Rogalski and S. B. Palmer, "Solid State Physics", Gordon Breach Science publishers, (2000).
5. N. W. Ashcroft and N. D. Mermin, "Solid State physics", Cengage Learning, (2003).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Describe the behavior of electrons in solids including the concept of energy bands and effect of the same on material properties.	1,2,3	Understanding
CO-2	Examine the Vibration of crystals with mono atomic basis and Einstein model of the density of states.	1,3	Applying
CO-3	Explain the Energy levels in one and three dimension using Free Electron Fermi Gas and Fermi Surfaces concept.	1,2,3	Analyzing
CO-4	Differentiate Quantum theory of diamagnetism and paramagnetism.	1,3	Analyzing
CO-5	Summarize the electrical, thermal, magnetic and dielectric properties of solid.	2, 3, 4	Evaluating

Relationship Matrix

Semester	Course Code		Title of the Course					Hours		Credits
IV	21PCPH41		ADVANCED SOLID STATE PHYSICS					75		4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓		
CO-2	✓	✓		✓	✓	✓		✓		
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓		✓	✓	✓		✓		
CO-5	✓		✓	✓	✓		✓	✓	✓	
	Number of matches (✓) = 35 Relationship = **High**									

SEMESTER- IV

Course Title	**NUCLEAR AND ELEMENTARY PARTICLE PHYSICS**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCPH42**
Course Type	**DSC-XI**
Credits	**4**
Marks	**100**

General Objective:

To impart knowledge about nucleus of the atom and nature of elementary particles

Course Objectives:

CO	The learners will be able to
CO-1	Emphasize the general properties of deuteron.
CO-2	Examine the nuclear decay properties and its applications.
CO-3	Estimate the nuclear models and its behaviour.
CO-4	Correlate the concept of fission and fusion in nuclear reaction.
CO-5	Invent the higher level knowledge of elementary particles.

UNIT – I NUCLEAR FORCES (15 Hours)

Deuteron - Ground and excited states of deuteron - magnetic dipole and electric quadrupole moments of deuteron - n-p scattering at low energies - scattering length - phase shift analysis - The spin dependence of nuclear force - shape independent effective range theory of n-p scattering - p-p scattering at low energies - meson theory of nuclear force.

UNIT – II NUCLEAR DECAYS (15 Hours)

Gamow's theory of alpha decay - Fermi theory of beta decay - Beta ray spectrum - Fermi and Gamow - Teller selection rules - parity violation - neutrino hypothesis - internal conversion - nuclear isomerism - Radioactive decay.

UNIT – III NUCLEAR MODELS (15 Hours)

Liquid drop model - Weizsackers mass formula - mass parabola - nuclear stability - Bohr Wheeler theory of nuclear fission - magic numbers - evidence for magic numbers - shell

model - spin orbit coupling - angular momentum and parities of nuclear ground states - magnetic moments - collective model - unified model.

UNIT - IV NUCLEAR REACTION (15 Hours)

Types of nuclear reactions - Nuclear reaction Kinematics: Q-equation - compound nuclear theory - Direct Reactions - Stripping - Pickup reaction - Reciprocity theorem - nuclear cross section - Plane wave born approximation - Theory of direct Interactions - Resonance Scattering - Breit Wigner one level formula - nuclear fission and fusion.

UNIT - V ELEMENTARY PARTICLES (15 Hours)

Classification of elementary particles - fundamental interactions - Conservation laws - CPT theorem - SU(3) multiplet - Isospin - Leptons - Strangeness and hyper charge - meson octet - baryon octet - baryon decouplet – Hadrons – Baryons - Invariance principles and symmetries - CP violation in neutral K-meson decay - Gellmann-Okubo mass formula - Color Quantum Number - Quark theory – Gauge theory of weak and strong interactions.

TEXT BOOKS

1. D.C.Tayal, "Nuclear Physics", Himalaya Publications, New Delhi, (1980). (Unit 1,2,3,4,5).
2. M.C Pandia and R.P.S Yadav "Elements of Nuclear Physics", Kedarnath Ramnath Publication, 4th Edition, New Delhi, (1972).
3. R.R.Roy and B.P Nigam, "Nuclear Physics", New Age International Ltd, New Delhi (1992).

REFERENCE BOOKS

1. Bernard Lcohen, "Concepts of Nuclear Physics", Tata - MC.Graw – Hill, New Delhi, (1995).
2. S.B Patel, "Nuclear Physics an Introduction", Wiley –Eastern Ltd, New Delhi, (2001).
3. S.L. Kakani, Shubhra Kakani, "Nuclear and Particle Physics", Viva Books, New Delhi, (2011).
4. B.B. Srivastava, "Fundamentals of Nuclear Physics", Rastogi Publications, Meerut, (2006).
5. K. Ilangovan, "Nuclear Physics", MJP Publishers, Chennai, (2012).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the general properties of deuteron and meson theory of nuclear forces.	1,3,4	Understanding
CO-2	Explain the nuclear decay processes and their outcomes of Fermi and Gamow-Teller transition rules.	2,4	Applying
CO-3	Explain the various types of nuclear models and its stability.	P2,3,4	Analyzing
CO-4	Evaluate the kinematics of various reactions and decay processes.	2,3	Analyzing
CO-5	Summarize the particles of Leptons and how the (electron) neutrinos and (electron) antineutrinos are produced during β+ and β- decays respectively.	2,3,4	Evaluating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
IV	21PCPH42		NUCLEAR AND ELEMENTARY PARTICLE PHYSICS			75			4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓		✓	✓	
CO-2			✓	✓	✓		✓		✓	
CO-3	✓		✓	✓	✓		✓	✓	✓	
CO-4	✓		✓	✓	✓		✓	✓		
CO-5	✓		✓	✓	✓		✓	✓	✓	
	Number of matches (✓) = 33 Relationship = **Medium**									

SEMESTER- IV

Course Title	**PROJECT**
Total Hrs.	**120**
Hrs./Week	**8**
Sub.Code	**21PPPH41**
Course Type	**PROJECT**
Credits	**8**
Marks	**150**

The following are the guidelines to be adhered to by the Postgraduate students :

- Individual Projects should be taken.
- The Project should be written in English only.
- The Minimum number of pages should be 60.
- Project observations, suggestions and summation/conclusion shall form part of the Project Report.
- The Projects will be evaluated by the Internal Examiner and the External Examiner for 150 marks. The distribution of mark should be 90 marks for the Project Report and 60 marks for the Viva-Voce Examination. The Division of marks for the Project Report is as follows:

Particulars	Internal Examiner	External Examiner
Wording of Title	5	5
Objectives / Formulation including Hypothesis	10	10
Review of Literature	15	15
Relevance of the Project to Social Needs	10	10
Methodology / Technique / Procedure Adopted	30	30
Summary / Findings / Conclusion / Summation	10	10
Bibliography / Annexure / Foot notes / Works Cited / Works Consulted	10	10
Total	90	90

- The Internal Examiner and the External Examiner will award the marks for each candidate. The average mark obtained by the candidate is considered marks for the Project Report.

SEMESTER- IV

Course Title	**APPLIED OPTICS AND LASER PHYSICS**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH41A**
Course Type	**DSE-IV A**
Credits	**4**
Marks	**100**

General Objective:

This Course focuses on the fundamental concepts of optics in lasers, optical fiber communications and optoelectronics.

Course Objectives:

CO	The learners will be able to
CO-1	Understand the theoretical understanding of optics and photonic crystals.
CO-2	Implement the various optical techniques and its applications.
CO-3	Illustrate the working principle of various lasers and its types.
CO-4	Appraise the generation of high power pulses by the control of the laser output.
CO-5	Formulate the physical parameters using laser beam as a source and to study the laser applications in various fields.

UNIT-I PHYSICAL OPTICS AND PHOTONIC CRYSTALS (12 Hours)

Wave motion - superposition of waves- interference – diffraction - polarization- basics of coherence theory - temporal and spatial coherence - statistical properties of laser speckle patterns - information processing using speckle patterns- laser speckle contrast imaging- Photonics crystals - 2D & 3D - colloidal photonic crystals- light propagation through disordered media - localization of light - photonic glass - random lasing.

UNIT–II APPLICATIONS OF OPTICAL TECHNIQUE (12 Hours)

Image formation (first – order optics) – aberrations - prisms and mirrors - stops and apertures- basic optical devices- the design of optical systems - general aplanatic points - solid immersion lens - numerical aperture increasing lens - Mie scattering technique - AFM

colloidal probe technique - magnetic chaining technique - knife edge scanning to measure laser beam profile - knife edge scanning based liquid refractometer.

UNIT – III LASER FUNDAMENTALS AND TYPES (12 Hours)

Basic construction and Principle of Lasing – Einstein relations and gain coefficient – Creation of a population inversion-Three level system-Four level system –threshold gain-Coefficient for lasing – Laser types- Solid state lasers- Ruby laser - Nd:YAG Laser-Semiconductor lasers - features of semiconductor lasers- diode lasers- gas laser : He-Ne laser - CO_2 laser- liquid lasers - dye lasers.

UNIT – IV LASER OPERATION (12 Hours)

Optical resonantor-Laser mode-Axial modes-Transverse modes-Modification in basic Laser –basic principle of mode locking – Active mode locking –Passive mode locking –Q – Switching-Pulse shaping

UNIT – V APPLICATIONS OF LASERS (12 Hours)

Material processing- laser generated plasma and laser deposition of thin film - isotope separation - lasers in medicine and surgery - laser interferometry and speckled metrology - laser induced fusion – LIDAR - laser gyros - laser cooling and trapping of atoms - magnetic and optical traps - lasers in communications - information storage systems - computing.

TEXT BOOKS

1. M.Bornand, E. Wolf, “Principles of Optics”, 7th Ed., Cambridge University Press, (1999).
2. J.D. Joannopoulos, R.D. Meade, J.N. Winn, “Photonic Crystals: Molding the Flow of light”, 2nd Ed, Princeton University Press, (2008).
3. Ajoy Ghatak and Thyagarajan, “Lasers-Theory and Applications”, McMillan, (2002).

REFERENCE BOOKS

1. William T Silfvast, “Laser Fundamentals”, Cambridge University Press, 2nd ed., (2004).
2. Orazio Svelto , “Principles of lasers”, Springer, 5th ed., (2010).
3. L.Tarasov, “Laser Physics and applications”, Mir Publishers, (1986).
4. S. Mohan, V.Arjunan, M. Selavarani, M. Kanchana Mala, “Laser Physics”, MJP Publishers, (2012).
5. Chaudhary, Yadav, Sharma, “Atomic, Molecular and laser Physics”, A Pragati Edition, (2006).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the basic concept of physical optics and photonic crystals.	1,3,4	Understanding
CO-2	Apply the applications of various optical techniques	1,2,3	Applying
CO-3	Categorize the laser types and its operation.	1,2,4	Analyzing
CO-4	Assess the longitudinal and transverse modes of laser cavity.	1,3	Evaluating
CO-5	Adapt the applications of laser in medical, information storage and communication system.	2,3,4	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PEPH41A	APPLIED OPTICS AND LASER PHYSICS	60	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓		✓	✓	
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		
CO-3	✓	✓	✓	✓	✓	✓	✓		✓	
CO-4	✓	✓		✓	✓	✓		✓		
CO-5	✓		✓	✓	✓		✓	✓	✓	
	Number of matches (✓) = 37 Relationship = **High**									

SEMESTER- IV

Course Title	**ELEMENTARY NUMERICAL ANALYSIS**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH41B**
Course Type	**DSE-IV B**
Credits	**4**
Marks	**100**

General Objective:

This Course teaches the students to improve the skills in numerical methods by using the numerical analysis software and computer facilities.

Course Objectives:

CO No	The learners will be able to
CO-1	Impart the knowledge on the basics of C program and the Elementary numerical analysis.
CO-2	Execute the learners with the basic concepts of measurements, error analysis and error estimation.
CO-3	Reframe the computational skill using Physics and Mathematical formulations.
CO-4	Develop the problem solving skills using various numerical methods.
CO-5	Solving the various mathematical concepts for finding any difficult tasks.

UNIT - I C PROGRAMMING (12 Hours)

Introduction – Basic structure of C Program – Tokens-keywords-Identifier and Constants-Basic data types-Operators and Expressions – Library functions – getchar Functions and putchar Functions – Control Statements-Classes and Objects-Constructors and Destructors-Operator overloading and Inheritance.

UNIT - II ERROR, COMPUTER ARITHMETIC AND ROOT FINDING (12 Hours)

Errors: Definition, sources, Propagation of error, summation, least squares data fitting, eigenvalue problem, nonlinear systems- The method of iteration-Bisection method, Newton's method: Error analysis, error estimation, Secant method: Error analysis, , Regula Falsi-method- comparison of Newton and Secant methods-The method of Least squares.

UNIT - III INTERPOLATION (12 Hours)

Finite difference– Newton-Gregory formula for Forward interpolation-backward interpolation-- divided differences, properties of divided differences, Newton's divided difference –Important theorems on divided difference-Polynomial interpolation: linear interpolation, Lagrange's interpolation for both equal and unequal intervals- Quadratic interpolation, higher-degree interpolation,-Extrapolation- Inverse interpolation. Interpolation by iteration.

UNIT – IV NUMERICAL INTEGRATION AND ORDINARY DIFFERENTIAL EQUATIONS (12 Hours)

General quadrature formula for equidistant values of argument x- The Trapezoidal and Simpson rules - Error formulae: An error formula for Trapezoidal and Simpson's rule - Richardson Extrapolation - periodic interpolation - Ordinary differential equations: theory of differential equations - Euler's methods - Taylor and Runge-Kutta methods second order, third order and fourth order (no derivation).

UNIT - V SOLUTION OF SYSTEMS OF LINEAR EQUATIONS (12 Hours)

Systems of linear equations - Eigenvalues and Eigenvectors - Gauss elimination: Partial Pivoting - calculation of inverse matrices - operations count - The LU Factorization: Compact Variants of Gauss Elimination - tri-diagonal systems - iteration methods:Gauss – Jordon method - Jacobi method and Gauss-Seidel method - Power method Least square method for inconsistent systems - Ill conditioned systems - Relaxation method.

TEXT BOOKS

1. K.Atkinson and W.Han," Elementary Numerical Analysis", 3rd Edition, Wiley-India, (2011).
2. Byron Gottfried, "Programming with C", 3 rd Edition, Tata McGraw Hill Publications (2010).
3. B.S.Grewal and J.S.Grewal, "Numerical Methods in Engineering and Science", Khannapublishers, Delhi (1994).

REFERENCE BOOKS

1. M.K.Venkataraman, "Numerical Methods in Science and Engineering", The National Publishing Co. Chennai (2006).
2. Lorenzo Robbiano, "Solutions of Systems of Linear Equations", Springer-Verlag Italia (2011).
3. S.R.K. Iyengar, Rajendra K. Jain,"Mathematical Methods", Alpha Science International Ltd., (2006).
4. S.R.K. Iyengar, Rajendra K. Jain, "Numerical Methods", New Age International, New Delhi.
5. S.R.K. Iyengar, Rajendra K. Jain, "Advanced Engineering Mathematics", Narosa Publication, Fifth Edition, (2016).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the concepts of C program.	1,2,3	Understanding
CO-2	Develop the concepts of errors and root finding.	1,3	Applying
CO-3	Classify various types of interpolations.	1,3	Analyzing
CO-4	Solve the ordinary differential equation using power series approximation and Euler's Runge-Kutta method.	2,4	Creating
CO-5	Write the solution of systems of linear equations	2,4	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PEPH41B	ELEMENTARY NUMERICAL ANALYSIS	60	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓		
CO-2	✓	✓		✓	✓	✓		✓		
CO-3	✓	✓		✓	✓	✓		✓		
CO-4			✓	✓	✓		✓		✓	
CO-5			✓	✓	✓		✓		✓	
	Number of matches (✓) = 30 Relationship = **Medium**									

SEMESTER- IV

Course Title	**QUANTUM FIELD THEORY**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEPH41C**
Course Type	**DSE-IV C**
Credits	**4**
Marks	**100**

General Objective:

Students are educating to describe various quantum mechanical phenomena using a modified concept of fields.

Course Objectives:

CO	The learners will be able to
CO-1	Paraphrase the knowledge about Lagrangian and Hamiltonian Formulations.
CO-2	Explain the quantization of field of charged particles.
CO-3	Compare the interaction of quantum field with perturbation theory.
CO-4	Review the scattering theory and the behaviour of spin.
CO-5	Develop the knowledge of quantum electrodynamics field.

UNIT - I CLASSICAL FIELDS (12 Hours)

Lagrangian & Hamiltonian Formulations- Variational Principle- Euler-Lagrange equations-Noether's theorem & Conservation Laws- Lorentz transformations and Conservation of Energy-momentum and angular momentum tensor- Internal symmetries and associated conservation laws- Free field- canonical quantization-The simple harmonic oscillator-The free scalar field.

UNIT – II QUANTIZATION OF RELATIVISTIC FREE FIELDS (12 Hours)

Scalar Fields- Field Quantization- Energy of Free Neutral Scalar Particles- Propagator of Free Scalar Particles- Complex Case- Field Quantization- Energy of Free Charged Scalar Particles- Propagator of Free Charged Scalar Particles- Behavior under Discrete Symmetries- Space Inversion- Time Reversal Charge Conjugation- Spacetime Behavior of Propagators- Wick Rotation- Feynman Propagator in Minkowski Space.

UNIT – III INTERACTION QUANTUM FIELDS & PERTURBATION THEORY (12 Hours)

Interaction Picture- Dyson's formula- Wick's theorem - An example : recovering the Propagator, Nucleon scattering- Examples of Scattering Amplitudes - Mandelstam Variables - The Yukawa Potential- φ 4 Theory - Connected Diagrams and Amputated Diagrams- Time Evolution Operator- Covariant Pertubation theory- Normal product; Time ordered product & Wick's theorem- Invariant amplitude and Feynman rules- Scattering cross section.

UNIT –IV QUANTIZING THE DIRAC FIELD (12 Hours)

A Glimpse at the Spin-Statistics Theorem- The Hamiltonian- Fermionic Quantization- Fermi-Dirac Statistics- Dirac's Hole Interpretation- Propagators- The Feynman Propagator- Yukawa Theory- An Example: Putting Spin on Nucleon Scattering- Feynman Rules for Fermions- Examples- The Yukawa Potential Revisited- Pseudo-Scalar Coupling

UNIT- V QUANTUM ELECTRODYNAMICS (12 Hours)

Maxwell's Equations- Gauge Symmetry- The Quantization of the Electromagnetic Field- Coulomb Gauge- Lorentz Gauge- Coupling to Matter- Coupling to Fermions- Coupling to Scalars QED- Naive Feynman Rules- Charged Scalars- Scattering in QED- The Coulomb Potential- Elementary ideas on spontaneous symmetry breaking-Goldstone theorem (without proof) – Spontaneously broken gauge theory and Higgs-Kibble mechanism – Standard model for eletro-weak interactions (Glashow-Salam -Weinberg).

TEXT BOOKS

1. David Lurie, "Quantum Field Theory", New York, Interscience Publishers, (1968).
2. Dr. David Tong, Quantum Field Theory, http://www.damtp.cam.ac.uk/user/tong/qft.html d.tong@damtp.cam.ac.uk
3. L.H. Ryder, "Quantum Field Theory", Cambridge University Press, (1985).

REFERENCE BOOKS

1. 1. T D Lee, "Particle Physics & Introduction to Field Theory", Harwood academic Publishers, London, 1982}.
2. P. Ramond: Field Theory: "A Modern Primer", Sarat Book House, New Delhi, (2007).
3. C. Itzykson and J.B. Zuber, "Quantum Field Theory", International Series In Pure and Applied Physics, Mcgraw-hill, New York, USA (1980).
4. Zee, "Quantum Field theory in a Nutshell", Princeton University Press, Second Edition, (2010).
5. Matthew D.Schwartz, "Quantum Field Theory and the Standard Model" , Cambridge University Press, New York, (2014).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand the Lagrangian and Hamiltonian formulations and various conservation laws.	1,2,3	Understanding
CO-2	Apply the quantization of relativistic free fields.	1,3	Applying
CO-3	Analyze the interaction picture and perturbation theory.	2,3,4	Analyzing
CO-4	Explain Fermi-Dirac statistics and Feynman propagator.	1,3	Evaluating
CO-5	Assess the concept of Quantum Electrodynamics, gauge theory and Higgs-Kibble mechanism.	2,3,4	Evaluating

Relationship Matrix

Semester	Course Code		Title of the Course					Hours	Credits	
IV	21PEPH41C		QUANTUM FIELD THEORY					60	4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓		
CO-2	✓	✓		✓	✓	✓		✓		
CO-3	✓		✓	✓	✓		✓	✓	✓	
CO-4	✓	✓		✓	✓	✓		✓		
CO-5	✓		✓	✓	✓		✓	✓	✓	
	Number of matches (✓) = 34 Relationship = **Medium**									

SEMESTER- IV

Course Title	**ADVANCED PHYSICS PRACTICALS - II**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCPH4P1**
Course Type	**PRACTICAL-VII**
Credits	**2**
Marks	**100/2**

General Objective:

To train the students with advanced experimental techniques in Physics and to handle sophisticated equipments and analyze the data

Course Objectives:

CO	The learners will be able to
CO-1	Establish the resistivity and the band-gap of the given semiconductor sample using four probe technique.
CO-2	Estimate the fermi energy of the different metal wires.
CO-3	Predict the value of band-gap of the given p-n junction using reverse saturation current.
CO-4	Express the concepts behind various physics experiments such as polarizability of liquids, dispersive power of prism, refractive index of glass, ultrasonic wave velocity of liquids, young's modulus of materials etc.,
CO-5	Build the exposure to measure some of the physical parameters with maximum accuracy.

(Any Eight)

1. Equipotential surface-different shapes.
2. Resistivity- four probe method.
3. Band gap energy - Thermistor / Semiconductor.
4. Fraunhofer diffraction using laser.
5. Determination of Fermi energy(E_F) – Metal wires (atleast three wires).
6. Michelson Interferometer.
7. Study of Zeeman effect and determine e/m of an electron.
8. Rydburg's constant using constant deviation spectrometer.
9. Measurement of Brewster's angle of a substance and hence determine the refractive index.
10. GM counter-verification of inverse square law.
11. Electrodepostion of semiconducting thin films.

12. Hollow prism-Polarizability of liquids.
13. Calibration of hall probe into Gauss meter using search coil.
14. B-H curve-Determination of hysteresis energy loss.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Explain the principle of equipotential surface for different shapes.	1,3,4	Understanding
CO-2	Analyse resistivity and band gap energy using four probe method.	2,4,5	Analyzing
CO-3	Measure the Brewster's angle and refractive index of a substance and determine Fermi energy of metal wires.	2,4,5	Evaluating
CO-4	Determine e/m of an electron and study the Zeeman effect.	2,3,4	Evaluating
CO-5	Formulate the basic principles and concepts of Fraunhofer diffraction.	1,3,4	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
IV	21PCPH4P1		ADVANCED PHYSICS PRACTICALS - II			60			2	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓		✓	✓	
CO-2	✓	✓	✓	✓	✓		✓		✓	✓
CO-3	✓	✓	✓	✓	✓		✓		✓	✓
CO-4	✓		✓	✓	✓		✓	✓	✓	
CO-5	✓	✓	✓	✓	✓	✓		✓	✓	
	Number of matches (✓) = 39 Relationship = **High**									

SEMESTER- IV

Course Title	**NUMERICAL METHODS AND C++ PROGRAMMING IN PHYSICS**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCPH4P2**
Course Type	**PRACTICAL-VIII**
Credits	**2**
Marks	**100/2**

General Objective:

This course provides a way to solve problems quickly using Numerical Methods and C++ Programming in Physics.

Course Objectives:

CO No.	The learners will be able to
CO-1	Demonstrate the mathematical methods which are required for physics problems.
CO-2	Explore the solution of linear, transcendental, simultaneous equations.
CO-3	Reframe the regression using least square, interpolating methods.
CO-4	Develop the knowledge about eigen values of matrices, evaluation of integrals.
CO-5	Rewrite the scientific programming language C++, writing programs using C++ for the numerical methods learned.

(Any Eight)

1. Curve fitting - straight line fit and data interpolation (application - cauchy's constant).
2. Solution of simultaneous equations - Gauss elimination method.
3. Solution of radioactive decay problem - Runge kutta method.
4. Solution of radioactive decay problem - Euler's method.
5. Evalution of area under the curve-Simpson's rule.
6. Newton Raphson Method - Solution of transcendal equation.
7. Newton Raphson Method - Solution of polynomial equation.
8. Monte Carlo method - Evaluation of definite integrals.
9. Eigen values and eigen vectors of symmetry matrices.
10. Matrix multiplication (application – rotation matrices).

11. Newton's Law of cooling (or any physics problem) using numerical differentiation.
12. Uniform random number generator - Park - Miller method.
13. Gaussian random number generator - Box - Muller method.
14. Numerical solution of one - dimensional Schrodinger equation.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Mapped	Cognitive Level
CO-1	Understand and apply numerical methods which has enormous applications in the field of Science and Engineering	2,3,4	Understanding and Applying
CO-2	Apply the Monte carlo method to solve the definite integrals.	2,3,4	Applying
CO-3	Analyse the various computational methods like Euler, Newton-Raphson and Runge-Kutta useful to solve research problems.	2,4,5	Analysing
CO-4	Determine the eigen values and eigen vectors of symmetry matrices.	2,3,4	Creating
CO-5	Design the various simulation techniques which can be used in future by students to analyse the data.	2,4,5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course				Hours	Credits		
IV	21PCPH4P2		NUMERICAL METHODS AND C++ PROGRAMMING IN PHYSICS				4	2		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓		✓	✓	✓		✓	✓	✓	
CO-2	✓		✓	✓	✓		✓	✓	✓	
CO-3	✓	✓	✓	✓	✓		✓		✓	✓
CO-4	✓		✓	✓	✓		✓	✓	✓	
CO-5	✓	✓	✓	✓	✓		✓		✓	✓
	Number of matches (✓) = 37 Relationship = **High**									

INTERDISCIPLINARY COURSES (2021 – 2024)							
SEM	**TITLE OF THE COURSE**	**COURSE CODE**	**H/W**	**C**	**MARKS**		
					I	**E**	**T**
DEPT. OF ENGLISH							
II	SOFT SKILLS	**21PIEN11**	**2**	**2**	**40**	**60**	**100/2**
III	ENGLISH FOR BUSINESS COMMUNICATION	**21PIEN31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF HISTORY							
II	INDIAN HISTORY FOR COMPETITIVE EXAMINATIONS UPTO 1707A.D	**21PIHS11**	**2**	**2**	**40**	**60**	**100/2**
III	INDIAN HISTORY FOR COMPETITIVE EXAMINATIONS FROM (1707-1947 A.D)	**21PIHS31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF COMMERCE							
II	ENTREPRENEURIAL DEVELOPMENT	**21PICO11**	**2**	**2**	**40**	**60**	**100/2**
III	HUMAN RESOURCE MANAGEMENT	**21PICO31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF MATHEMATICS							
II	DISCRETE STRUCTURE – I	**21PIMA11**	**2**	**2**	**40**	**60**	**100/2**
III	DISCRETE STRUCTURE – II	**21PIMA31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF CHEMISTRY							
II	ANALYTICAL BIOCHEMISTRY	**21PICH11**	**2**	**2**	**40**	**60**	**100/2**
III	INDUSTRIAL CHEMISTRY	**21PICH31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF COMPUTER SCIENCE							
II	DIGITAL LITERACY	**21PICS11**	**2**	**2**	**40**	**60**	**100/2**
III	DIGITAL TECHNOLOGY	**21PICS31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF MICROBIOLOGY							
II	MICROBIOLOGY AND HUMAN HEALTH	**21PIMB11**	**2**	**2**	**40**	**60**	**100/2**
III	ENTREPRENEURSHIP IN MICROBIOLOGY	**21PIMB31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF PHYSICS							
II	THE BASICS OF DIGITAL ELECTRONICS	**21PIPH11**	**2**	**2**	**40**	**60**	**100/2**
III	ENERGY PHYSICS	**21PIPH31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF ZOOLOGY							
II	ORNAMENTAL FISH CULTURE	**21PIZO11**	**2**	**2**	**40**	**60**	**100/2**
III	APPLIED ZOOLOGY	**21PIZO31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF NUTRITION AND DIETETICS							
II	DIET THERAPY-I	**21PIND11**	**2**	**2**	**40**	**60**	**100/2**
III	DIET THERAPY-II	**21PIND31**	**2**	**2**	**40**	**60**	**100/2**

THE SCHEME OF EXAMINATIONS UNDER CHOICE BASED CREDIT SYSTEM

- The medium of instruction in all the UG and PG Programmes is English and Students shall write the CIA Tests and the Semester Examinations in English. Three CIA Tests for one hour each will be conducted. For the calculation of CIA Tests marks the average of the best two tests will be taken. The portion for each test can be 1.5 units of the unitized syllabi.
- Two assignments for the Undergraduate Programmes and one assignment and one seminar for the Postgraduate Programmes are compulsory.
- Two Practical Examinations will be conducted for CIA at the end of the semester and the average will be taken.

Distribution of Marks for the Students admitted into the UG and PG Programmes from the academic year 2021-2022
CIA Tests and Semester Examinations

Undergraduate, Certificate, Diploma and Advanced Diploma Programmes						
Course Type	TOTAL MARKS	CIA TESTS MAX.MARKS	SEMESTER EXAMINATION Max. Marks	PASSING MINIMUM		
				CIA	SEM. EXAM	OVERALL
Theory	100	25	75	Nil	30	40
Practical (2Hrs.)	50	20	30	Nil	12	20
Practical (4Hrs.)	100	40	60	Nil	24	40
Project	100	Nil	Report- 60 Marks Viva-Voce- 40 Marks	Nil	Nil	100

Postgraduate Programmes						
Course Type	TOTAL MARKS	CIA MARKS	SEMESTER EXAM	PASSING MINIMUM		
				CIA	SEM. EXAM	OVERALL
Theory	100	40	60	Nil	30	50
Practical	50	20	30	Nil	15	25
Practical (for PG Maths only)	100	40	60	Nil	30	50
Project Report	150	Nil	Project Report- 90 Marks Viva-Voce Examination - 60 Marks	Nil	Nill	150

CIA TESTS

Distribution of Marks

Components	Tests (A)			Assignment (B)	Seminar (C)	Record Note (D)	Total (A+B+C+D)
	I	II	III	5	-	-	25
UG-Theory	20	20	20				
	The Average of the Best Two Tests:20						
PG-Theory	30	30	30	5	5	-	40
	The Average of the Best Two Tests:30						
UG-Practical (2 hrs)	15	15		-	-	5	20
	The Average of the Tests: 15						
UG-Practical (4 hrs)	30	30		-	-	10	40
	The Average of the Tests: 30						
PG-Practical	15	15		-	-	5	20
	The Average of the Tests: 15						
PG-Practical (Maths only)	30	30		-	-	10	40
	The Average of the Tests: 30						

Question Pattern for CIA Test (Theory)

Programme	Question Paper Pattern			Total (A+B+C)
	Part-A	Part-B	Part-C	
UG	MCQs-8x0.5=4 marks	Internal Choice (Either or type). 2x4=8 marks Answer should not exceed 250 words	Internal Choice (Either or type) 1x8=8 marks Answer should not exceed 500 words	20
PG	MCQs-20x0.5=10 marks	Internal Choice (Either or type) 3x4=12 marks Answer should not exceed 250 words	Internal Choice (Either or type) 1x8=8 marks Answer should not exceed 500 words	30

End Semester Examination (ESE)

The students who have put in the required number of days of attendance are eligible to appear for the End Semester Examinations irrespective of whether they have passed in the CIA Tests or not. They have to pay the examination fees for all the current courses and the arrear courses, if any,

and submit the application form before the due date specified for the purpose. For any reason, the dates will not be extended. Hall tickets will be issued only for those who have paid the fees. The question papers for the End Semester Examinations for all the theory courses of the UG and the PG Programmes will be set for 75 marks.

Question Pattern for End Semester Examinations (Theory)

Programme	Question Paper Pattern			Total (A+B+C)
	Part-A	**Part-B**	**Part-C**	
UG	MCQs- 30x0.5=15 marks	Internal Choice (Either or type) 5x4=20 marks Answer should not exceed 250 words	Internal Choice (Either or type) 5x8=40 marks Answer should not exceed 500 words	**75**
PG	MCQs- 30x0.5=15 marks	Internal Choice (Either or type) 5x4=20 marks Answer should not exceed 250 words	Internal Choice (Either or type) 5x8=40 marks Answer should not exceed 500 words	$\left(\frac{x}{75} \times 60\right)$ **60**

The Question Paper Pattern for the End Semester Examinations (Practical)

The Question Paper Pattern is designed by the respective departments.