ST. MARY'S COLLEGE (AUTONOMOUS)

Re-accredited with A+ Grade by NAAC

Thoothukudi – 628001, Tamil Nadu

(Affiliated to Manonmaniam Sundaranar University)

Syllabus

M.Sc. Physics

School of Physical Sciences

Outcome Based Curriculum

(w.e.f. 2021)

Preamble

The PG department of Physics aims to develop the potential of students through rigorous academic and practical exposure, field projects and robust industry interactions. Industrial visits, workshops, guest lectures and skill development programmes are conducted to hone the skills of students to suit the requirement of recruiters, thereby enhancing the career aspects of our students. We promote a nurturing environment to help our students in identifying their core competencies and refining them.

Vision

To build a foundation for excellence and encourage the development of the institution as a premier institution by igniting and promoting enthusiasm, interests and passion, in the study of Physics as a part of curriculum.

Mission

To awaken the young minds and discover their talents both in theory and in practical Physics, through dedication to teach, commitment towards students and innovative instructional methods like PPT and visual aids.

To develop strategy in the department for continuous improvement.

Programme Outcomes

PO No.	**Upon completion of this course, students will be able to**
PO 1	obtain in-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods in science.
PO 2	understand their subject areas more clearly and develop skills to critically reflect upon the theory they learn.
PO 3	adopt the scientific methods and hypothesis testing in designing and execution of experiments.
PO 4	think critically, work independently and focus in research oriented activities.
PO 5	inculcate an ability to engage in life-long learning to improve professional competency.
PO 6	extend and understand the impact of science on society.
PO 7	apply their professional ability for entrepreneurship and self-employment.
PO 8	understand and commit to professional ethics and social responsibility.

Program Specific Outcomes:

PSO No	Students of M.Sc., Physics will be able to	PO Mapped
PSO 1	Demonstrate and understand the principles and theories of physics. These includes the following classical mechanics, Electromagnetic theory, Electronics and experimental methods, microprocessor and microcontroller, Quantum mechanics, thermodynamics and statistical mechanics, Nuclear and particle physics, Atomic and molecular spectroscopy, Nanoscience and technology and condensed matter Physics	1
PSO 2	Apply algebra, calculus, tensors and complex variables to solve physics problems.	4
PSO 3	Demonstrate the ability to do the lab experiments and apply the principles learnt in class	3
PSO 4	Undertake a major, individual project and report their results in a full scientific report oral or poster presentation. Critically asses a project to evaluate the best strategy to achieve the desired outcome.	4
PSO 5	Extend and understand the impact of physics and science on society	6
PSO 6	Demonstrate written and oral communicating physics related topics	2
PSO 7	A research-oriented learning that develops analytical and integrative problem-solving approaches.	3
PSO 8	Help to communicate effectively on energy aspects with the society at large.	8

ST. MARY'S COLLEGE (AUTONOMOUS), THOOTHUKUDI

Master of Science (Physics)

Course Structure (w. e. f 2021)

Semester – I

Subject	Course code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
					CIA	ESE	Total
Core I	21PPHC11	Classical Mechanics	6	5	40	60	100
Core II	21PPHC12	Mathematical Physics I	6	5	40	60	100
Core III	21PPHC13	Electronics and Experimental methods	6	5	40	60	100
Elective I	21PPHE11/ 21PPHE12	A. Crystal growth & Thin films B. Research Methodology	6	4	40	60	100
Core Practical I	21PPHCR1	Electronics	3				
Core Practical II	21PPHCR2	General Physics	3				
			30	**19**	**160**	**240**	**400**

Semester – II

Subject	Course code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
					CIA	ESE	Total
Core IV	21PPHC21	Mathematical Physics II	6	5	40	60	100
Core V	21PPHC22	Electromagnetic Theory	6	5	40	60	100
Core VI	21PPHC23	Thermodynamics and Statistical Mechanics	6	5	40	60	100
Elective II	21PPHE21/ 21PPHE22	A. Bio medical Instrumentation B.Microprocessor and Microcontroller	6	4	40	60	100
Core Practical I	21PPHCR1	Electronics	3	3	40	60	100
Core Practical II	21PPHCR2	General Physics	3	3	40	60	100
			30	**25**	**240**	**360**	**600**

Semester – III

Subject	Course code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
					CIA	ESE	Total
Core VII	21PPHC31	Quantum Mechanics – I	6	5	40	60	100
Core VIII	21PPHC32	Atomic and Molecular Spectroscopy	6	5	40	60	100
Core IX	21PPHC33	Solid State Physics- I	6	5	40	60	100
Elective III	21PPHE31/ 21PPHE32	A. Nano science and Technology B. Energy sources	6	4	40	60	100
Core Practical III	21PPHCR3	Microprocessor and Microcontroller& C++	3				
Core Practical IV	21PPHCR4	Advanced Electronics	3				
Self Study Course/ MOOC/ Internship (optional)	21PPHSS1/ 21PPHM2/ 21PPHI1	Physics for Lectureship	-	+2		100	100
			30	**19+2**	**240**	**360**	**500**

Semester – IV

Subject	Course code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
					CIA	ESE	Total
Core X	21PPHC41	Quantum Mechanics – II	6	5	40	60	100
Core XI	21PPHC42	Solid State Physics- II	6	5	40	60	100
Core XII	21PPHC43	Nuclear and Particle Physics	6	5	40	60	100
Core Project	21PPHP41	Project	6	6	40	60	100
Core Practical III	21PPHCR3	Microprocessor and Microcontroller& C++	3	3	40	60	100
Core Practical IV	21PPHCR4	Advanced Electronics	3	3	40	60	100
			30	**27**	**200**	**300**	**500**

Master of Science (Physics)

Components	No. of Courses	Total no. of hours	Credits	Extra credit
Core	12	72	60	
Elective	3	18	12	
Core practical	4	24	12	
Project	1	6	6	
MOOC	1			2
Self Study Course	1			2
	Total	**120**	**90**	**4**

SEMESTER - I			
Core - I	**CLASSICAL MECHANICS**		
Code : 21PPHC11	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

Objectives:

- Enable the students to understand the basic principles of classical mechanics
- Enhance their problem solving skill towards real life classical system

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Recall basic concepts related to continuous mechanical system.	1	Re
CO 2	Classify the motion of bodies under the influence of the system of force.	5	Ev
CO 3	Understand the method of separation of variables	2	Un
CO 4	Estimate the motion of rigid bodies, molecules, planets, satellites and ships by studying Euler's angles.	3	Ev
CO 5	Interpret extremely accurate results when studying large objects and speeds approaching the speed of light.	3	Ap
CO 6	Explain the difference between Lagrangian and Hamiltonian formulation.	1	Un
CO 7	Imagine the planar and spatial motion of rigid body.	1	Cr
CO 8	Solve the problems using their knowledge and skills in classical mechanics.	2	Cr

SEMESTER - I			
Core - I	**CLASSICAL MECHANICS**		
Code : 21PPHC11	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

UNIT I: Fundamental Principles and Lagrangian Formulation

Mechanics of a particle and system of particles –conservation laws- constraints – Principle of virtual work - Generalized coordinates - D' Alembert's principle – Lagrange's equation from D'Alembert's principle –applications of Lagrange's equation (simple pendulum, Atwood machine, compound pendulum) – Hamilton's principle & Lagrange's equation from Hamilton's principle.

UNIT II: Two Body Central Force Problems

Equivalent one body problems - general features of central force motion-Equivalent one dimensional problem: general features of the orbits-stability of orbits and conditions for closure- Motion under inverse square force: Kepler's problems -Virial theorem -Unbound motion: Rutherford scattering - Centre of mass and laboratory co-ordinates.

UNIT III: Hamilton's Formulation

Hamilton's equation from variational principle- principle of least action – Canonical Transformation-Legendre transformation- Lagrange and Poisson's brackets – Angular momentum and Poisson bracket Invariance of Poisson's brackets with respect to canonical transformations-Hamilton–Jacobi Equation - Harmonic Oscillator Problem -Hamilton's characteristic function- Action angle variable - Problem of Harmonic oscillator using action-angle variable.

UNIT IV: Rigid Body Problems

Generalized coordinates of a rigid body- Body and space reference systems-Euler's angles – Angular momentum and inertia tensor-Principle moments of inertia - Moments of Inertia for different body systems - Euler's equations of motion –Torque-free motion of a rigid body- Force free motion of a symmetrical top.

UNIT V: Relativistic Mechanics

Postulates of Special theory of Relativity – Lorentz transformations – consequences of Lorentz transformations- Relativistic energy - Relation between momentum and energy - Particles with zero rest mass - The Lagrangian and Hamiltonian formulation of relativistic Mechanics – Covariant formulation of Lagrangian and Hamiltonian.

Text Books:

1. Dr.Gupta S L, Kumar V and Sharma H V. *Classical Mechanics. Meerut:* Pragati Prakashan. 30th edition 2018.
2. Dr.Upadhyaya J C. *Classical Mechanics.* Mumbai: Himalaya Publishing House 3rd Edition 2019.

Books for Reference:

1. Gupta B D Satya Prakash. *Classical Mechanics*. 9th revised and Enlarged Edition. 1991.
2. Goldstein Poole and Safko. *Classical Mechanics.* Chennai: Person Education. 3rd Edition 2002.

SEMESTER - I			
CORE - II	**MATHEMATICAL PHYSICS – I**		
Code : 21PPHC12	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

Objectives:

- Enable the students to solve simple mathematics and make them understand the physical significance behind them
- Enable the students to understand the concepts and applications of mathematical theories.

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Evaluate the area of irregular shape by Green's theorem.	2	Ev
CO 2	Recall the basic and the special types of matrices.	1	Re
CO 3	Understand the concepts of feedback control systems with finite dimensional vector spaces.	7	Un
CO 4	Apply special functions for Wireless communication and alternating current transmission.	2	Ap
CO 5	Understand the geometrical interpretation of complex numbers.	1	Un
CO 6	Explain the characteristic equation of a matrix using Cayley Hamilton Theorem.	3	Ev
CO 7	Understand the advanced concepts in evaluating double integral and area enclosed by plane curves	2	Un
CO 8	Apply group theory to various disciplines of Physics.	3	Ap

SEMESTER - I			
CORE - II	**MATHEMATICAL PHYSICS – I**		
Code : 21PPHC12	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

UNIT I: Differentiation & Integration of vectors

Concepts of scalar & vector point functions –gradient of a scalar function – geometrical meaning of gradient – divergence of a vector function – curl – line integral – surface integral – volume integral – Green's Theorem – Stoke's Theorem – Gauss theorem of divergence.

UNIT II: Linear Algebra

Matrices: Review – Special types – Transpose – Conjugate – Conjugate Transpose – Symmetric and AntiSymmetric – Hermitian and Skew-Hermitian – Determinant – Singular and Non-Singular – Adjoint – Inverse – Orthogonal – Unitary – Trace – Rank - Cramer's rule – Eigen values, Eigen-vectors: Characteristic equation of a Matrix – Cayley-Hamilton theorem.

UNIT III: Special Functions I and Partial Differential Equations

Legendre Function: Legendre's Equation – Generating Function – Rodrigue's Formula – Orthogonality – Recurrence Formulae – Bessel Function: Bessel's Function of the First kind – Generating Function – Recurrence Formulae.

Introduction – Laplace equation (Cartesian – 3D only) – Heat flow equation (3D only) – Equation motion for the vibrating string (D'Alembert's solution only).

UNIT IV: Complex Analysis

Complex variables– Limits and continuity – Differentiability –Analytic function- Cauchy-Riemann equations(necessary and sufficient condition, polar form)– Cauchy theorem – Cauchy integral formula – Taylor's theorem – Laurent theorem – Singular points – Residues – Method of finding residues- Residue theorem – Evaluation of definite integrals (unit circle type & evaluation $\int_{-\infty}^{+\infty} \frac{f_1(s)}{f_2(s)}$ only).

UNIT V: Group Theory

Group, subgroup, classes – invariant, subgroups, factor groups –homomorphism and isomorphism – group representation – reducible and irreducible representation – Schur's lemmas, great orthogonality theorem – character table.

Text Books:

1. Satya Prakash. *Mathamatical Physics.* New Delhi: Sultan Chand & Sons. 6th edition 2019.
2. Dass H K. *Mathematical Physics*. New Delhi: S.Chand & Company LTD. 8th Edition 2018.
3. Chattopadhyay P K. *Mathematical Physics.* New Delhi: New Age International Publishers. 2nd Edition 2013.

Books for reference:

1. Erwin Kreyszig, *Advanced Engineering Mathematics.* Asia: John Wiley and sons.8th Edition 2005.
2. Gupta B D. *Mathematical Physics.* Vikas Publishing house PVT LTD. 4th Edition 2010.

SEMESTER - I			
CORE - III ELECTRONICS AND EXPERIMENTAL METHODS			
Code : 21PPHC13	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

Objectives:

- Enable the students to realize the principle of digital electronics and its applications
- Encourage the students to draw their own circuits and therefore make them to understand the concept

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Discuss the working principle of Tunnel Diode, photodiode, LED, LCD, photo conductor and Gunn diode	1	Un
CO 2	Define Hall Effect	1	Re
CO 3	Construct waveform generators such as Square wave generator, triangular wave generator and Schmitt trigger	1, 3	Cr
CO 4	Discuss the functions of registers and counters	1	Un
CO 5	Distinguish between the different types of registers	1	An
CO 6	Analyze the working of D/A and A/D converters	1	An
CO 7	Classify the working mechanism of different types of transducers	1	Ev
CO 8	Differentiate between intrinsic and extrinsic semiconductors	1	An

SEMESTER - I			
CORE - III	**ELECTRONICS AND EXPERIMENTAL METHODS**		
Code : 21PPHC13	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

UNIT I: Semiconductor Physics

Energy band theory of semiconductor-Definition of intrinsic and extrinsic semiconductors – Fermi level in intrinsic & extrinsic semiconductor-Diode: tunnel diode-photodiode-LED- LCD –photo conductor-Gunn diode-Hall effect

UNIT II: OP-AMP Applications

Introduction-the practical op-amp –Input modes and parameters-op-amp audio amplifier-- Waveform generators: Sine and pulse wave generator-triangular wave generator –Schmitt trigger

UNIT III: Registers and Counters

Types of registers – Serial in-Serial out – Serial in-Parallel out – Parallel in-Serial out – Parallel in-Parallel out – Universal Shift registers Asynchronous counters – Synchronous counters – Changing the counter modulus – Decade counters.

UNIT IV: D/A and A/D conversion

Variable-resistor networks – resistive divider-Binary ladders – D/A converters – D/A accuracy and resolution – A/D converter – Simultaneous conversion – Counter method – continuous A/D conversion – A/D techniques – A/D accuracy and resolution.

UNIT V: Transducers

Transducer-electric transducers –classification of transducers – Summary of factors influencing the choice of Transducers–Resistive transducers: Strain Gauges- Theory of strain gauges – Capacitive transducers – Transducers using change in area of plates – Transducers using change in distance between plates –Variation of dielectric constant for measurement of displacement –advantages of capacitive transducers –Piezo electric transducers

Text Books:

1. Kakani S K, Bhandari K C, *Electronics Theory and Applications*. New Delhi: New Age International Publishers. Reprint. 2014
2. Thomas L. Floyd. *Electronic Devices conventional current version.* Pearson India Education Services Pvt.Ltd. 9th Edition 2020.
3. Jacob Milman and Christos C. Halkias. *Integrated Electronics.* India: Tata Mc Graw Hill. 2nd Edition1991.
4. Donald P. Leach, Albert Paul Malvino and Goutam Saha. *Digital Principles and Applications.* New Delhi: The Mc GRAW-Hill Publishing Company Ltd. 6th edition 2008.
5. Sawhney A K. *Electrical and Electronic Measurements and Instrumentatin.* Delhi: Dhanpat Rai Sons, Educational and Technical Publishers. 4th edition.

Book for reference:

1. Ramakanth A. Gayakwad. *Op-Amp and Linear Integrated Circuit.* New Delhi: Prentice Hall of India Pvt. Ltd.1988.

SEMESTER - I			
ELECTIVE – I	**A. CRYSTAL GROWTH & THIN FILMS**		
Code : 21PPHE11	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Objectives:

- Make the students to know the crystal growth and thin film techniques and to know their characterization techniques
- Make the students to choose their own project independently

Course Outcome:

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO 1	generate an understanding of self-assembly during the process of growth	1	Un
CO 2	apply the processskills of scientific inquiry during experimentation	4	Ap
CO 3	Classify the arrangement of SEM, TEM	4	Ev
CO 4	apply the techniques of SEM and TEM to their own research projects	5	Ap
CO 5	distinguish the differences and similarities between different deposition techniques.	1	An
CO 6	categorize selection of deposition techniques for various applications	1	An
CO 7	use more techniques for the preparation of crystals and thin films	4	Ap
CO 8	recognize appropriate material for the fabrication of a device	4	Re

SEMESTER - I			
ELECTIVE - I	**A. CRYSTAL GROWTH & THIN FILMS**		
Code : 21PPHE11	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

UNIT I: Introduction

Crystal growth – significance of Single crystals - crystal growth techniques- chemical physics of crystal growth. Nucleation – Theories of nucleation - classical theory of nucleation – Heterogeneous nucleation- Kinetics of crystal growth.

UNIT II: Growth Techniques

Solution growth: Low temperature solution growth – crystal growth system – High temperature solution growth. Gel growth: various types of gel – Experimental procedure– Biological crystallization.

UNIT III: Characterization Technique

Diffraction analysis – X-ray diffraction- electron & neutron diffraction - TEM, instrumental details - SEM – AFM Thermal analysis-thermo gravimetric analysis-differential thermal analysis-differential scanning calorimeter- Micro hardness (Nano hardness) – Classification of hardness test –Vickers hardness test – Knoop hardness test.

UNIT IV: Thin film

Preparation of thin films: thermal evaporation- flash evaporation -electron gun beam method – cathodic sputtering- chemical vapour deposition. Thickness measurements – ellipsometry – interferometry.

UNIT V: Technological application of thin film

Thermistor-varistor-strain gauge element-capacitor - active devices-microelectronics, IC and other applications- Discrete resistive components: resistors-carbon films-oxide and nitride films- cermet films-metal films.

Text Books:

1. Dr. Santhana Ragavan P and Ramasamy P. *Crystal growth processes and methods*. Kru Publications. 2000.
2. Rajendran V. *Material Science.* NewDelhi: Mcgraw hill. 1st reprint 2012.
3. Goswami A. *Thin film fundamental.* New Delhi: New age international (P) Ltd. 1st Edition 1996.

Books for Reference:

1. Brice J C. *Crystal growth processes.*London: Blackie & Son Ltd.1986.
2. Pamplin B R. *Crystal growth.* 2nd Edition 1980.
3. Hurle D T J, *Crystal pulling from melt.* 1990.
4. Raghavan V. *Material science & Engineering – A first course.* 5th Edition 1974.

SEMESTER - I			
ELECTIVE -I	**B. RESEARCH METHODOLOGY**		
Code : 21PPHE12	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Objectives:

- Enable the students to understand research problem and research design
- Enable the students to understand the steps behind research paper writing

Course Outcomes:

CO No.	**Upon completion of this course, students will be able to**	**PSOs addressed**	**CL**
CO 1	List the types of research depending on the approaches	1	Re
CO 2	Explain the criteria of a good research	6	Un
CO 3	Examine the selection process of the problem based on necessity.	4	An
CO 4	Recall the features of good research	4	Re
CO 5	Apply secondary data methods of collecting primary data	6	Ap
CO 6	Grade the formulation of the selected problem	4	Ev
CO 7	Identify the meaning of interpretation techniques	4	An
CO 8	Predict the types of reports based on the research mechanism	6	Cr

SEMESTER - I			
ELECTIVE -I	**(B) RESEARCH METHODOLOGY**		
Code : 21PPHE12	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

UNIT I: An Introduction to Research Methodology

Meaning of research-Objectives-Types of research- Research Approaches-Significance-Research methods versus methodology- Research and scientific method- Importance of knowing how research is done- Research process- Criteria of good research- Problems encountered by researchers in India.

UNIT II: Defining the Research Problem and Research design

Research problem- Selecting the problem- Necessity of defining a problem-Technique involved in defining a problem- Meaning of research design- Need- Features of good Design-Important Concepts-Basic principles of experimental designs.

UNIT III: Plagiarism

Plagiarism - Forms of plagiarism - Unintentional plagiarism - Examples of plagiarism - Consequences - How to avoid plagiarism - Being aware of and identifying different types of plagiarism - Things you can do to avoid plagiarism - Types of plagiarism - Online plagiarism - Web of science - h-index - Scopus.

UNIT IV: Review of literature

Need for reviewing literature- What to review and for what purpose - Literature search procedure- Sources of literature- Planning the review work – Note taking – The planning process- Selection of a problem for research- Formulation of selected problem.

UNIT V: Interpretation and report writing

Meaning of interpretation- Technique- Precaution- Significance- Different steps- Layout of research reports - Types of reports- Oral presentation- Mechanics of writing a research report- Precautions for writing a research report.

Text Books:

1. Kothari C R and Gaurav Garg. *Research methodology methods and techniques.* Delhi: New age international. 3rd Edition 2014.
2. Krishna swamy O R, Ranganatham M. *Methodology of research in social studies.* Mumbai*:* Himalaya Publishing House. 2nd Edition 2011.
3. https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism (Plagiarism)
4. https://www.scanmyessay.com/plagiarism/consequences-of-plagiarism.php (Consequences)
5. https://www.scanmyessay.com/plagiarism/types-of-plagiarism.php (Types of plagiarism)
6. https://www.scanmyessay.com/plagiarism/how-to-avoid-plagiarism.php (How to avoid plagiarism)
7. https://www.scanmyessay.com/plagiarism/online-factors.php (Online plagiarism)
8. https://en.m.wikipedia.org/wiki/Web_of_Science (Web of science)
9. https://en.m.wikipedia.org/wiki/H-index (h-index)
10. https://en.m.wikipedia.org/wiki/Scopus (Scopus)

Books for Reference:

1. Gupta S P. *Statistical methods. New Delhi:* Sultan Chand & Sons. 40th Edition. 2011.
2. Saravanavel P. *Research Methodology.* Jaipur: Kitab Mahal. Reprint, 16th Edition 2010.

SEMESTER - II			
CORE IV	**MATHEMATICAL PHYSICS II**		
Code : 21PPHC21	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

Objectives:

- Enhance the ability of the students by providing higher level mathematics such as tensor, special functions, transformations etc
- Enable the students to understand the principle behind the concepts and their real life application

Course Outcome:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Analyse the experimental data with the aid of Fourier transform	4	An
CO 2	Blend the concepts of tensor calculus in moment of inertia	1	Cr
CO 3	Recall the basic notations of generating functions and special functions	1	Re
CO 4	Apply computational techniques to solve a wide range of numerical problems arising in physics	2	Ap
CO 5	Explain the concepts of Laplace Integral	1	Un
CO 6	Solve mathematical problems arising in physics by a variety of mathematical techniques.	2	Cr
CO 7	Employ the knowledge of critical thinking and problem solving	5	Ap
CO 8	Employ correct method to solve a particular problem	2	Ap

SEMESTER - II			
CORE IV	**MATHEMATICAL PHYSICS II**		
Code : 21PPHC21	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

UNIT I: Linear differential equations of first & second order

Order and degree of a differential equation- solution of differential equations of first order & first degree (variables separable, homogeneous equation)- linear differential equations of second order with constant coefficients-method of finding complementary function- rules to find particular integral- problems.

UNIT II: Tensors

Notations and conventions–contravariant vector-covariant vector- tensors of second rank – equality and null tensor– addition and substraction – outer product of tensors– inner product of tensors– symmetric and anti symmetric tensor– metric tensor– Cartesian tensor– isotropic tensor– stress, strain and Hooke's law-Moment of inertia tensor.

UNIT III: Special Functions II

Hermite functions: Hermite Differential Equation– Hermite Polynomials– Recurrence Formulae– Rodrigue's Formula **Laguerre function:** Differential equation– Laguerre polynomial – Generating Function– Rodrigue's Formula– Recurrence Relation.

UNIT IV: Numerical methods

Solution of non – linear equation: Newton – Raphson's method – Solution of Linear Algebraic Equations: Gauss elimination, Interpolation: Lagrange's interpolation– Inverse interpolation – Finite differences– Newton's forward and backward interpolation – Numerical Integration: Trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule – Runge-Kutta method (Fourth order).

UNIT V: Fourier & Laplace's Integral Transforms

Fourier Integral Transforms: Fourier transform- properties of FT – FT of a derivative-Finite FT **Laplace Integral transform:** properties of Laplace transform-Laplace transforms of derivative of a function– Laplace transform of integral – inverse Laplace transform– properties of inverse Laplace transform- Evaluation of ILT by convolution theorem- Method of partial fractions for evaluation of ILT

Text Books:

1. Satya Prakash. *Mathematical Physics*. New Delhi: Sultan Chand &Sons. 4th Edition 2004.
2. Joshi A W. *Matrices and tensors in Physics.* Delhi: New Age International Publishers. Reprint, 3rd Edition 2010.
3. Singaravelu A. *Numerical Methods*. Chennai: Meenakshi Agency. 2nd Edition 2011.

Books for Reference:

1. Chattopadhyay P K. *Mathematical Physics.* Delhi: New Age International Publishers. Reprint 2001.
2. Dass H K. *Mathematical Physics.* New Delhi: S.Chand& Company LTD. 4th Edition 2004.

SEMESTER - II			
CORE V	**ELECTROMAGNETIC THEORY**		
Code : 21PPHC22	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

Objectives:

- Make the students to understand the basics of electro, magneto statics as well as electrodynamics
- Make them to know the propagation of waves and wave guides

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Recall the fundamental concepts of electromagnetic theory	1	Re
CO 2	Compare electrostatics with magnetostatics	1	Un
CO 3	Construct Maxwell's equations and identify each mathematical operator and physical quantity in the equations	3	Ap
CO 4	Formulate potential problems within electrostatics, magnetostatics	2	Cr
CO5	Analyze different waves and conduct a mock trial on electromagnetic radiation	5	An
CO 6	Summarize the types of wave guides	1	Un
CO7	Distinguish transmission lines and waveguides and analyze propagation of signal in different modes	1	An
CO8	Obtain solutions for the problems in electromagnetic theory	2	Cr

SEMESTER - II			
CORE V	**ELECTROMAGNETIC THEORY**		
Code : 21PPHC22	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

UNIT I: Electrostatics

Coulomb's Law – Electric field – Continuous charge distribution – Gauss Law – Poisson's Equation and – Laplace's Equation – Work Done to move a point charge – Energy of a point charge and continuous charge distribution – Gauss Law in the presence of dielectric – Susceptibility, Permittivity and Dielectric constant of linear dielectrics.

UNIT II: Magnetostatics

Biot-Savart's – Steady current – Magnetic field of a steady current – Ampere's Law – Comparison of Magnetostatics and Electrostatics – Magnetic vector potential – Multipole expansion of the vector potential – Effects of a Magnetic field on atomic orbits – Ampere's law in Magnetized Materials.

UNIT III: Electrodynamics

Maxwell Equation (Both Differential and Integral Formulations) – Scalar and Vector Potentials – Gauge transformations – Lorentz and Coulomb Gauges – Continuity Equation – Poynting Vector and Poynting's Theorem – Maxwell's Stress Tensor.

UNIT IV: Electromagnetic Waves and Radiations

The Wave Equation for E and B – Monochromatic plane waves – Magnetic Charge – Propagation of EM Waves in Linear media – Reflection and transmission at normal and oblique incidence– Radiation – Electric dipole radiation –Magnetic dipole radiation.

UNIT V: Wave Guides

Wave guides TM mode, TE mode and TEM mode – Rectangular wave guide TE – Rectangular wave guide TM mode – Circular wave guide – resonant cavities.

Text Books:

1. David J. Griffiths. *Introduction to Electrodynamics.* Chennai: Prentice hall of India. 2nd Edition 1989.
2. Satya Prakash. *Mathamatical Physics.* New Delhi: Sultan Chand & Sons. 6th Edition 2019.

Books for Reference:

1. Paul Lorraius and Dale Corson. *Electromagnetic Fields and Wave.* CBS Publishers & distributors. 2nd Edition 2003.

SEMESTER - II			
CORE VI THERMODYNAMICS AND STATISTICAL MECHANICS			
Code : 21PPHC23	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

Objectives:

- Enable the students to understand different ensembles
- Make them to understand different microscopic system

Course Outcomes:

CO No.	**Upon completion of this course, students will be able to**	**PSOs addressed**	**CL**
CO 1	Understand working knowledge of the zeroth, first, second and third law of thermodynamics	1	Un
CO 2	Apply statistics in different systems containing atoms and molecules	2	Ap
CO 3	Inspect the partition function for the microcanonical, canonical, grand canonical ensemble	1	An
CO 4	Recall the loss of thermodynamics and equipartition theorem from the statistical description using microstates	1	Re
CO 5	Assess about phase transitions and black body radiation	5	Ev
CO 6	Apply energy changes in chemical reaction using the first law of thermodynamics	2	Ap
CO 7	Estimate the Statistical properties of Random Walks and fluctuations in ensembles	1	Cr
CO 8	Determine the physical properties of the system using various correlation functions in Ising Model	6	Ev

SEMESTER - II			
CORE VI THERMODYNAMICS AND STATISTICAL MECHANICS			
Code : 21PPHC23	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

UNIT I: Thermodynamics

Thermodynamics –System and its surroundings- Zeroth, First, Second and Third law of thermodynamics-applications-Reversible and irreversible process-heat engines-Kelvin Planck statement of the second law – Entropy –change of entropy in a reversible & irreversible process-Joule Thompson expansion– Maxwell's thermodynamic relations – Thermodynamic potentials – Chemical potential and Gibbs Duhem equation

UNIT II: Thermodynamics of Magnetism

Chemical potential – phase equilibrium and the phase rule-dependence of vapour pressure on total pressure-surface tension- vapour pressure of a liquid drop – The Reversible voltaic cell- black body radiation- Thermodynamics of magnetism.

UNIT III: Basis of Statistical Mechanics

Phase space – Ensemble – Liouville theorem – Conservation of extension in phase – Equation of motion – Equal a priori probability – Statistical Equilibrium – Micro canonical Ensemble – Quantisation of Phase space – Symmetry of wave functions – Effect of symmetry of counting – Various distributions using micro canonical ensemble.

UNIT IV: Ensemble & Statistical Thermodynamics

Gibbs paradox – Sackur- Tetrode equation – Entropy of a system in contact with a heat reservoir- Ideal gas in canonical ensemble – Grand canonical ensemble – Ideal gas in grand canonical ensemble – Comparison of various ensembles – Quantum distributions using other ensembles Macro states and microstates – Bose-Einstein distribution function – Fermi-Dirac distribution function – Maxwell-Bolltzman distribution function – Partition function

UNIT V: Ising model and Fluctuations

Phase transitions of the second kind – Ising model – Bragg-Williams approximations – Kirkwood method-One dimensional Ising model-Fluctuations in ensembles – concentration fluctuations in quantum statistics – One dimensional random walk – Brownian motion.

Text Books:

1. Dass V N. *Heat and thermodynamic.*Delhi: Dominant Publishers. 1st Edition 2005.
2. Gupta M C. *Statistical Thermodynamics.* New Delhi: New Age International P Ltd. Reprint 2009.
3. Sears Salinger. *Thermodynamics, Kinetic Theory and Statistical Thermodynamcis.* New Delhi: Narosa publishing house pvt Ltd.3rd Edition 2017.
4. Agarwal B K, Melvin Eisner. *Statistical Mechanic.* New Delhi: New age international P Ltd. Reprint 2002.

Books for reference:

1. Kerson Huang. *Statistical Mechanics.* New York: John Wiley & Sons, Inc. Second edition. 1987.
2. Dasgupta A K. *Fundamentals of Statistical Mechanics. Culcutta:* New Central Book Agency (P) Ltd. 2000.
3. Sears and Zymanski. *Statistical Mechanics.* New York: McGraw Hill Book Company.1961.
4. Federick Reif. *Fundamentals of Statistical and thermal Physics,* Singapore: McGraw Hill International Editions.1985.

SEMESTER - II			
ELECTIVE - II A. BIO-MEDICAL INSTRUMENTATION			
Code :21PPHE21	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Objectives:

- Give the students basic knowledge about different life saving machines
- Enable the students to understand the principle behind the working of these instruments

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Define resting and action potentials	1	Re
CO 2	Classify the uses of electrode paste	1	Ap
CO 3	Discuss the principle of operation of different types of transducers	1	Un
CO 4	Interpret the output of bio potential recorders such as ECG, EEG and EMG	1	Ev
CO 5	Investigate internal and external pacemakers	1	An
CO 6	Illustrate the working of different kinds of radiation monitoring instruments	1	Ap
CO 7	Recognise the importance of computers in medicine	1	Un
CO 8	Evaluate the need for various imaging techniques such as Computer Tomography, Thermography and MRI	1	Ev

SEMESTER - II			
ELECTIVE - II A. BIO-MEDICAL INSTRUMENTATION			
Code :21PPHE21	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

UNIT I: Human physiological systems and transducers

Cells and their structure-resting and action potentials – Design of medical instruments – Components of the Bio-medical instrument system – Electrodes: electrode potential-purpose of electrode paste-electrode material-Types of electrodes – Transducers Types: active – magnetic induction type-piezoelectric-photovoltaic-thermo electric-passive-resistive

UNIT II: Bio-Potential Recorders

Introductions- characteristics- ECG: origin-lead configuration-practical consideration-analysis – EEG: origin-brain waves –analysis – EMG:recording set up-determination of conduction velocities in motor nerves

UNIT III: Physiological Assist Devices And Operation Theatre Equipments

Pacemakers: energy requirements to excite heat muscle-methods of stimulation-different modes of operation:Ventricular synchronous pacemaker-Atrial synchronous pacemaker Kidney Machine: Renal function-dialysis-hemodialysis-peritoneal dialysis – Ventilators – Anesthesia machine

UNIT IV: Safety Instruments

Radiation Safety Instrumentation-Physiocological Effect due to 50 Hz current passage – Microshock and Macroshock – Electrical accidents in hospitals – Devices to protect against electrical hazards.

UNIT V: Advances In Biomedical Instrumentation

Computers in medicine – Lasers in medicine – Endoscopes – cryogenic surgery – Nuclear Imaging techniques – Computer Tomography –MRI

Text Books:

1. Dr. Arumugam M. *Biomedical Instrumentation.* Chennai: Anuradha publications. 10th Edition 2013.

SEMESTER - II			
ELECTIVE II B. MICROPROCESSOR AND MICROCONTROLLER			
Code :21PPHE22	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

Objectives:

- Enable the students to understand microprocessor and microcontroller
- Enable them to write simple programs
- Enable them to interface microprocessor and microcontroller with other simple devices

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Understand the architectures and instruction sets of microprocessors and microcontrollers	1	Un
CO 2	Verify bus transactions, memory organisation and address decoding, basic I/O interfaces and port addressing	1	Ev
CO 3	Apply and implement learned algorithm design techniques and data structures to solve the problems	2	Ap
CO 4	Understand the interfacing of peripheral devices like I/O ports, keyboards, displays, ADCs, DACs, stepper motor	1	Un
CO 5	Analyze concepts associated with interfacing a microprocessor to memory and to I/O devices	6	An
CO 6	Estimate how to control components of a microprocessor based system through the use of interrupts	4	Cr
CO 7	Recall a microprocessor programming model at a level that enables to write assemble language programs for the processor meeting given specifications	6	Re
CO 8	Understand the popular 8051 Microcontroller ,the processor family and Time delay	1	Un

SEMESTER - II			
ELECTIVE II B. MICROPROCESSOR AND MICROCONTROLLER			
Code :21PPHE22	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

UNIT I: Microprocessor Architecture and Instruction set

Intel 8085 Architecture-Instruction format-8085 programming model-instruction classification-8085Instructionset – Data transfer operations –Arithmetic instructions – Logic operations-Branch operations.

UNIT II: Microprocessor Programming & Counters and Time Delays

Writing assembly language programs-Programming techniques: Looping, Counting and Indexing –Stack-Subroutine- -8085 Interrupt-counters and time delays

UNIT III: Microprocessor Interfacing

Techniques for time delay-Basic interfacing concept-8255(PPI)-Interfacing Keyboard and Seven Segment Display- Microprocessor based stepper motor-waveform generator using ADC and DAC

UNIT IV: Microcontroller Programming

Addressing mode of microcontroller 8051-arithmetic and logical instruction-8051 assembly language programmes: addition, subtraction, division, multiplication- interfacing 8051 with LED display and keyboard.

UNIT V: Addressing Modes & Delay

Register Addressing -Direct byte addressing- Register indirect addressing-Immediate addressing-Logical Instructions-Time delay for 8051-Assembling and running an 8051 program

Text Books:

1. Ramesh Gaonkar. *Microprocessor Architecture Programming and Applications with The 8085.* India: Penram International Publishing Private Limited. Fifth edition. 2011.
2. Karuna Sagar D, *Microcontroller, 8051.* Delhi: Narosha publishing house PVT Ltd, Print.2011.
3. Dr.Godse A P. *Microprocessor and Microcontroller.* Technical Publications. Fourth Revised edition.2017.

Books for reference:

1. Aditya.P.Mathur. *Introduction to Microprocessors.* New Delhi: Tata Mc Graw Hill Education P Ltd. Third Edition.
2. Ram B and Sanjay Kumar. *Fundamental of microprocessors and micro controllers.* New Delhi: Dhanpat rai Publications (P) Ltd. seventh revised Edition.

SEMESTER - I & II			
CORE PRACTICAL I	**ELECTRONICS**		
Code : 21PPHCR1	**Hrs/Week:- 3**	**Hrs/Semester:- 45**	**Credits:3**

(Any 12 Experiments)

1. Modulus counters 2 to 9
2. FET Characteristics
3. Construction of constant current source
4. D/A converter
5. Triangular wave and Ramp generator
6. A/D converter
7. RS,$\overline{RS}$ flip flops using NAND and NOR gates
8. JK, D and T flip flops using NAND and NOR gates.
9. JK Master Slave flip flop
10. Serial in Parallel out shift register
11. Multiplexer and Demultiplexer
12. K map simplification and implementation of basic and universal gates by SOP and POS
13. BCD adder subtractor
14. Design of asynchronous counter
15. Verification of Boolean algebra
16. SCR Characteristics and power control

SEMESTER - I & II			
CORE PRACTICAL–II GENERAL PHYSICS			
Code :21PPHCR2	**Hrs/Week: 3**	**Hrs/Semester:45**	**Credits: 3**

(Any 12 Experiments)

1. Hall Effect, Carrier concentration.
2. BH curve tracing and Hysteresis loss
3. Elliptical fringes – Young's modulus
4. Resistivity of semiconductor by Four Probe method at different temperatures
5. Resistivity two probe measurement at different temperatures.
6. Band Gap measurement
7. Determination of dielectric constant for Ferro electric substance
8. LASER Experiment: Thickness of insulation of a wire by Diffraction method
9. Solar spectrum
10. Iodine Absorption Spectra
11. Polarizability of liquids using hollow prism
12. Susceptibility- Quincke's method
13. Hyperbolic fringes - Young's modulus of glass plate
14. Rydberg's constant
15. Ultrasonic interferometer
16. Refractive Index of the liquid at various concentrations using laser
17. Wavelength of He-Ne laser
18. Resolving Power of grating and prism using spectrometer.

SEMESTER - III			
Core - VII	**QUANTUM MECHANICS – I**		
Code: 21PPHC31	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

Objectives:

- To enable students, understand the fundamentals of Quantum Mechanics and their applications to microscopic systems.

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Recall Schrodinger equation	1	Re
CO 2	Describe Ehrenfest's theorem and its verification	1	Un
CO 3	Discuss Heisenberg Uncertainty principle	1	Un
CO 4	Evaluate the commutation relations between the various quantum mechanical operators	1	Ev
CO 5	List the properties of Ket and Bra vectors	1	Re
CO 6	Discuss the linear harmonic oscillator problem using wave formalism and matrix formulation	2	Un
CO 7	Interpret equations of motion in the Schrodinger picture, Heisenberg picture and Interaction picture	1, 2	Ap
CO 8	Combine spin and angular momenta	1	Ap

SEMESTER - III			
Core - VII	**QUANTUM MECHANICS – I**		
Code : 21PPHC31	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

UNIT I: Fundamentals of wave mechanics

Wave Particle Duality – De - Broglie waves – Equation of motion of matter waves (Time Independent Schrodinger equation and Time dependent Schrodinger equation) – Physical interpretation - Normalized and orthogonal wave functions – Solution of Schrodinger equation– Expectation values - Probability current density –Ehrenfest Theorem– Uncertainty principle– Applications.

UNIT II: Operators

Hilberts space - linear vector space -Bra &Ket vectors - properties – Dirac Notation – Operator(linear, Hermitian, projection, unitary, parity) – Representation in discrete bases – Representation in continuous bases - position and momentum representation.

UNIT III: Applications of Schrödinger equation to one, three Dimensional problems

Particle in a box - Rectangular Potential Barrier – Applications of Barrier penetration – Particle in one dimensional infinitely deep potential well –One dimensional Linear Harmonic Oscillator (Eigen values and Eigen functions)- Harmonic oscillator - Rigid rotator with free axis - Rigid rotator in a fixed plane - Hydrogen atom.

UNIT IV: Matrix Representation and Angular momentum

Schrodinger, Heisenberg matrix representation - Angular momentum operator - Total angular momentum operators – Commutation relations – Eigen values of J^2 ,J_z , J_+, J- , J_x and J_y – Clebsch Gorden coefficients – Calculation of Clebsch Gorden coefficients $J_1 = 1/2$, $J_2 = 1/2$.

UNIT V: Identical Particle and Spin

Symmetric and anti – Symmetric wave function – Particle exchange operator – Pauli's Exclusive principle – Spin matrices of electron– Commutation relation – Properties of Pauli operator – Pauli Eigen values and Eigen function – Electron Spin function – Statistical Weight- Density operator and Density matrix – Time dependent of density matrix.

Text Books:

1. Schiff L. *Quantum Mechanics.* New Delhi: Tata Mc-Graw Hill Education Private Limited. Second reprint, Fourth Edition 2019.
2. Aruldhas G. *Quantum Mechanics.* Delhi: Prentice Hall of India Learning Private Limited.Twenty First Print,Second edition 2019.
3. Satya Praksh. *Advanced Quantum Mechanics*.Meerut: Kedar Nath Ram Nath Publications. Fifth revised edition 2021.

Books for Reference:

1. Mathews P.M and Venkatesan K. *A Text Book of Quantum Mechanics*. NewDelhi: Tata McGraw Hill Publishing Company Limited. 16th reprint ,second edition.2007
2. Shankar R. *Principles of Quantum Mechanics.* New York: Plenum Publishers. Second Edition 1994.
3. Sakurai J J. *Modern Quantum Mechanics.* Addison- Wesley Publishing Company. Revised edition 1994.
4. Rajasekar S and Velusamy R. *Quantum Mechanics I: Fundamentals.* London: CRC Press. Taylor and Francis group- Boca Raton. e-book version 2015.

SEMESTER - III			
CORE - VIII ATOMIC AND MOLECULAR SPECTROSCOPY			
Code:21PPHC32	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

Objectives:

- To enable the students to understand the atomic and molecular spectrum with the ultimate clarity that quantum mechanics allows.
- To enhance the knowledge of origin of atomic spectra, rotational, vibrational, Raman and Mossbauer spectroscopy.

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Explain the structure of atoms and the origin of the observed spectra	1	Un
CO 2	Examine rotational spectra, get information about molecular dimension and atomic masses	4	An
CO 3	Examine rotational Raman spectra and understand the techniques in instrumentation	3	An
CO 4	Apply knowledge of Mossbaur spectroscopy in solid state physics and nanotechnology	4	Ap
CO 5	Assess how nuclear spins are affected by magnetic field and able to explain what happens when radio frequency radiation is observed	1	Ev
CO 6	Recall the basic hydrogen spectra	1	Re
CO 7	Explain the key properties of many electron atoms and the importance of the Pauli's exclusion principle	1	Ev
CO 8	Solve problems in atomic and molecular physics	2	Ap

SEMESTER - III			
CORE - VIII ATOMIC AND MOLECULAR SPECTROSCOPY			
Code:21PPHC32	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

UNIT I: Spectra of atoms

Hydrogen Spectrum-Angular momentum-Larmor Precession-Energy of a magnetic moment in a magnetic field-Vector atom model-Spin –orbitinteraction-Spectra of alkali atoms-angular momentum of many electrons atoms-Normal Zeeman Effect-Anomalous Zeeman Effect-Paschen - Back Effect-hyperfine structure-Stark Effect-LambShift- Characteristic X-ray Spectra.

UNIT II: Microwave Spectroscopy

Microwave Spectroscopy: The rotation of molecules–Rotational spectra–Diatomic molecules–Polyatomic molecules–Techniques and Instrumentation-Microwave spectrometer-Applications.

UNIT III: Infra-Red Spectroscopy

Infra-Red Spectroscopy: Vibrational energy of a diatomic molecule-The vibrating diatomic molecule – The Diatomic vibrating rotator-The interactions of rotations and vibrations- The vibrations of polyatomic molecules- IRspectrometer-FTIR-Applications.

UNIT IV: Raman Spectroscopy and Mossbauer Spectroscopy

Theory of Raman spectroscopy-Rotational Raman spectra- vibrational Raman spectra- mutualexclusion principle-Raman spectrometer-structure determination using IR and RamanSpectroscopy-Resonance Raman scattering.

Mossbauer Spectroscopy: Principles of Mossbauer-Applications of Mossbauer Spectroscopy

UNIT V: Resonance Spectroscopy

NMR: Magnetic properties of nuclei-Resonance condition-NMR instrumentation-Relaxationprocess-Bloch equation-Chemical shift- NMR imaging

ESR: The hyperfine structure – Double resonance – Fine structure - Techniques of ESRspectroscopy.

Text Books:

1. Banwell C N. *Fundamentals of Molecular spectroscopy*. New Delhi: Tata McGraw hill Publishing Company. 9th reprint ,4th Edition 2020.
2. Aruldhas G. *Molecular structure & Spectroscopy.* Prentice Hall Private Ltd. Second edition 2018.

Books for reference:

1. Barrow G M. *Introduction to Molecular Spectroscopy.* MGH Publishing Company.17th print.
2. Gary M. Lampman, Donald L.Pavaia, George S.Keiz, James R.Vyvyan. *Spectroscopy.* Delhi: Cengage Learning India P Ltd. 4th Edition.
3. Dutta M K. *Atomic and Molecular Spectroscopy.* Delhi: IVY Publishing House. 1st Edition 2010.
4. Suresh Chandra. *Molecular Spectroscopy.* New Delhi: Narosa Publishing House Ltd.

SEMESTER – III			
CORE - IX	**SOLID STATE PHYSICS- I**		
Code: 21PPHC33	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

Objectives:

- To enable the students to employ classical and quantum mechanical theories needed to understand the physical properties of solids

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Recall about the crystal structure and degree of ordering to atom binding and packing	1	Re
CO 2	Compare the Energy Bands and the number of orbital	5	Un
CO 3	Explain the physics of different types of bonds in crystalline structure	1	Un
CO 4	Solve band structure calculations for simple systems	6	Cr
CO 5	Apply the role of effective electron mass in electron dynamics	1	Ap
CO 6	Estimate the thermal ionization of donors and acceptors	4	Ev
CO 7	Describe diffraction using the reciprocal lattice	1	Re
CO 8	Deduce Bloch's theorem from the Schrödinger equation for electrons in a periodic potential	6	An

SEMESTER – III			
CORE - IX	**SOLID STATE PHYSICS- I**		
Code: 21PPHC33	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

UNIT I: Bonding In Solids

Forces between atoms – Cohesive Energy – Ionic Bonding – Lattice Energy of Ionic Crystals – Evaluation of Madelung constant – Covalent Bond – Metallic Bond – Intermolecular Bond – Dispersion Bond – Dipole Bonds – Hydrogen Bonds – Properties of various Bonds.

UNIT II: Crystal Structure

Lattice representation- Bravais Lattice – Unit Cell – Weigner-Sietz Cell – Miller Planes – Spacing – Crystal System – Metallic Crystal Structure: SC, BCC, FC, HCP – Structure Factor of Diamond, ZnS, NaCl, CsCl.

UNIT III: Diffraction of Waves and Reciprocal lattice

Bragg's Law – X-ray Spectrometer – Powder Crystal method – Neutron Diffraction and Electron Diffraction – Rotating Crystal Method – The Laue Method – Reciprocal lattice – Diffraction conditions– Laue equations – Reciprocal lattice to SC, BCC and FCC Crystals.

UNIT IV: Crystal Imperfection and Lattice Dynamics

Point Defect – Vacancies, Schottky and Frenkel defect – Line Imperfection – Screw Dislocation – Burger Vectors– Grain Boundaries - Tilt, Twin Boundaries – Stacking Defect Specific Heat: Dulong – Petit Law – Einstein Debye's Theory – Density of modes in one and three dimensions – Anharmonic crystal interaction: Thermal expansion, Thermal conductivity, Thermal resistivity – UMKLAPP process.

UNIT V: Electrons Theory

Energy level – Fermi Dirac Distribution – Free electron gas in three dimensions – Heat capacity of electron gas – Electron conductivity ohms law, Matthiessen's rule – Hall effect – Wiedeman Franz law – Nearly free electron model – Bloch function –KronigPenney model.

Text Books:

1. Pillai S O. *Solid State Physics.* New Age International (P) Limited. Reprint, 8th Edition 2018.
2. Charles Kittel. *Introduction to Solid State Physics.* Wiley Publications. Reprint 2019.

Books for Reference:

1. Puri R K, Babbar V K. *Solid State Physics.* New Delhi: S Chand Publications.Reprint, First Edition 2021.
2. Palanisamy P K. *Solid State Physics.* Chennai: Scitech publications Private Ltd. Reprint 2013.
3. Ali Omar M. *Elementary Solid-State Physics Principle and Applications*. Pearson Publication. Reprint 2019.
4. Wahab M A. *Numerical Problems in Solid State Physics.* Narosa Publishing house Pvt. Ltd. Reprint 2019.

SEMESTER - III			
ELECTIVE -III A. NANO SCIENCE AND TECHNOLOGY			
Code:21PPHE31	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Objectives:

- To synthesize the nanomaterial by eco-friendly methods, characterize the synthesized nanomaterials and apply in different fields for the welfare of society.
- To introduce and give an insight into the fascinating area of Nanoscience.

Course Outcomes:

CO No.	**Upon completion of this course, students will be able to**	**PSOs addressed**	**CL**
CO 1	Recall a thorough knowledge of basic underline disciplines of nanoscience and nanotechnology	4	Re
CO 2	Explain the preparation, characterization and properties of nanomaterials	6	Un
CO 3	Analyze the types and properties of carbon nanotubes	1	An
CO 4	Assimilate existing and new concepts, methodology and researches and apply them in their academic research environment	7	Ev
CO 5	Aware of challenges, risks and promises of nano technological development	6	An
CO 6	Synthesise the nanomaterials by physical, chemical and biological methods and evaluate their properties.	6	Ev
CO 7	Characterise the synthesized nanomaterials by various techniques.	5	Ev
CO 8	Apply the nanomaterials in energy storage, food and in day-to-day life.	8	Ap

SEMESTER - III			
ELECTIVE -III A. NANO SCIENCE AND TECHNOLOGY			
Code: 21PPHE31	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

UNIT I: Synthesis and Characterization of Nanoparticles

History of Nanotechnology- Nano structures - Synthesis of oxide nano particles- Synthesis ofmetallic nano particles - Synthesis of semiconductor nanoparticles - Structural characterization (X-Ray Diffraction, Scanning Tunneling Microscopy, Atomic Force Microscopy)-Properties of Nanomaterials.

UNIT II: Carbon nanotube

Carbon nanotube - Carbon allotropes (Diamond, Graphite, Carbon nanotubes) - Types of Carbon nanotubes – Graphene sheet to single walled nanotube - Synthesis of carbon nanotubes (Electric arc -Discharge method, Laser method, Fluidised bed CVD method, Solar production of Carbon nanotubes) -Purification and properties of Carbon nanotubes.

UNIT III: Quantum well, Quantum wire and Quantum dots

Introduction - preparation of Quantum nanostructures - Fermi gas and Density of states –Calculation of the density of states in 1,2 and 3 dimension- Infrared detector - Quantum wire (Production,Structure, Use), Quantum dot - Application of Quantum dots – Quantum dot information storage, Quantum dot Infrared photodetectors-Quantum dot Lasers.

UNIT IV: Magneto electronics

Magneto electronics: Nano crystalline soft magnetic materials-Permanent magnetic materials-TheoreticalBackground-Super para magnetism-Coulomb Blockade-Single electron transistor-Spintronics-Giant magneto resistance-Quantum Hall Effect-fractional Quantum Hall Effect.

UNIT V: Applications of Nanotechnology

Applications of Nanotechnology: Chemistry and Environment - Energy applications ofNanotechnology -Information and Communication- Heavy industry - Consumer goods - Nano medicine -Tissue engineering-medical applications of molecular nanotechnology (Nanorobots, Cell repair machines, Nano nephrology)

Text Books:

1. Dr. Geraldin Jayam S R. *Nano Physics*.

Books for Reference:

1. Shanmugam S. *Nanotechnology*. Chennai: MJP Publishers. 2011.
2. Parthasarathy B K. *Nanostructure and Nanomaterials.* Delhi: Isha Books. 2007.
3. Uday Kumar. *Concepts in Nano chemistry.* New Delhi: Anmol Publications Pvt. Ltd. 2013.
4. Bandyopadhyay A K. *Nano Materials*.New Age International Publishers. 2nd Edition.2012.
5. Viswanathan B. *Nano Materials*. New Delhi: Narosa Publishing House. 2013.

SEMESTER - III			
ELECTIVE -III	**B. ENERGY SOURCES**		
Code: 21PPHE32	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Objectives:

To facilitate the students to achieve a clear conceptual understanding of energy sources and its pros and cons

Course Outcomes:

CO No.	**Upon completion of this course, students will be able to**	**PSOs addressed**	**CL**
CO 1	outline the technologies that are used to harness the power of solar energy	1	An
CO 2	discuss the positive and negative aspects of solar energy in relation to natural and human aspects of the environment	5	Un
CO 3	Summarize the structure of biomass.	8	Ev
CO 4	Assess economic factors affecting geothermal energy production	5	Ev
CO 5	Analyse and critically evaluate emerging geothermal technologies.	8	An
CO 6	Compare chemical energy to mechanical energy.	1	An
CO 7	Write the uses of Hydrogen energy	5	Cr
CO 8	List the main characteristics (advantages/disadvantages) for fuel cells.	8	Ap

SEMESTER - III			
ELECTIVE -III	**B. ENERGY SOURCES**		
Code: 21PPHE32	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

UNIT I: Solar Radiation

Introduction – Solar constant – Solar Radiation at the Earth's surface – Solar Radiation data– Estimation of Average Solar Radiation– Solar Radiation on Tilted surfaces - Solar Radiation Geometry– Solar Radiation measurements

UNIT II: Bio Mass

Biomass Conversion Technologies– Photosynthesis– Classification of Biogas plants– Advantages and Disadvantages of Flooting Drum plant– Advantages and Disadvantages of fixed Dome Type Plant– Selection of site for a Biogas plant -Community Biogas plants– Materials used for Biogas generation

UNIT III: Geothermal Energy

Estimates of Geothermal Power – Nature of Geothermal Fields – Geothermal Sources– Interconnection of Geothermal Fossil Systems– Advantages and Disadvantages of Geothermal Energy over other Energy forms– Applications of Geothermal Energy– Material selection for Geothermal Power Plants– Geothermal Expansion– Geothermal Well Drilling– Operational and Environmental Problems.

UNIT IV: Chemical Energy: Batteries

Introduction– Basic Battery Theory– Definitions of Fundamental Quantities– Battery Fundamental Characteristics– Different types of Battery arrangement– Classification of Batteries– Advantages of Batteries for Bulk Energy Storage.

UNIT V: Hydrogen Energy

Introduction– Electrolysis or the Electrolytic production of Hydrogen– Hydrogen Storage– Hydrogen Transportation– Hydrogen Technology Development in India (or) Safety and Management -Solar Energy Methods– Hydrogen as an alternative fuel for motor vehicles– Utilization of Hydrogen Gas

Text Books:

1. Rai G D. *Non-conventional energy sources.* Khanna Publishers. 2011.

Book forReference:

1. Sukhatme S P. *Solar Energy – Principles of Thermal Collection and Storage.* McGraw-Hill Education. 3rd Edition 2009.

2. Vaughn Nelson.*Introduction to Renewable Energy.* CRC Press. 1st Edition. 2011.

3. David Herak. *Biomass for energy applications.* MDPI. 1st Edition 2021.

SEMESTER – III			
SELF STUDY COURSE (Optional) PHYSICS FOR LECTURESHIP II			
Code :21PPHSS1	**Hrs/Week:**	**Hrs/Semester:**	**Credits: +2**

UNIT I: Mathematical Methods of Physics

Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley- Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.

UNIT II: Classical Mechanics

Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body Collisions-scattering in laboratory and Centre of mass frames. Rigid body dynamics- moment of inertia tensor. Non- inertial frames and pseudo forces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of Relativity-Lorentz transformations, relativistic kinematics and mass–energy equivalence. Dynamical systems, Phase space dynamics, stability analysis. Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton - Jacobi theory.

UNIT III: Electromagnetic Theory

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magneto statics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar

and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation-from moving charges and dipoles and retarded potentials.

UNIT IV: Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro-and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law. First-and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation.

UNIT V: Electronics and Experimental Methods

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo-and hetero- junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators and similar circuits). A/D and D/A converters. Microprocessor and microcontroller basics. Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting.

Book for Study:

1. Melemnganba Chenglei W. *UGC-CSIR JRF/NET Physical Science.* India: Arihant Publications. 2015.

SEMESTER – IV			
CORE X	**QUANTUM MECHANICS – II**		
Code: 21PPHC41	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

Objectives:

- To enable students, acquire a thorough understanding about advanced quantum mechanics and their relevance in solving advanced quantum mechanical problems.

Course Outcome:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Describe time independent perturbation theory and its application to the first order Stark effect in Hydrogen atom	1	Re
CO 2	Discuss time dependent perturbation theory and transition probability	1	Un
CO 3	Derive Fermi- Golden rule	2	An
CO 4	Write the Relativistic theory in quantum mechanics	1	Cr
CO 5	Describe scattering by a square well potential using Born approximation and Partial wave analysis	1	Un
CO 6	Employ WKB approximation in quantum problems	1	Ap
CO 7	Explain Dirac's equation for a free particle	1	Ev
CO 8	Apply approximation methods to solve problems	1	Ap

SEMESTER – IV			
CORE X	**QUANTUM MECHANICS – II**		
Code: 21PPHC41	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

UNIT I: Independent Quantum Approximation Methods I

Stationary perturbation theory – non-degenerate case – I and II order degenerate case-perturbed harmonic oscillator – Zeeman Effect (without electron spin) – first order stark effect in hydrogen atom – Application of variation method: ground state of helium – zero point energy of one dimensional harmonic oscillator.

UNIT II: Approximation Methods II

Application of variation method: ground state of Hydrogen atom- Deuteron problem- Vander Waals interaction- WKB Approximation – principle of the method – connection formulas of penetration of a barrier - Application of WKB method: probability of penetration of barrier – theory of alpha decay, Geiger -Nuttel law – application to bounce state – potential state.

UNIT III: Time Dependent Quantum Approximation Method & Semi-Classical Theory of Radiation

Time dependent perturbation theory – first order perturbation – Fermi Golden rule – harmonic perturbation – second order perturbation theory – absorption and induced emission– electric dipole approximation– transition probability.

UNIT IV: Scattering Theory

Scattering Cross – section– Scattering amplitude- Partial waves– Scattering by central potential– Optical theorem- Ramsaur Townsend Effect- Scattering by an attractive square well potential– Breit – Wignar formula– Scattering length– Phase Shift– Integral equation– Born approximation and its validity – Laboratory and centre of mass co – ordinate systems.

UNIT V: Relativistic Quantum Mechanics

Klein Gordon Equation– Interpretation of Klein Gordon equation– particle in a Coloumb field– Dirac's equation for a free particle– Dirac matrices– Probability density– Negative Energy states– Spin of a Dirac particle– Magnetic Moment of the electron– Spin – Orbit interaction– Radial equation for an electron in a central potential– The Hydrogen atom– Lamb Shift

Text Books:

1. L. Schiff. *Quantum Mechanics.* New Delhi: Tata Mc-Graw Hill Education Private Limited. Second reprint, 4th Edition 2019.
2. G. Aruldhas. *Quantum Mechanics.* Delhi: Prentice Hall of India Learning Private Limited.Twenty First Print,2nd Edition 2019.
3. Satya Praksh. *Advanced Quantum Mechanics*.Meerut: Kedar Nath Ram Nath Publications. 5th Edition 2021

Books for Reference:

1. P. M. Mathews and K. Venkatesan. *A Text Book of Quantum Mechanics*. NewDelhi: Tata McGraw Hill Publishing Company Limited. 16th reprint ,2nd Edition 2007
2. R. Shankar. *Principles of Quantum Mechanics.* New York: Plenum Publishers. 2nd Edition 1994.
3. J. J. Sakurai. *Modern Quantum Mechanics.* Addison- Wesley Publishing Company. Revised edition 1994.
4. S. Rajasekar and R. Velusamy. *Quantum Mechanics I: Fundamentals.* London: CRC Press. Taylor and Francis group- Boca Raton. e-book version 2015.

SEMESTER - IV			
CORE XI	**SOLID STATE PHYSICS- II**		
Code:21PPHC42	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

Objectives:

- To enhance knowledge and understanding of the properties of condensed materials.

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Understand the properties of solids	1	Un
CO 2	Demonstrate the types of Polarizability	2	Ap
CO 3	Compare the magnetic properties of solid materials	1	An
CO 4	Reason the working of magnetic mirror and SQUID	1	An
CO5	Identify theproperties of insulators and ferro electricity.	1	An
CO 6	Develop the research work in the field of material science and nanotechnology	1	Cr
CO7	Solve the problems related basic crystallography.	1	Cr
CO8	Discuss the quantum theory of magnetic materials	1	Ap

SEMESTER - IV			
CORE XI	**SOLID STATE PHYSICS- II**		
Code:21PPHC42	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 5**

UNIT I: Dielectrics

Review of basic formulas – Local field of an atom – Clausius-Mossotti relation – Polarizability – Electronic Polarizability – Ionic Polarizability – Orientational Polarizability – Dipolar relaxation – Dielectric loss – Dielectric breakdown – Frequency and Temperature dependence on Polarization.

UNIT II: Superconductivity

Introduction – Properties of superconductivity – Meissner effect – Thermal properties – Type I and type II superconductors – London Equation –BCS Theory – Quantum Tunneling **–** Josephson tunneling- Applications: Magnetic mirror, SQUID, High Tc Superconductors

UNIT III: Magnetic properties of Materials

Basic terms, Formulas – Classification of Materials – Magnetic Materials -Langevin's Theory of Diamagnetism– Langevin's Theory of Paramagnetism – Quantum Theory of Paramagnetism – Ferromagnetism – Weiss Molecular Field Theory – Ferromagnetic Domains – Domain Theory – Anti Ferromagnetism – Ferri magnetism.

UNIT IV: Ferroelectrics and Piezoelectric

Ferroelectric crystals – Displacive Transition – Landau Theory of Phase Transition – Second Order Transition – First Order Transition – Ferroelectric Domain – Piezoelectricity.

UNIT V: Smart Materials

Metallic Glasses: Preparation- Properties- Applications- Shape Memory Alloys (SMA): Phases of SMA- Characteristics- Properties of Ni-Ti Alloy- Applications- Advantages and Disadvantages-Bio materials: Classifications- Applications- ceramics- Bio-polymers.

Text Books:

1. Pillai S O. *Solid State Physics.* New Age International (P) Limited. Reprint, 8th edition. 2018.
2. Charles Kittel. *Introduction to Solid State Physics*. Wiley Publications. Reprint. 2019.
3. Dr. Mani P. *Engineering Physics II.* Chennai: Shri Dhanam Publishers. 10th Edition 2016.

Books for Reference:

1. Puri R K, Babbar V K. *Solid State Physics*. New Delhi: S Chand Publications. Reprint,First Edition. 2021.
2. Palanisamy P K. *Solid State Physics.* Chennai: Scitech publications Private Ltd. Reprint. 2013.
3. Wahab M A. *Numerical Problems in Solid State Physics.* Narosa Publishing house Pvt. Ltd. Reprint.2019.
4. Ali Omar M, *Elementary Solid-State Physics Principle and Applications.* Pearson Publication. Reprint. 2019.

SEMESTER - IV			
CORE XII	**NUCLEAR AND PARTICLE PHYSICS**		
Code:21PPHC43	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

Objectives:

- To enhance the knowledge of nuclear reactor, bombs and the elementary particles
- To extend the knowledge about different nuclear models, nuclear decay, properties of nuclear forces and elementary particles.

Course Outcomes:

CO No.	**Upon completion of this course, students will be able to**	**PSOs addressed**	**CL**
CO 1	List the basic atomic properties of nuclei	1	Re
CO 2	Classify the different types of nuclear reactions	5	Un
CO 3	Examine the different types of nuclear models and their properties	6	An
CO 4	Categorize the nuclear forces and the theories related to it	1	An
CO 5	Classify the types of elementary particles	1	Ev
CO 6	Distinguish the fission and fusion	1	An
CO 7	Relate the deuteron properties and reactions	2	Ap
CO 8	Examine the origin of various terms in nuclear physics	1	An

SEMESTER - IV			
CORE XII NUCLEAR AND PARTICLE PHYSICS			
Code:21PPHC43	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

UNIT I: Theories of Decay

Gamow's theory of alpha decay - General features of beta ray spectrum - Fermi's theory of beta decay-Forms of interaction and selection rules- parity selection rules-Parity in beta decay-The neutrino (Helicity of Neutrino) - electron capture.

UNIT II: Nuclear reaction

Introduction of nuclear reaction-Conservation laws-Q value equation -Theories of nuclear reaction- Particle induced nuclear reactions-Electromagnetic radiation induced nuclear reactions-Compound Nucleus-Reciprocity theorem- Direct reactions- Theory of stripping and pick up reactions-Statistical theory of nuclear reaction.

UNIT III: Nuclear models & Nuclear Energy

Liquid drop model- The Shell model- nuclear fission- Mass and energy of Fission Fragments-Neutron emission in fission Process-Prompt and Delayed Neutrons- Spontaneous Fission- Barrier Penetration-Theory of Spontaneous Fission-The Nuclear Chain Reaction.

UNIT IV: Nuclear Forces

The Deuteron -Ground state of Deuteron -Excited states of deuteron- Meson theory of nuclear force - Nucleon-nucleon scattering - Neutron proton scattering at low energies- Spin dependence of n-p scattering- Effective range theory of n-p scattering.

UNIT V: Elementary Particles

Classification of elementary particles- Fundamental Interactions-Conservation laws- C-P-T Theorem-SU (2) and SU (3) symmetries-baryon octet-Meson Octet-Baryon decouplet - Gellmann-Okubo mass Formula-Quarks.

Text Books:

1. Pandya M L and Yadav R P S. *Elements of Nuclear Physics*.Meerut : Kedar Nath& Ram Nath publications .Revised Reprint. 2008.
2. Tayal D C. *Nuclear Physics.* Himalaya Publishing House. Reprint 1985.

Books for reference:

1. Irving Kaplan. *Nuclear Physics.* USA: Wesley publishing company. Nineteenth Reprint, Second Edition.
2. Sharma R C. *Nuclear Physics.* Meerut : KedarNath& Ram Nath publications .6th revised edition.

3.Devanathan V. *Nuclear Physic.* New Delhi: Narosa Publishing. Revised Reprint. 2008.

SEMESTER – IV			
CORE	**PROJECT**		
Code :21PPHP41	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 6**

FORMAT FOR PREPARATION OF PROJECT REPORT FOR M.Sc. Physics

1. IDENTIFICATION OF THE PROBLEM:

Students are given the freedom of choosing the topic of the project. It may be theoretical or practical and may be from any one of the following areas.

a) Physics-Theoretical
b) Physics-Practical
c) Electronics
d) Computational Physics
e) Micro Processor
f) Interdisciplinary projects involving concepts of physics

2. ARRANGEMENT OF CONTENTS:

The sequence in which the project report material should be arranged and bound should be as follows:

Cover page and Title page
Bonafide Certificate
Abstract
Table of contents
List of Tables
List of Figures
List of Symbols, Abbreviations& Nomenclature
Chapters
Appendices
References

3. PAGE DIMENSION AND BINDING SPECIFICATIONS:

The dimension of the project report should be in A4 size. The project report should be bound using flexible cover of the thick white art paper. The cover should be printed in black letters and the text for printing should be identical.

Total number of pages should not exceed 70.

4. PREPARATION FORMAT:

Cover page & Title page-A specimen copy of the cover page &Title page of the project report are given in Appendix 1.

Bonafide Certificate –The Bonafide Certificate shall be in double line spacing using Font Style Times New Roman and Font Size 14.

The Certificate shall carry the supervisor's signature and shall be followed by the supervisor's name, academic designation (not any other responsibilities of administrative nature), department and full address of the institution where the supervisor has guided the student. The term SUPERVISOR must be typed in capital letters between the supervisor's name and academic designation.

Preface- preface should be one page synopsis of project report typed double line spacing Font Style Times New Roman and Font Size 14.

Table of contents-The table of contents should list all material it as well as any material which precedes the title page and Bonafide Certificate will not find a place among the items listed in the Table of Contents but the page numbers of which are in lower case Roman letters. One and a half spacing should be adopted for typing the matter under this head.

List of Tables- The list should use exactly the same caption as they appear above the tables in the text. One and a half spacing should be adopted for typing the matter under this head. The table should be introduced in the appropriate places in the text.

List of Figures-The list should use exactly the same captions as they appear below the figures in the text. One and a half spacing should be adopted for typing the matter under this head. The figures should be introduced in the appropriate places in the text.

List of Symbols, Abbreviation & Nomenclature- One and a half spacing should be adopted for typing the matter under this head. Standard symbols, abbreviation should be used.

Chapters-The chapters may be divided into 5 parts

1. Introduction to project
2. Literature survey
3. Method and methodology/Working/ Experimental Techniques
4. Result Analysis
5. Conclusion

1. The main text will be divided into several chapters and each chapter may be further divided into several divisions and subdivisions.
2. Each chapter should be given an appropriate title.
3. Tables and figures in the chapter should be placed in the immediate vicinity of the reference where they are cited.
4. Footnotes should be sparingly. They should be typed single space and placed directly underneath in the very Same page, which refers to the materials they annotate.

Appendices- Appendices are provided to give supplementary information, which is included in the main text may serve as a distraction and cloud the central theme

1. Appendices should be numbered using numerals, Eg. Appendix 1, Appendix2 etc.
2. Appendices tables and references appearing in the Appendices should be numbered and referred to at appropriate places just as in the case of chapters.
3. Appendices shall the title of the work reported and the same title shall be made in the contents page also.

List of references: The listing of references should be typed 4 spaces below the heading "REFERENCES "in alphabetical order in single spacing left- justified. The reference material should be listed in the alphabetical order of the first author. The name of the author / authors should be immediately followed by the year and other details.

A typical illustrative list given below relates to the citation examples coated above

REFERENCES

1. Ariponnammal, S. and Natrajan, S.(1994)'transport phenomena of SmSel – X Asx',Pramana- journal of physics vol. 42 , No.1,pp 421-425.
2. Bernard R.W and Kellogg, C. (1980)'applications of convolution operators to problems in univalent function theory ', Michigan Mach, J., Vol.27,pp.81-94 .
3. Shin, K.G.&Mckay, N.D.(1984) "Open loop minimum time control of mechanical manipulations & its applications", Proc. Amer. Contr. Conf., San Diego, C A, pp. 1231-1236.

Tables and Figures- By the word table, is meant tabulated numerical data in the body of the project report as well as in the appendices. All other non- verbal materials used in the body of the project work and appendices such as charts , graphs, maps, photos& diagrams may be designated as figures .

5. TYPING INSTRUCTIONS

The impression on the typed copies should be black in colour.

One and a half spacing should be used for typing the general text. The general text shall be typed in the Font style “Times New Roman” & Font size 14.

Book For Reference :

1. Kothari C R. *Research Methodology-Methods and Techniques*. New Delhi: New Age International Publishers. 2nd Edition 2005.

SEMESTER - III			
CORE PRACTICAL - III C++, MICROPROCESSOR& MICROCONTROLLER			
Code :21PPHCR3	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 3**

C++(Any 6 Experiments)

1.The Discrete Fourier transform

2. Currents in a network

3. Area under a curve using Monte Carlo and Simpsons rule

4. RungeKutta solution to radioactive decay problem

5. Euler solution to two-dimensional motion of a particle in a gravitational field

6. Roots of a transcendental equation

7. Curve fitting to a Gaussian, an exponential function, Cauchy's constant problem to a straight line

8. Eigen value and Eigen vectors of a matrix

9. Solution of linear harmonic oscillator and anharmonic oscillator

10. Frequency response of a series/parallel LCR Resonance circuit –Evaluation of Q-factor and bandwidth

MICROPROCESSOR& MICROCONTROLLER (Any 6 Experiments)

1. A/D converter using Microprocessor
2. D/A converter using Microprocessor
3. Rolling Display using Microprocessor
4. Stepper motor control using Microprocessor
5. Addition, Subtraction, Multiplication and Division (using various address. modes)
6. Data manipulation using Microprocessor (Ascending, descending, max and min)
7. Counters using Microprocessor
8. Display of any character
9. Traffic controller
10. Voltage/Temperature measurement
11. Digital clock
12. Wave form generator
13. Frequency measurement
14. Addition, Subtraction, Multiplication, Division-Microcontroller

SEMESTER - IV			
CORE PRACTICAL IV ELECTRONICS -II			
Code:21PPHCR4	**Hrs/Week: - 6**	**Hrs/Semester: - 90**	**Credits:3**

(Any 12 Experiments)

1. OP-AMP: Basic circuits (Inverting amplifier, non-Inverting amplifier, Summing amplifier and Difference amplifier)
2. Wien's Bridge oscillator OP-AMP
3. Op-amp: I to Vconverter, V to I converterand square wave generator
4. OP-AMP parameter calculation
5. Synchronous counter using IC 7476
6. Digital comparator IC based
7. Schmitt trigger using IC 555
8. Code converter
9. Parity Checker/generator and comparator using gates
10. Op-amp: Phase shift operator
11. Op-amp: Solving I order simultaneous equations
12. Construction of a series voltage regulator using transistor
13. Construction of II order active filters (low pass,high pass and band pass) using IC 741
14. UJT Characteristics and relaxation oscillator
15. Application of Flip flop
16. Triggering circuit if SCR
17. AC power control TRIAC
18. Switching characteristics of power MOSFET