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.2019)

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 Outcome

PO.No.	At the end of the M.Sc. Program, the 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.

Course Structure (w.e.f 2019)

Semester – I

Subject	*Subject code*	*Title of the paper*	*Contact Hours/ Week*	*Credits*	*Max. Marks*		
					CIA	*ESE*	*Total*
Core I	19PPHC11	Classical Mechanics	6	4	40	60	100
Core II	19PPHC12	Mathematical Physics I	6	4	40	60	100
Core III	19PPHC13	Electronics and Experimental methods	6	4	40	60	100
Core IV	19PPHC14	Crystal growth & Thin films	6	4	40	60	100
Core Practical I	19PPHCR1	Electronics - I	3				
Core Practical II	19PPHCR2	Non-Electronics	3				
			30	**16**			

Semester – II

Subject	*Subject code*	*Title of the paper*	*Contact Hours/ Week*	*Credits*	*Max.Marks*		
					CIA	*ESE*	*Total*
Core V	19PPHC21	Nano Science and Technology	5	4	40	60	100
Core VI	19PPHC22	Mathematical Physics II	5	4	40	60	100
Core VII	19PPHC23	Electromagnetic Theory	5	4	40	60	100
Core VIII	19PPHC24	Microprocessor and Microcontroller	5	4	40	60	100
Core IX	19PPFW21	Field Work	4+	3	40	60	100
Core Practical I	19PPHCR1	Electronics - I	3	4	40	60	100
Core Practical II	19PPHCR2	Non-Electronics	3	4	40	60	100
			30	**27**			

It is mandatory for students to complete one MOOC Course during the first year of study. (19PPHM21) 2 Credits

Semester – III

Subject	*Subject code*	*Title of the paper*	*Contact Hours/ Week*	*Credits*	*Max. Marks*		
					CIA	*ESE*	*Total*
Core X	19PPHC31	Quantum Mechanics – I	6	4	40	60	100
Core XI	19PPHC32	Atomic and Molecular Spectroscopy	6	4	40	60	100
Core XII	19PPHC33	Thermodynamics and Statistical Mechanics	6	4	40	60	100
Core XIII	19PPHC34	Research Methodology	6	4	40	60	100
Core XIV Practical III	19PPHCR3	Microprocessor and Microcontroller& C++	3				
Core XV Practical IV	19PPHCR4	Electronics - II	3				
Self Study Course/ MOOC	19PPHSS1 / 19PPHM31	Physics for Lectureship	-	+2		100	100
			30	**16+2**			

Semester – IV

Subject	*Subject code*	*Title of the paper*	*Contact Hours/ Week*	*Credits*	*Max.Marks*		
					CIA	*ESE*	*Total*
Core XVI	19PPHC41	Quantum Mechanics – II	5	4	40	60	100
Core XVII	19PPHC42	Condensed Matter Physics	4	4	40	60	100
Core XVIII	19PPHC43	Nuclear and Particle Physics	5	4	40	60	100
Core Practical III	19PPHCR3	Microprocessor and Microcontroller& C++	3	4	40	60	100
Core Practical IV	19PPHCR4	Electronics - II	3	4	40	60	100
Elective -I	19PPHE41/ 19PPFW41	Elective/Field work/Study tour	3+	3	40	60	100
Core XXI	19PPHP41	Project	7+	8	40	60	100
			30	**31**			

Master of Science (Physics)

Components	Credit per Semester	No. of Courses	Credits	Extra Credits
Core	4	15	60	
Field work	3	1	3	
Practical	4	4	16	
Elective/field work/study tour	3	1	3	
Project	8	1	8	
MOOC	2	1		+2
Self Study Course/MOOC	2	1		+2
		Total	90	+4

Program Specific Outcome

PSO No	Students of M.Sc., Physics will be able to
PSO 1	understand the principles and theories of area of physics such as Mechanics, Electromagnetic theory, Electronics and Nuclear and particle physics.
PSO 2	apply algebra, calculus, tensors and complex variables to solve physics problems.
PSO 3	demonstrate the ability to do the lab experiments and apply the principles learnt in class
PSO 4	undertake major and minor projects and report their results in a full scientific report through oral or poster presentation.
PSO 5	understand the impact of physics on society.
PSO 6	Compile oral and written scientific communication and will prove that they can think critically and work independently.
PSO 7	use analytical and integrative problem-solving approaches through research oriented learning.
PSO 8	communicate effectively on energy aspects with the society at large.

SEMESTER - I			
Core - I	**Classical Mechanics**		
Code : 19PPHC11	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

Vision:

To enhance the knowledge of the students in motion of macroscopic objects moving at a speed much less than that of light.

Mission:

To develop the basic concepts like dynamics of system of particles, motion of the rigid body, Lagrangian and Hamiltonian formulation of mechanics.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	define and understand basic concepts related to continuous mechanical system.	1	Re
CO - 2	explain the motion of bodies under the influence of the system of force.	5	Un
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	understand the planar and spatial motion of rigid body.	1	Un
CO - 8	describe problems using their knowledge and skills in classical mechanics.	2	Un

SEMESTER - I			
Core - I	**Classical Mechanics**		
Code : 19PPHC11	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

Unit I: Fundamental Principles and Lagrangian Formulation

Mechanics of a particle and system of particles –conservation laws- constraints –Principle of virtual work- D' Alembert's principle – Lagrange's equation from D'Alembert' sprinciple – 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

Unit III: Hamilton's Formulation

Hamilton's equation from variational principle- principle of least action – Canonical Transformation-Legendre transformation- Lagrange and Poisson's brackets – Relation between 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.

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 –Rotational kinetics energy of a rigid body)- 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- The Lagrangian and Hamiltonian formulation of relativistic Mechanics–Covariant formulation of Lagrangian and Hamiltonian.

Text Books:

1. Dr. S. L. Gupta, V. Kumar & H. V. Sharma, Classical Mechanics,2010, Pragati Prakashan.
2. Jc Upadhyaya, Classical Mechanics, 2014, Himalaya Publishing House.

Unit	Book No.	Chapters / Sections
I	2	1.6,1.7,2.3,2.5, 2.6,2.7,2.11
II	1	4.1,4.2,4.3,4.4,4.5.1,4.6,4.7
III	2	5.5,5.11,6.1,6.2,7.2-7.6,8.2-8.4,8.6
IV	2	10.1-10.3,10.6-10.8,10.11-10.13
V	2	12.9-12.11,13.3,13.5 ,13.11,14.8

Books for Reference:

1. Classical Mechanics - B.D. Gupta Satya Prakash – Nineth revised and Enlarged Edition 1991.
2. Classical Mechanics - Goldstein, Poole and safko - Third Edition (2002), Person Education, Inc.

SEMESTER - I			
CORE - II	**Mathematical Physics – I**		
Code : 19PPHC12	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

Vision

To make the students competent and capable problem solvers using techniques that requires mathematical skills and an understanding of limiting cases.

Mission

To analyze and visualize the solution in terms of special functions and how to use in practice the Bessel functions, Legendre polynomial.

Course Outcome:

CO No.	Upon completion of this course, students will be able to	PSO 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	recall the incompleteness of the statistical interpretations relating to the summing of an infinite number of probabilities to yield a meaningful solution.	2	Re
CO 8	apply group theory to various disciplines of Physics.	3	Ap

SEMESTER - I			
CORE - II	**Mathematical Physics – I**		
Code : 19PPHC12	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

Unit I: Vector Calculus

Review of Vector Algebra – Gradient of a scalar field - Divergence of a vector function - Curl of a vector function – Gauss Divergence theorem – Stokes's theorem – Green's theorem (Proof only).

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 $\int_{-\infty}^{+\infty} \frac{f_1(x)}{f_2(x)} dx$ 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, Sultan Chand & Sons, New Delhi.
2. H.K.Dass, Mathematical Physics, S.Chand & Company LTD, Fourth Revised Edition 2004
3. P.K. Chattopadhyay, Mathematical Physics, New Age International Publishers, Reprint (2001)

Unit	Book No.	Chapters / Sections
I	1	1.1,1.2,1.4,1.5,1.7,1.9,1.12
II	1	2.2, 2.5-2.11, 2.14, 2.19, 2.23, 2.27, 2.31-2.32
III	1	6.7-6.11,6.17,6.21,6.22,8.2,8.11,8.13
IV	2	7.3-7.10,7.31-7.33, 7.39-7.47
V	3	8.1-8.7

Books for Reference:

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

SEMESTER - I			
Core - III	**Electronics and Experimental Methods**		
Code : 19PPHC13	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

Vision

To enable students to understand the working principle and the utility of advanced semiconductor devices, digital circuits and Transducers

Mission

To deepen the knowledge of students about diodes, Op-Amp applications, D/A and A/D converters, counters, registers and the functions of different types of transducers through detailed study of relevant theory and problem solving.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO 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	sketch waveform generators such as Square wave generator,triangular wave generator and Schmitt trigger	1, 3	Ap
CO - 4	discuss the functions of registers and counters	1	Un
CO - 5	describe the different types of registers	1	Un
CO - 6	explain the working of D/A and A/D converters	1	Un
CO - 7	identify the working mechanism of different types of transducers	1	Un
CO - 8	recognise intrinsic and extrinsic semiconductors	1	Un

SEMESTER - I			
Core - III	**Electronics and Experimental Methods**		
Code : 19PPHC13	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

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-AMPApplications

Basics of OP-AMP –inverting & non-inverting OP-AMP-differential amplifier – Analogintegrationanddifferentiation – Comparators -Waveform generators: Square wave generator -triangular wave generator -Schmitttrigger

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/Dconversion

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: StrainGauges- 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 – disadvantages of capacitive transducers –uses of capacitive transducers - Piezoelectric transducers – Modes of operation of piezoelectric crystals – uses of piezoelectric materials and transducers

Text Books:

1. S.K Kakani, K.C. Bhandari,Electronics Theory and Applications, 2014 reprint, New Age International Publishers, New Delhi.
2. Jacob Milman and Christos C.Halkias, Integrated Electronics, Tata Mc Graw Hill Edition,India, 1991.
3. Donald P.Leach,Albert Paul Malvino and Goutam Saha, Digital Principles and

Applications, sixth edition 2008, The McGRAW-Hill Publishing CompanyLtd.,New Delhi.

4. A.K.Sawhney,Electrical and Electronic Measurements and Instrumentation,Dhanpat Rai Sons,Educational and Technical Publishers,Delhi, Eighteenth revised and enlarged edition 2007.

Unit	Book No.	pages
I	1	6 -14,18-19,27-28,49-53,55-59,65-67,72-75
II	2	566-578,612-616,640-642,649-655
III	3	308-325,341-346, 349 – 352, 357 – 359, 363 - 366
IV	3	438-467,471-472
V	4	935-942, 949 – 950, 964-966,1014-1023,1028-1032, 1037

Book for Reference:

1.Ramakanth A. Gayakwad, "Op-Amp and Linear Integrated Circuits", Prentice Hall of India Pvt. Ltd., New Delhi, 1988

SEMESTER - I			
Core - IV	**Crystal Growth & Thin films**		
Code :19PPHC14	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Vision

To enable the study of different methods of crystal formation for various types of crystals with different symmetries and thin films along with their applications.

Mission

To introduce characterization methods, thin films and other types of materials such as polymers, ceramics & glass.

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 process skills of scientific inquiry during experimentation	4	Ap
CO - 3	understand the foundation of SEM, TEM	4	Un
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	recognise appropriate material for the fabrication of a device	4	Un

SEMESTER - I			
Core - IV	**Crystal Growth & Thin films**		
Code :19PPHC14	**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.

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.

Unit III: Characterization Technique

Diffraction analysis – X-ray diffraction- electron & neutron diffraction - TEM, instrumental details - SEM – AFM. Microhardness (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

Text Books:

1. Dr.P. SanthanaRagavan and P.Ramasamy,Crystal growth processes and methods.
2. V.Rajendran, Material Science, Mcgraw hill, First reprint 2012, New Delhi.
3. A.Goswami, Thin film fundamentals, First Edition 1996, New age international, (p), Ltd. New Delhi.

Unit	Book No.	Section
I	1	1.1, 1.2, 1.4, 1.5, 2.2, 2.2.1- 2.2.3
II	1	4.1, 4.2, 4.8, 5.4.3, 5.4.6
III	2	3.3, 3.19, 3.4.3, 3.11, 3.10, 3.18, 3.13, 3.14, 3.15.1,3.15.2
IV	3	4.1, 4.2, 5, 7, 9.2.2, 9.2.3
V	3	3.1, 3.2, 3.3, 4, 6, 7

Books for Reference:

1. J.C.Brice, Crystal growth processes
2. B.R.Pamplin, Crystal growth, second edition
3. D.T.J.Hurle , Crystal pulling from melt
4. V.Raghavan, Material science & Engineering – A first course
5. William D.Callister,Jr., Martial science & Engineering an introduction ,V edition.

SEMESTER – II			
Core VII	**Nanoscience and Technology**		
Code : 19PPHC21	**Hrs / Week : 5**	**Hrs / Semester : 75**	**Credits : 4**

Vision

To synthesize the nanomaterial by eco-friendly methods, characterize the synthesized nanomaterials and apply in different fields for the welfare of society.

Mission

To introduce and give an insight into the fascinating area of Nanoscience.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO 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 – II			
Core VII	**Nanoscience and Technology**		
Code : 19PPHC21	**Hrs / Week : 5**	**Hrs / Semester : 75**	**Credits : 4**

Unit I- Synthesis and Characterization of Nanoparticles

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

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, Infrared photodetectors, Lasers.

Unit IV-Magneto electronics

Magneto electronics **:**Nano crystalline soft magnetic materials-Permanent magnetic materials-Theoritical background-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 of Nanotechnology -Information and Communication- Heavy industry - Consumer goods - Nano medicine - medical applications of molecular nanotechnology (Nanorobots, Cell repair machines, nanonephrology)

Text Book:

1. Nano Physics, Dr.Sr.GeraldinJayam

Unit	Book no.	Section5,1.7,1.9
I	1	1.1-1.5,1.7,1.9
II	1	2.1,2.2,2.3,2.4,2.6-2.6.1,2.6.2,2.6.5
III	1	4.1-4.5,4.8,4.9,4.12
IV	1	5.1-5.6,5.9,5.10
V	1	5.14,5.15

Books for Reference:

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

SEMESTER - II			
Core VIII	**Mathematical Physics II**		
Code : 19PPHC22	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Vision:

To introduce students to methods of mathematical physics and to develop required mathematical skills to solve problems in quantum mechanics, electrodynamics and other fields of theoretical physics.

Mission:

To enhance the knowledge in probability, integral transforms special functions, tensors and numerical methods.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	analyse the experimental data with the aid of Fourier transform	4	An
CO - 2	understand the basic of tensor calculus and to describe motion and deformation of body	1	Un
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 VIII	**Mathematical Physics II**		
Code : 19PPHC22	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Unit I: Probability and Fourier's Integral Transforms

Probability: Probability– definitions - Binomial distribution, Poisson distribution, normal distribution.

Fourier Integral Transforms: Fourier transform- properties of FT-FT of a derivative-Finite FT

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 antisymmetric 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: Laplace's Integral Transforms

Laplace 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

Unit	Book No.	Pages/sections
I	1	11.2,11.20,11.21,9.2,9.3,9.4,9.7
II	2	15.2,15.3,15.4,15.5,16.1,16.2,16.3,16.4,16.6,18.1,19.3,19.4,19.5,19.7
III	1	6.29,6.30,6.31,6.32,6.34,6.35,6.36,6.37
IV	3	1.1, 1.16, 1.53, 2.1, 2.13, 2.59, 2.61, 2.75, 3.27, 3.31
V	1	9.9,9.10,9.11,9.15,9.17,9.18,9.19,9.20

Text Books:

1. Satya Prakash, Mathematical Physics, Fourth revised Edition 2004, Sultan Chand &Sons.
2. Matrices and tensors in Physics, A.W. Joshi, New Age International Publishers, Revised Third Edition (1995), Reprint 2010.
3. Numerical Methods - A. Singaravelu, Meenakshi Agency, Chennai
4. P.K. Chattopadhyay, Mathematical Physics, New Age International Publishers, Reprint (2001) and
5. H.K.Dass ,Mathematical Physics, S.Chand & Company LTD, Fourth Revised Edition 2004.

SEMESTER - II			
Core IX	**Electromagnetic Theory**		
Code : 19PPHC23	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Vision

To know the fundamentals of electricity and magnetism.

Mission

To study the properties of electromagnetic waves and how they are propagated through waveguides.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO 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
CO -5	analyze different waves and conduct a mock trial on electromagnetic radiation	5	An
CO - 6	summarize the types of wave guides	1	Un
CO - 7	distinguish transmission lines and waveguides and analyze propagation of signal in different modes	1	An
CO - 8	obtain solutions for the problems in electromagnetic theory	2	Cr

SEMESTER - II			
Core IX	**Electromagnetic Theory**		
Code : 19PPHC23	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Unit I: Electrostatics

Coulomb'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 charge distribution – Gauss Law in the presence of dielectric – Susceptibility, Permittivity and Dielectric constant of linear dielectrics.

Unit II: Magnetostatics

Biot-Savart's and Ampere's Law - 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 - Poynting Vector and Poynting's Theorem – Maxwell's Stress Tensor.

Unit IV: Electromagnetic Waves and Radiations

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

Unit V: **Wave Guides**

Wave guides – Rectangular wave guide TE - Rectangular wave guide TM mode – Circular wave guide – resonant cavities.

Text Books:

1. David J.Griffiths, Introduction to Electrodynamics, Prentice hall of India,2nd edition (1989)
2. SatyaPrakash, Mathematical Physics, Fourth revised Edition 2004, Sultan Chand &Sons.

Unit	Book No.	Sections
I	1	2.1.2, 2.2.1, 2.3.3, 2.4.1-2.4.3, 4.2.3, 4.3.1, 4.4.1
II	1	5.2, 5.3.4, 5.4, 5.4.3, 6.1.3, 6.3.1
III	1	7.3.3, 7.3.5, 7.4.1, 7.4.2, 7.4.3, 7.5.2, 7.5.3
IV	1	8.1.2, 8.2.3, 8.2.5, 8.3, 9.1.2, 9.1.3
V	2	8.25-8.28

Books for Reference:

1. Paul Lorraius and Dale Corson, Electromagnetic Fields and Waves, CBS Publishers & distributors, 2nd edition 2003

SEMESTER - II			
Core X	**Microprocessor and Microcontroller**		
Code :19PPHC24	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Vision

To enable the students to understand the fundamentals of architectures and instruction sets of microprocessors and microcontrollers**.**

Mission

To enhance the knowledge of students about the fundamental concepts of Microprocessor and micro controller through a systematic study of programming model, Instruction set, Arithmetic instructions, Programming techniques, Basic interfacing concept, Counters and Timers and Microcontroller Programming using arithmetic and logical instruction.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	Understand the architectures and instruction sets of microprocessors and microcontrollers	1	Un
CO - 2	Understand and explain bus transactions, memory organisation and address decoding, basic I/O interfaces and port addressing	1	Un
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	Recall concepts associated with interfacing a microprocessor to memory and to I/O devices	6	Re
CO - 6	Understand how to control components of a microprocessor based system through the use of interrupts	4	Un
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 ARM Architecture	1	Un

SEMESTER - II			
Core X	**Microprocessor and Microcontroller**		
Code :19PPHC24	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Unit I: Microprocessor Architecture and Instruction set

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

Unit II: Microprocessor Programming and Interrupts

Writing assembly language programs-Programming techniques: Looping, Counting and Indexing–Stack-Subroutine-Examples of assembly language programming: Addition-subtraction-multiplication-Division (in different modes)-Ascending and descending order-to find the largest and smallest number in data array-8085 Interrupt.

Unit III: Counters and Time Delays

Counters and time delays - Illustrative program: Hexadecimal Counter - Zero to nine modulus ten counter -Generating pulse waveforms - Debugging counter and time delay programs.

Unit IV: Basics of 8051 microcontroller

Introduction – 8051 Microcontroller hardware –oscillator and clock- Input/output Pins, Ports and Circuits – External Memory – Counters and Timers – Serial Data Input/output – Interrupts.

Unit V: Embedded Systems –ARM

Introduction-Instruction set-Comparative features of ARM versions-processor and Memory Organisation-Features in CISC

Text Books:

1. Ramesh Gaonkar, Microprocessor Architechture, Programming and Applications with the 8085,
Penram International Publishing(India)Private Limited, Fifth edition,2011.
2. Karuna Sagar, Microcontroller 8051, 2011 print, Narosha publishing house PVT Ltd, Delhi
3. Raj Kamal , Embedded Systems Architecture, Programming and Design, Second Edition

Unit	Book No.	Pages
I	1	105-108,32-42, 47-50, 176-210
II	1	210-214, 228-231, 296-315, 376-379
III	1	275 - 291
IV	2	2.1-2.18
V	3	89-94,96-100

Books for Reference:

1.Aditya.P.Mathur, Introduction to Microprocessors , 3rd Edition, Tata McGraw Hill Education P Ltd, New Delhi.

2. B.Ram and Sanjay Kumar, Fundamental of microprocessors and microcontrollers, Seventh revised Edition, Dhanpat rai Publications (P) Ltd, New Delhi

SEMESTER - II			
Core V Practical I	**Electronics –I**		
Code : 19PPHCR1	**Hrs/Week:- 6**	**Hrs/Semester:- 90**	**Credits:4**

(Any 12 Experiments)

1. Modulus counters 2 to 10
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,$\overline{R}\overline{S}$ 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

SEMESTER - II			
Core VI Practical – II	**Non-Electronics**		
Code :19PPHCR2	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

(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 prismusingspectrometer.

SEMESTER - III			
Core XII	**Quantum Mechanics -I**		
Code :19PPHC31	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

Vision

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

Mission

To enhance the knowledge of students about the fundamental concepts of Quantum Mechanics through a systematic study of Schrodinger equation and wave function,Operators and Heisenberg Uncertainty Principle, Angular Momentum, Matrix Mechanics, Various Pictures and Density matrix and their application to systems such as Linear Harmonic Oscillator,Particle in an infinite square well potential and Particle in a magnetic field.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO 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	explain Schrodinger picture, Heisenberg picture and Interaction picture	1	Un

SEMESTER - III			
Core XII	**Quantum Mechanics -I**		
Code :19PPHC31	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

Unit I: Schrodinger equation and wave function

Introduction – Construction of Schrodinger equation – Solution of time dependent equation – Physical interpretation of $\psi^*\psi$– Conditions on allowed wave functions - Box normalization – Conservation of probability – Expectation value –Ehrenfest's theorem – Verification of Ehrenfest's theorem – Linear harmonic oscillator – particle in an infinite square well potential – Particle in a magnetic field.

Unit II: Operators andHeisenberg Uncertainty Principle

Operators, Eigen values and Eigen functions: Linear operators, commuting and non-commuting operators – Self-adjoint and Hermitian operator – Discrete and continuous Eigen values. Classical uncertainty relation –Heisenberg uncertainty relation – Implication of uncertainty relation –Illustration of uncertainty relation – Gamma-Ray microscope – Doppler effect.

Unit III: Angular Momentum

The Angular momentum operators — Angular momentum commutation relations – Eigen values and Eigen functions of L^2 and L_z - General Angular momentum – Eigen values of J^2 and J_z - Angular momentum matrices – Spin Angular momentum – Spin vectors for spin-1/2 system - Addition of angular momenta – C.G coefficients.

Unit IV: Matrix Mechanics

Linear vector space – Matrix representation of operators and wave functions – Unitary transformation – Schrodinger equation and other quantities in matrix form – Application of matrix mechanics – Dirac's Bra and Ket notations – Properties of bra and Ket vectors – Hilbert space.

Unit V: Various Pictures and Density matrix

Schrodinger picture – Heisenberg picture – Interaction picture – comparison of three representations–Density matrix for a single system – Density matrix of an ensemble – Time evolution of density operator – A spin ½ system.

Text Books:

1. S. Rajasekar and R. Velusamy, Quantum Mechanics I: Fundamentals, CRC Press, Taylor and Francis group- Boca Raton, London, e-book version 2014.
2. G. Aruldhas, Quantum Mechanics, Second edition, Twentieth printing 2019, Prentice-Hall of India Learning Private Limited, Delhi.

Unit	Book no.	Sections / Page No
I	1	2.1 – 2.9
II	1	3.1 – 3.5, 8.1 – 8.5
III	2	206 - 229
IV	1	6.1, 6.2, 6.3, 6.4, 6.6, 6.7, 6.8, 6.10, 6.11
V	1	7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9

Books for Reference:

1. L. Schiff, Quantum Mechanics, Third Edition 2010,Tata Mc-Graw Hill Education Private Limited, New Delhi
2. P. M. Mathews and K. Venkatesan , A Text Book of Quantum Mechanics, Tata McGraw Hill Publishing Company Limited, New Delhi, 38th reprint 2007
3. R. Shankar, Principles of Quantum Mechanics, Second Edition 1994, Plenum Publishers, New York.
4. J. J. Sakurai, Modern Quantum Mechanics, Revised edition 1994, Addison- Wesley Publishing Company.

SEMESTER - III			
Core XIII	**Atomic and Molecular Spectroscopy**		
Code :19PPHC32	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

Vision:

To enable the students to understand the atomic and molecular spectrum with the ultimate clarity that quantum mechanics allows.

Mission:

To enhance the knowledge of origin of atomic spectra, rotational, vibrational, Raman and mossbauer spectroscopy.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	explain the structure of atoms and the origin of the observed spectra	1	Un
CO - 2	interpret rotational spectra, get information about molecular dimension and atomic masses	4	Un
CO - 3	explain pure rotational Raman spectra and understand the techniques in instrumentation	3	Un
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	understand problems in atomic and molecular physics	2	Un

SEMESTER - III			
Core XIII	**Atomic and Molecular Spectroscopy**		
Code :19PPHC32	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

Unit I: Spectra of atoms

Hydrogen Spectrum-Angular momentum-Larmor precession-Vector atom model-Spin -orbit interaction-Spectra of alkali atoms-angular momentum of many electrons atoms-Normal Zeeman Effect-Anomalous Zeeman Effect-Paschen - Back Effect-hyperfine structure-Stark Effect-Lamb Shift-Characteristic X-ray Spectra-Moseley's law

Unit II: Microwave Spectroscopy

Microwave Spectroscopy: The rotation of molecules– Rotational spectra– Diatomic molecules – Polyatomic molecules–Microwave spectrometer- Applications

Unit III: Infra-Red Spectroscopy

Infra-Red Spectroscopy: The vibrating diatomic molecule – The Diatomic vibrating rotator-The interactions of rotations and vibrations- The vibrations of polyatomic molecules- IR spectrometer-FTIR-Applications

Unit IV: Raman Spectroscopy and Mossbauer Spectroscopy

Theory of Raman spectroscopy-Rotational Raman spectra- vibrational Raman spectra- mutual exclusion principle-Raman spectrometer-structure determination using IR and Raman spectroscopy-Resonance Raman scattering-Raman microscopy

Mossbauer Spectroscopy: Principles of Mossbauer-Applications of Mossbauer Spectroscopy

Unit V: Resonance Spectroscopy

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

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

Text Books:

1. C.N.Banwell, Fundamentals of Molecular spectroscopy, 4thEdition,Tata McGraw hill Publishing Company, NewDelhi.
2. G.Aruldhas, Molecular structure & Spectroscopy, Second Edition, Prentice hall Private Ltd.

Unit	Book no.	Sections / Page No
I	2	3.2,-3.4,3.6-3.9,3.12-3.16,3.18-3.20
II	1 2	2.1-2.4, 2.7 6.14
III	1 2	3.1,3.2,3.4,3.5 7.16 ,7.18,7.19
IV	2 1	8.2-8.6,8.12,8.16,8.17 Chapter 9
V	2 1	10.1-10.6,10.8,10.19 7.5

Books for Reference:

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

SEMESTER - III			
Core XIV	**Thermodynamics and Statistical Mechanics**		
Code : 19PPHC33	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

Vision:

To enable the students to understand the Fundamentals of Thermodynamics and Statistical Mechanics

Mission:

To enhance the knowledge of students about the fundamental concepts of Thermodynamics and Statistical Mechanics through the study of zeroth, first, second and third law of Thermodynamics, partition function for micro canonical, canonical and grand canonical ensemble, fluctuations, Random Walk and Brownian Motion and Ising Model.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO 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	demonstrate the partition function for the microcanonical, canonical, grand canonical ensemble	1	Un
CO - 4	recall the loss of thermodynamics and equipartition theorem from the statistical description using microstates	1	Re
CO - 5	extend knowledge about phase transitions and fluctuations in ensembles	5	Un
CO - 6	apply energy changes in chemical reaction using the first law of thermodynamics	2	Ap
CO -7	understand the Statistical properties of Random Walks	1	Un
CO - 8	determine the physical properties of the system using various correlation functions in Ising Model	6	Ev

SEMESTER - III			
Core XIV	**Thermodynamics and Statistical Mechanics**		
Code : 19PPHC33	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

Unit I: Thermodynamics

Zeroth, First, Second and Third law of thermodynamics – Entropy – Maxwell's thermodynamic relations – Thermodynamic potentials – Chemical potential and Gibbs Duhem equation

Unit II: Basis of Statistical Mechanics

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

Unit III: Ensemble

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.

Unit IV: Statistical Thermodynamics

Macrostates and microstates – Bose-Einstein distribution function – Fermi-Dirac distribution function – Maxwell-Bolltzman distribution function – Partition function –- Bose-Einstein condensation – Einstein and Debye theories of the specific heat capacity of a solid

Unit V: Ising model and Fluctuations

Phase transitions of the second kind – Ising model – Bragg-Williams approximations – Fowler-Guggenheim approximation – One dimensional Ising model.

Fluctuations in ensembles – concentration fluctuations in quantum statistics - One dimensional random walk – Brownian motion.

Text Books:

1. V.N Dass, Heat and thermodynamics, First Edition, 2005, Dominant Publishers, Delhi.
2. M.C Gupta,Statistical Thermodynamics, Reprint 2009, New age international P Ltd, New Delhi.
3. Sears Salinger, Thermodynamics, Kinetic Theory and Statistical Thermodynamcis, third edition, Narosa publishing house pvt Ltd, New Delhi.
4. Statistical Mechanics, B.K Agarwal, Melvin Eisner, Reprint 2002, New age international P Ltd, New Delhi.

Unit	Book no.	Sections / Page No
I	1 2 3	1-2, 14-19, 70-71, 76-77,154-160, 173-187 5.5 7.7
II	4	1.2,1.3,1.5-1.10, 2.2,2.5-2.7
III	4	3.5, 3.6, 4.2,4.3,4.6 - 4.9
IV	3 4	11.3,11.9,11.10, 11.13,11.14, 13.1,13.2 6.2
V	4	11.1 -11.4, 11.6,10.3-10.6

Books for Reference:

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

SEMESTER - III			
Core XV	**Research Methodology**		
Code : 19PPHC34	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Vision

To provide the best scientific methods in understanding the basic principles of research, both theoretical and experiment and to keep up the level of their scientific research.

Mission

To represent the underlying sub disciplines of research in physics and to promote new areas of research with an emphasis an interdisciplinary and applied research.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO 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	understand the selection process of the problem based on necessity.	4	Un
CO 4	recall the features of good research	4	Re
CO 5	apply secondary data methods of collecting primary data	6	Ap
CO 6	understand the formulation of the selected problem	4	Un
CO 7	understand the meaning of interpretation techniques	4	Un
CO 8	list the types of reports based on the research mechanism	6	Re

SEMESTER - III			
Core XV	**Research Methodology**		
Code : 19PPHC34	**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: Data Analysis

Meaning and importance of data- sources of data- use of secondary data methods of collecting primary data: general- observation-experimentation- simulation.

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. CR Kothari, Research methodology methods and techniques.
2. OR Krishna swamy,M.Ranganatham, Methodology of research in social studies.

Unit	Book No.	Page Number
I	1	1-29
II	1	30-50
III	2	163-182
IV	2	63-82
V	1	403-420

Books for Reference:

1. MH Gopal, An introduction to research procedure in social science.
2. SP Gupta, Statistical methods.

SEMESTER - III	
Self Study Course (Optional) Physics for Lectureship II	
Code :19PPHSS1	**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 similarcircuits). 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.

Text Book:

1. Truman's Series UGC-CSIR JRF/NET Physical Sciences, Danika Publishing Company,New Delhi.

SEMESTER - IV			
CORE XVIII	**Quantum Mechanics -II**		
Code :19PPHC41	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Vision

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

Mission

To enhance the knowledge of students in advanced quantum mechanics through a systematic study of Time Independent Perturbation theory, Time dependent Perturbation theory, Scattering theory, Identical particles and Relativistic Quantum Theory and their applications to quantum mechanical systems.

Course Outcome:

CO No.	Upon completion of this course, students will be able to	PSO 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	Describe Einstein coefficients	2	Un
CO 4	Define classical scattering cross section	1	Re
CO 5	Describe scattering by a square well potential using Born approximation and Partial wave analysis	1	Un
CO 6	Define Identical particles, symmetric and antisymmetric wavefunctions	1	Re
CO 7	Explain Dirac's equation for a free particle	1	Ev
CO 8	Explain spin of a Dirac particle	1	Ev

SEMESTER - IV			
CORE XVIII	**Quantum Mechanics -II**		
Code :19PPHC41	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Unit I: Approximation Methods I

Time Independent Perturbation Theory: Introduction- Theory for non-degenerate case - Application to non-degenerate levels- Theory for degenerate levels- First order Stark effect in Hydrogen atom.

Unit II: Approximation Methods II

Time Dependent Perturbation Theory:Introduction- Transition probability- constant Perturbation-Harmonic perturbation- adiabatic perturbation- sudden approximation - Semi classical theory of radiation- calculation of Einstein coefficients.

Unit III: Scattering theory

Classical scattering cross section – Centre of mass and laboratory co-ordinate systems – Scattering amplitude – Green's function approach – Born approximation – Partial wave analysis – Scattering form a square well system.

Unit IV: Identical particles

Introduction, Permutation symmetry, Symmetric and antisymmetric wave functions, The exclusion principle, Spin eigenfunctions of two electrons, Exchange interaction, Collisions between identical particles

Unit V: Relativistic Quantum Theory

Klein – Gordon equation – Dirac equation for a free particle – Spin of a Dirac particle – Particle in a potential – Relativistic particle in a box – Relativistic hydrogen atom – Electron in a field – Spin orbit energy.

Text Books:

1. 1. S. Rajasekar and R. Velusamy, Quantum Mechanics I: Fundamentals, CRC Press, Taylor and Francis group- Boca Raton, London, e-book version 2014.

Unit	Book no.	Sections / Page No
I	1	13.1, 13.2, 13.3, 13.4, 13.5
II	1	14.1, 14.2, 14.3, 14.4, 14.5, 14.6, 14.7, 14.8
III	1	17.1, 17.2, 17.3, 17.4, 17.5, 17.6, 17.7, 17.8
IV	1	18.1, 18.2, 18.3, 18.4, 18.5, 18.6, 18.8
V	1	19.1, 19.2, 19.3, 19.6, 19.7, 19.9, 19.10, 19.11, 19.12

Books for Reference:

1. L. Schiff, Quantum Mechanics, Third Edition 2010, Tata Mc-Graw Hill Education Private Limited, New Delhi
2. P. M. Mathews and K. Venkatesan ,A Text Book of Quantum Mechanics, Tata McGraw Hill Publishing Company Limited, New Delhi, 38th reprint 2007
3. R. Shankar, Principles of Quantum Mechanics, Second Edition 1994, Plenum Publishers, New York.
4. J. J. Sakurai, Modern Quantum Mechanics, Revised edition 1994, Addison- Wesley Publishing Company.
5. G. Aruldhas, Quantum Mechanics, Second edition, Twentieth printing 2019, Prentice-Hall of India Learning Private Limited, Delhi.

SEMESTER - IV			
Core XIX	**Condensed Matter Physics**		
Code :19PPHC42	**Hrs/Week: 5**	**Hrs/Semester: 60**	**Credits: 4**

Vision

To enable the students to learn how central concepts in condensed matter physics can be applied to model physics effects.

Mission

To introduce a broad spectrum of chemical bonding, crystal structure, diffraction, magnetism and a brief survey of superconductivity.

Course Outcome:

CO No.	Upon completion of this course, students will be able to	PSO 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 orbitals	5	Un
CO 3	Explain the physics of different types of bonds in crystalline structure	1	Un
CO 4	Classify condensed matter upon its degree of order with emphasis on scattering experiments	5	Un
CO 5	Explain the effective electron mass and apply it to describe electron dynamics in semiconductors	1	Un
CO 6	Estimate the thermal ionization of donors and acceptors	4	Ev
CO 7	Apply the knowledge of magnetism to explain natural physical process and related technological advances	2	Ap
CO 8	Assess ferromagnetic order from ant ferromagnetic order	4	Ev

SEMESTER - IV			
Core XIX	**Condensed Matter Physics**		
Code :19PPHC42	**Hrs/Week: 5**	**Hrs/Semester: 60**	**Credits: 4**

Unit I: Crystal Structure & Crystal binding

Brillouin zones-Reciprocal lattice to sc lattice-Reciprocal lattice to bcc lattice- Reciprocal lattice to fcc lattice-Fourier analysis of the basis - Structure factor of the bcc lattice- structure factor of the fcc lattice. Crystals of inert gases-Vander waals- London interaction-Repulsive interaction-Equilibrium lattice constants-cohesive energy-Ionic crystals- Electrostatic or Madelung energy-Evaluation of the Madelung constant

Unit II: Energy Bands

Nearly Free electron model -Bloch Functions – Kronig-Penny Model-Wave Equation of electron in a periodic potential-Number of orbitals in a band

Unit III: Crystal vibrations

Vibrations of crystals with monatomic basis-First Brillouin zone- Group velocity- long wavelength limit-Derivation of force constants from experiment - Two atoms per primitive basis -Quantization of elastic waves - Phonon momentum – Inelastic scattering by phonons.

Unit IV: Semiconductor Crystals

Band gap-intrinsic carrier concentration-Intrinsic mobility-impurity conductivity-Donor states-Acceptor states- Thermal ionization of donors and acceptors -thermo electric effects-semimetals-superlattices-Bloch oscillator- zener tunneling.

Unit V: Magnetism

Langevin dia magnetism equation-Quantum theory of dia magnetism of mono nuclear systems-paramagnetism-Ferro magnetic order-curie point and the exchange of integral- Temperature dependence of saturation- magnetization- saturation magnetization at absolute zero-magnons-Quantization of spin waves-thermal excitation of magnons-ferrimagnetic order-Curie temperature and susceptibility of ferrimagnets- iron garnets- anti ferro magnetic order-susceptibility below the neel temperature-antiferro magnetic magnons.

Text Books:

1.Charles Kittel, Introduction to Solid state Physics, Wiley, 7th Edition, 1995.

Unit	Book No.	Page Number
I	1	33-41,49-67
II	1	163-181
III	1	89-102
IV	1	185- 187,205-218
V	1	297-302,321-344

Books for Reference:

1. L. V. Azaroff, Introduction to Solids (McGraw Hill), 9th Reprint, Newyork.
2.P.K.palanisamy, Solid State Physics, 2013 Reprint, Scitech publications Private Ltd, Chennai.
3. H.C.Gupta , Solid State Physics, II Edition, Vikas Publishing home Ltd, Noida.
4. R.L.Singhal, Solid State Physics, KedarNath and Ram Nath publishers, Meerut.
5. M.Ali Omar,Elementary Solid state Physics, 1975, Addison-Wesley Pub. Co. edition

SEMESTER - IV			
Core - XX	**Nuclear and Particle Physics**		
Code :19PPHC43	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Vision:

To enhance the knowledge of nuclear reactor, bombs and the elementary particles

Mission:

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

Course Outcome:

CO No.	Upon completion of this course, students will be able to	PSO 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	Explain the different types of nuclear models and their properties	6	Un
CO 4	Discuss the nuclear forces and the theories related to it	1	Un
CO 5	Classify the types of elementary particles	1	Un
CO 6	Distinguish the fission and fusion	1	An
CO 7	Understand the deuteron properties and reactions	2	Un
CO 8	Explain the origin of various terms in nuclear physics	1	Un

SEMESTER - IV			
Core - XX	Nuclear and Particle Physics		
Code :19PPHC43	Hrs/Week: 5	Hrs/Semester: 75	Credits: 4

Unit I: Theories of Decay

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

Unit II: Nuclear reaction

Introduction of nuclear reaction-Conservation laws-Q value equation -Theories of nuclear reaction- Compound nucleus-Reciprocity theorem- Direct reactions- Theory of stripping and pick up reactions-Statistical theorey 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- Theory of Nuclear Fission and The Liquid Drop Model- 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- SU (2) and SU (3) symmetries-baryon octet-Meson octet-Baryon decouplet - Gellmann-Okubo mass formula-Quarks.

Text Book:

1 M. L. Pandya and R. P. S. Yadav, Elements of Nuclear Physics, Revised Reprint 2008,KedarNath& Ram Nath publications, Meerut.

2. D. C. Tayal, Nuclear Physics,Reprint 1985, Himalaya Publishing House.

Unit	Book No.	Page Number/ Section
I	1	7.5, 8.4-8.8
II	1	11.1, 11.2 ,11.9-11.13
III	1	5.2, 5.4, 12-12.3, 12.6-12.9
IV	1	4.1-4.3, 4.5, 4.8, 4.9, 4.11
V	2	18.2-18.4, 18.18. 18.19

Books for Reference:

1. Irving Kaplan, Nuclear Physics, Nineteenth Reprint, Second Edition,Addision-Wesley publishing company, USA.
2. R.C. Sharma, Nuclear Physics, Sixth revised edition, K.Nath& Co Publications, Meerut.
3. V.Devanathan, Nuclear Physics, Revised Reprint 2008, Narosa Publishing,New Delhi.

SEMESTER - IV			
Elective - I A	**Bio-Medical Instrumentation**		
Code :19PPHE41	**Hrs/Week: 3+**	**Hrs/Semester: 45**	**Credits: 3**

Vision:

To enable students to understand the working principle and the utility of advanced biomedical instruments

Mission:

To enhance the knowledge of students about Human physiological systems and transducers, Bio-Potential Recorders, Physiological Assist Devices and Operation Theatre Equipments, Safety Instruments and Advances In Biomedical Instrumentation through detailed study of relevant theory

Course Outcome:

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO 1	define resting and action potentials	1	Re
CO 2	list the uses of electrode paste	1	Re
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	explain internal and external pacemakers	1	Un
CO 6	describe the working of different kinds of radiation monitoring instruments	1	Un
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 - IV			
Elective - I A	**Bio-Medical Instrumentation**		
Code :19PPHE41	**Hrs/Week: 3+**	**Hrs/Semester: 45**	**Credits: 3**

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

Unit	Book no.	Sections
I	1	1.2,1.5,2.2, 2.4 -2.4.4,2.5-2.5.7
II	1	4.1,4.2,4.3,4.3.1, 4.3.2,4.3.4, 4.3.5 ,4.4, 4.4.1, 4.4.2,4.4.5,4.5.1, 4.5.2
III	1	5.1, 5.2,5.2.1,5.2.2, 5.2.3,5.8, 6.8,6.9
IV	1	9.1 – 9.6
V	1	10.1-10.6,10.7, 10.10

Text Book:

1. Dr.M.Arumugam, Biomedical Instrumentation, Tenth reprint 2013, Anuradha publications, Chennai.

SEMESTER -IV			
Elective - I	**B**	**Laser and its Types**	
Code : 19PPHE41	**Hrs/Week: 3+**	**Hrs/Semester: 45**	**Credits:3**

Vision

To present the various aspects of the foundations, designs, operation and applications of laser along with the fundamentals of light matter interaction.

Mission

To gain a good knowledge about the building blocks of lasers and a significantly enhanced understanding of how lasers work and which type of lasers are most relevant for specific performance and subsequent applications.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO 1	Recall the forms of Polarisation modifiers	1	Re
CO 2	Explain the laser Exposition Pumping methods	1	Un
CO 3	Examine the confinement of laser beam with resonator	1	An
CO 4	Design the basic structure of p-n junction laser	1	Cr
CO 5	Interpret population inversion by the method of collision	1	Ev
CO 6	Compare semiconductor and gas lasers	1	Un
CO 7	Identify plasma and non-plasma schemes	1	Ap
CO 8	Find the scientific and historical origin of laser	1	Re

SEMESTER -IV			
Elective - I B	**Laser and its Types**		
Code : 19PPHE41	**Hrs/Week: 3+**	**Hrs/Semester: 45**	**Credits:3**

Unit 1: Peculiar Properties of Laser Light

Light waves – Monochromaticity – Brightness – Directionality – The laser Speckle Pattern – Light Interference – Coherence-Correlation – Measuring coherence – The Fabry-Perot Interferometer – The Michaelson Interferometer – Polarisation – Forms of Polarisation – Polarisation Modifiers.

Unit 2: Types of Lasers

Laser Exposition Pumping Methods – Photodissociation Laser – Ion and Atomic Laser – Molecular Laser – Electroionisation Laser – Chemical Laser – Plasma Laser – Confinement of Beam with Resonator.

Unit 3: Semiconductor Lasers and Gas Laser

Introduction – Basic concepts – Threshold Condition for Oscillation – Basic Structure of (p-n) Junction Laser – Confinement of Electromagnetic Radiation in p-n Junction – Quantum well Lasers – Introduction to Gas Laser – Population Inversion by Collision – Energy Levels of Helium and Neon – Design of He – Ne laser – CO_2 Laser

Unit 4: Far Ultraviolet and X-Ray Lasers

Introduction – Mossbauer Line Narrowing – Survey of Current XUV Laser – Non Plasma Schemes – Plasma Schemes: Collisionally Pumped Ne- like Se – X-Ray Laser Cavity – Uses of X-Ray Lasers.

Unit 5: Highlights in the Development of Laser

Laser: An Optical Achievement – Scientific and Historical origin of Laser – Highlights with Ammonia Beam – Analogous Phenomena in Nature – Einstein's Relation – Stimulated Emission, Population Inversion and Gain – Three Levels System – Properties of Laser Light

Text Books:

1. B M K Prasad, LASERS Techniques and Applications.

Unit	Book No.	Chapters / Sections
I	1	2.1 - 2.7
II	1	3.1 - 3.8
III	1	6.1 - 6.6, 4.1 – 4.4, 4.12
IV	1	12.1 – 12.7
V	1	8.1-8.8

Books for Reference:

1. John Gowar, Optical Communication System, Second Edition
2. John M Senior, Optical Fibre Communications Principles and Practice, Second Edition
3. Dr. R. K. Kar, Optics (Classical & Quantum)

SEMESTER - IV			
Core XXI	**Project**		
Code :19PPHP41	**Hrs/Week: 7+**	**Hrs/Semester:105**	**Credits: 8**

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

Books for Reference:

1. Ariponnammal, S. and Natrajan, S.(1994)'transport phenomena of Sm Sel – 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 f or Reference :

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

SEMESTER - IV			
Core XVI Practical - III	**C++, Microprocessor& Microcontroller**		
Code :19PPHCR3	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

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 XVII Practical IV Electronics -II			
Code : 19PPHCR4	**Hrs/Week:- 6**	**Hrs/Semester:- 90**	**Credits:4**

(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 V converter ,V to I converter and 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 circuits using PCB
13. Construction of a series voltage regulator using transistor
14. Construction of II order active filters(low pass, high pass and band pass) using IC 741
15. UJT Characteristics and relaxation oscillator