MANNAR THIRUMALAI NAICKER COLLEGE

PASUMALAI, MADURAI– 625 004

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

(Re-accredited with 'A' Grade by NAAC)

M.Sc., Physics

SYLLABUS AND REGULATIONS

UNDER
CHOICE BASED CREDIT SYSTEM (CBCS)
(For those who joined during 2018-2019 and after)

Regulations

Eligibility condition for admission

For admission to Post Graduate Programmers (P.G) a candidate should have passed the 3years degree course (under 10 + 2 + 3 pattern) (B.Sc., Physics) recognized by the university as equivalent there to.

Duration

Two years. Each year consists of 2 semesters. The duration of a semester is 90 working days.

Attendance

75% of the classes in each semester shortage of attendance can be condoned as per existing university rules.

Evaluation procedure:

A mark Statement with CGPA = $\frac{\sum(MarksXcredits)}{\sum(Credits)}$

Where the summations are over all paper appeared up to the current semester.

Examinations: 3 hours duration. Total marks 100 for all papers
External Internal ratio 75:25 with 2 Internal tests.

The scheme of Examination

The components for continuous internal assessment are:

Two tests and their average --15 marks

Seminar /Group discussion --5 marks

Assignment --5 marks

Total --25 marks

Pattern of the question paper (Summative Examinations)

The question paper may have 3 parts.

Duration of the Summative Examinations is 3 hours

The components for continuous internal assessment are:

Part –A

Six multiple choice questions (answer all) 6 x01= 06 Marks

Part –B

Two questions (‘either …. or ‘type) 2 x 07=14 Marks

Part –C

One question out of two 1 x 10 =10 Marks

Total 30 Marks

Pattern of the question paper for the Summative Examinations:

Note: Duration- 3 hours

Part –A

Ten multiple choice questions 10 x01 = 10 Marks

(No Unit shall be omitted; not more than two questions from each unit.)

Part –B

Five Paragraph questions (‘either …. or ‘type) 5 x 07 = 35 Marks

(One question from each Unit)

Part –C

Three Essay questions out of five 3 x 10 =30 Marks

(One question from each Unit)

Total 75 Marks

Minimum Marks for a Pass

A) Theory :

1. 50% of the aggregate (Internal +Summative Examinations).
2. No separate pass minimum for the Internal Examinations.
3. 34 marks out of 75 is the pass minimum for the Summative Examinations.

B) Practical :

1. No separate pass minimum for internal
2. 45% is the pass minimum for the External
3. 50% of the aggregate (external + internal)

C) Project :

1. No separate pass minimum for internal
2. 45% is the pass minimum for the External
3. 50% of the aggregate (external + internal)
4. Minimum of 25 pages in the project work excluding
    1. Introduction
    2. Reference
    3. Bibliography
    4. Tables
    5. Graphs

PROGRAMME SPECIFIC OUTCOMES

PSO1: To enable the studies to Learn different theoretical papers such as mathematical physics, classical and statistical physics and Quantum Mechanics for the strong base for higher studies.

PSO2: To enable the studies Solve real problems with the help of the formula and concepts studied.

PSO3: To enable the studies Study physical phenomena and their interpretations for regular uses.

PSO4: To enable the studies Constrict equipments to carryout experiments for studying the characterizations.

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COURSE PATTERN

S.No	Subject / Semester	1	2	3	4	5	6	Total Hours	Total Credits
1	I	Core 6(5)	Core 6(5)	Core 6(5)	Elective 6(4)	Prac 3(0)	Prac 3(0)	30	19
2	II	Core 6(5)	Core 6(5)	Core 6(5)	Elective 6(4)	Prac 3(3)	Prac 3(3)	30	25
3	III	Core 6(5)	Core 6(5)	Core 6(5)	NME 6(4)	Prac 3(0)	Project 3(0)	30	19
4	IV	Core 6(5)	Core 6(5)	Core 6(5)	Elective 6(4)	Prac 3(4)	Project 3(4)	30	27
TOTAL								**120**	**90**

SEMESTER-III							
Subject Code	**Subjects**	**No. of Course**	**Hours /week**	**Credits**	**Maximum Marks**		
					Int	**Ext**	**Total**
18PPHC31	Solid State Physics – I	1	6	5	25	75	100
18PPHC32	Quantum Mechanics – II	1	6	5	25	75	100
18PPHC33	Electrodynamics	1	6	5	25	75	100
18PPHN31	**Non Major Elective** Nanotechnology	1	6	4	25	75	100
18PPHCP3	Practical – III	-	3	-	-	-	-
18PPHPR1	Project /Review of recent aspects of physics	-	3	-	-	-	-
TOTAL		**4**	**30**	**19**	**100**	**300**	**400**

SEMESTER-IV							
Subject Code	**Subjects**	**No. of Course**	**Hours /week**	**Credits**	**Maximum Marks**		
					Int	**Ext**	**Total**
18PPHC41	Solid State Physics – II	1	6	5	25	75	100
18PPHC42	Nuclear Physics	1	6	5	25	75	100
18PPHC43	Molecular Spectroscopy	1	6	5	25	75	100
18PPHE41 18PPHE42 18PPHE43	**Elective** Astro Physics Network and communications Advanced Optics	1	6	4	25	75	100
18PPHCP3	Practical – III	1	3	4	40	60	100
18PPHPR1	Project /Review of recent aspects of physics	1	3	4	40	60 (40+20)	100
TOTAL		**6**	**30**	**27**	**180**	**420**	**600**

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Programme	**: PG**	**Part III**	**: Core**
Semester	**: III**	**Hours per week**	**: 6**
Subject Code	**: 18PPHC31**	**Credit**	**: 5**

SOLID STATE PHYSICS – I

Course Outcomes:
CO1: To Study the concept of crystal structures.
CO2: To understand the different type of bonds in a crystals.
CO3: To get knowledge of vibration of molecules.
CO4: To know about the Fermi gas and Fermi surfaces.

Unit – I Crystal structure: Periodic arrangements of atoms: Concepts of a lattice - lattice translation vectors- primitive lattice cell two and three dimensional lattice types-Miller indices of crystal planes- simple crystal structures like Sodium Chloride, Cesium Chloride, hexagonal and face centered close packed structures - diamond structure and cubic zinc sulphide structure.

Wave diffraction and the reciprocal Lattice: Diffraction of waves by crystals- Bragg's law- reciprocal lattice to sc, bcc and fcc lattices- Fourier analysis of the basis and structure factors of bcc and fcc lattices.

Unit –II Crystal binding and Elastic constants: Inert gas crystals- Van der waals-London interaction-repulsive interaction- ionic crystals - covalent crystals - metallic crystals- hydrogen bonds - atomic radii-analysis of elastic strains- Dilation- Stress components - elastic compliance and stiffness – constants – elastic energy density – elastic stiffness constant of cubic crystal- Bulk modulus and compressibility - elastic waves in cubic crystals [1 0 0] & [1 1 0] directions.

Unit – III Phonons I: Crystal vibrations: Vibrations of linear mono atomic and diatomic basis-quantization of elastic waves- phonon momentum.

Phonons II – Thermal properties**:** Planck distribution - density of states in one and three dimensions - Einstein and Debye theories of specific heat- anharmonicity of lattice vibrations-thermal expansion- Thermal conductivity - Normal Umklapp processes.

Unit –IV Free electron Fermi gas: Energy levels in one dimension- Fermi Dirac distribution for a free electron gas- periodic boundary condition and free electron gas in three dimension - Heat capacity of the electron gas- Ohm's law- Matthiessen rule - Hall effect- Wiedmann - Franz law-

Energy Bands: Nearly free electron model- Bloch function – Kronig-Penny model- approximate solution near a zone boundary.

Unit –V Fermi surfaces and metals: Reduced and periodic zone schemes- construction of Fermi surfaces- electron orbits- tight-binding method for energy bands- Wigner -Seitz method and cohesive energy- quantization of orbits in magnetic fields - De Hass-van Alphen effect.

Point defects: Lattice vacancies –diffusion-metals. Color centers: F centers-other centers in alkali halides.

Text Book:

1. Charles Kittel, Introduction to Solid State Physics, John Wiley & Sons, VIIIth Edition Reprint, New Delhi 2015.

Unit I – Chapters 1&2 Unit II – Chapter 3

Unit III – Chapters 4&5 Unit IV – Chapters 6&7

Unit V – Chapters 9&20

Reference Books:

1. S.O. Pillai, Solid State Physics, New Age Publications, New revised sixth edition,New Delhi, 2006.
2. N.W. Aschroft and N.D. Merin, Solid State Physics**,** Holt, Rinehart and Winston Publishers, Third Edition, New York 2016.
3. M.A.Wahab, Solid State Physics, Narosa Publishing House, Third Edition, New Delhi,1999.

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Programme	**: PG**	**Part III**	**: Core**
Semester	**: III**	**Hours per week**	**: 6**
Subject Code	**: 18PPHC32**	**Credit**	**: 5**

QUANTUM MECHANICS – II

Course Outcomes:
CO1: To get the knowledge of the Heisenberg model.
CO2: To understand the concept of scattering cross sections.
CO3: To reveal the theory of relativistic wave equation.
CO4: To understand the effect of symmetries in Quantum mechanics.

Unit-I: Representations, Transformations and Symmetries:

Heisenberg Method - Matrix Representation of Wave Function-Matrix Representation of Operator - Properties of Matrix Elements - Schrödinger Equation in Matrix Form - Eigen Value Problem-Unitary Transformation-Linear Harmonic Oscillator: Matrix Method - Symmetry Transformation - Translation in Space-Translation in Time-Rotation in Space-Space Inversion - Time Reversal.

Unit-II: Angular momentum:

Angular Momentum Operators-Angular Momentum Commutation Relation - Eigen values and Eigenfunction of L^2 and L_z-Eigenvalues of J^2 and J_z - Angular Momentum Matrices -Spin Vectors for Spin(1/2) System - Addition of Angular momentum : Clebsh - Gordan Coefficient

Unit-III: Many electron Atoms:

Indistinguishable particles – Pauli principles – Inclusion of spin – Spin functions for two electrons – Spin functions for three electrons – The helium atom – General field approximation – Thomas-fermi model of the atom – Hartree equation – Hartree-Fock equation.

Unit-IV: Scattering Theory:

Scattering Cross Section-Scattering Amplitude-Partial Waves - Scattering by a Central Potential: Partial Wave Analysis - Scattering by an Attractive Square Well Potential- Breit Wigner Formula - Scattering Length-Expression for Phase Shifts -Integral Equation - Born Approximation - Scattering by a Screened Coulomb Potential - Validity of Born Approximation.

Unit-V: Relativistic Wave Equations:

Klein-Gordan Equation - Interpretation of the Klein - Gordan Equation-Particle in a Coulomb Field-Dirac's Equation for a Free Particle-Dirac Matrices-Covariant Form of Dirac Equation-Probability Density-Plane Wave Solution - Negative Energy States-Spin of the Dirac Particle - Magnetic Moment of the Electron - Spin Orbit Interaction-Radial Equation for an Electron in a Central Potential - Hydrogen Atom.

Text Book:

1. Aruldhas.G, Quantum Mechanics, Second Edition , PHI Learning Private Limited, 2013.

Unit – I

Chapter 6 (Section 6.1 to 6.8) Chapter 7 (Section 7.1 to 7.6)

Unit – II

Chapter 8 (Section 8.1 to 8.9)

Unit – III

Chapter 13 (Section 13.1 to 13.10)

Unit – IV

Chapter 14 (Section 14.1 to 14.4, 14.6 to 14.13)

Unit – V

Chapter 15 (Section 15.1 to 15.14)

Reference Books:

1. Mathews.P.M and Venkatesan.K, A Text book of Quantum Mechanics, Second Edition Tata McGraw Hill Education Private Limited, 2012, New Delhi.
2. Kakani, Quantum Mechanics, Third Edition, Tata McGraw Hill Education Private Limited, 2012, New Delhi.
3. Devanathan.V, Quantum Mechanics, Second Edition Narosa Publishing House Private Ltd., 2011, New Delhi.

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Semester	**: III**	**Hours per week**	**: 6**
Subject Code	**: 18PPHC33**	**Credit**	**: 5**

ELECTRODYNAMICS

Course Outcomes:

CO1: To understand the principles of conservation of charge and superposition in electrostatics
CO2: To determine electric field energy due to charge distribution in a material media
CO3: To analyze the propagation of electromagnetic waves in a material medium
CO4: To study the electromagnetic radiation due to a charge distribution.

UNIT - I ELECTROSTATICS AND ELECTRIC FIELDS IN MATTER

Poisson's equation and Laplace's equation – potential of a localized charge distribution – electrostatic boundary conditions. Work and energy in electrostatics: work done to move a charge - energy of point charge distribution - energy of continuous charge distribution. Laplace's equation: Laplace's equation in one, two, and three dimensions - boundary conditions and uniqueness theorem – conductors and second uniqueness theorem. Separation of variables: Cartesian and spherical coordinates. Multipole expansion: Approximate potentials at large distances - monopole and dipole terms - origin of coordinates in multipole expansions - electric field of a dipole. Polarization: Dielectrics - induced dipoles - alignment of polar molecules. Field of a polarized object: Bound charges - physical interpretation of bound charges - field inside a dielectric.

UNIT - II MAGNETOSTATICS AND MAGNETIC FIELDS IN MATTER

Lorentz force law: Magnetic fields – magnetic forces – currents. Biot-Savart law: Steady currents – magnetic field of steady current. Divergence and curl of **B**: Applications of Ampere's law – comparison of magnetostatics and electrostatics. Magnetic vector potential: Vector potential – magnetostatic boundary conditions – multipole expansion of the vector potential. Magnetization: Diamagnets, paramagnets and ferromagnets - torques and forces on magnetic dipoles – effect of a magnetic field on atomic orbits. Field of a magnetized object: Bound currents – physical interpretation of bound currents – magnetic field inside matter.

UNIT - III ELECTRODYNAMICS AND CONSERVATION LAWS

Maxwell's equations: Ampere's law – magnetic charge – Maxwell's equations in matter – boundary conditions. Charge and energy: Continuity equation -
Poynting's theorem.

UNIT - IV ELECTROMAGNETIC WAVES

Electromagnetic waves in vacuum: Wave equation for **E** and **B** – monochromatic plane waves – energy and momentum in electromagnetic waves. Electromagnetic waves in matter: Propagation in linear media – reflection and transmission at normal incidence – reflection and transmission at oblique incidence. Absorption and dispersion: Electromagnetic waves in conductors – reflection at a conducting surface – frequency dependence of permittivity.

UNIT - V RADIATION AND RELATIVISTIC ELECTRODYNAMICS

Guided waves: Wave guides - waves in a rectangular wave guide – coaxial transmission line. Dipole radiation: Electric dipole radiation – magnetic dipole radiation. Relativistic electrodynamics: Magnetism as a relativistic Phenomenon – field transform – field tensor – electrodynamics in tensor notation – relativistic potentials.

Text Book

Griffiths, D.J., "**Introduction to Electrodynamics**", Third Edition, Prentice Hall of India Pvt. Ltd., 2003, New Delhi.

UNIT I	:	Chapter 2: Sections 2.3.3 to 2.4
		Chapter 3: Sections 3.1, 3.3 and 3.4
		Chapter 4: Sections 4.1 and 4.2
UNIT II	:	Chapter 5: Full except 5.3
		Chapter 6: Sections 6.1 and 6.2
UNIT III	:	Chapter 7: Sections: 7.33 to 7.36
		Chapter 8: Section 8.1
UNIT IV	:	Chapter 9: Sections 9.2 to 9.4
UNIT V	:	Chapter 9: Section 9.5
		Chapter 11: Sections 11.1.1 to 11.1.3
		Chapter 12: Section 12.3

Reference Books

1. Capri.A.Z., and Panat.P.V., "**Introduction to Electrodynamics**", Third Edition, Narosa Publishing House, New Delhi, 2006.
2. Greimer.W., Bromley, D.A., "**Electrodynamics"** Springer Berlin Heidelberg, 2006.
3. Jackson, J.D., "**Classical Electrodynamics**", Third Edition, Wiley India Pvt. Ltd. 2007, New Delhi.
4. Puri, S.P., "**Classical Electrodynamics**", First Edition, Narosa Publishing House Pvt. Ltd., 2011, New Delhi.
5. Shiozawa, T., Fleagle, J., "**Classical Relativistic Electrodynamics**", Springer Berlin Heidelberg, 2006.

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Programme	**: PG**	**Part IV**	**: NME**
Semester	**: III**	**Hours per week**	**: 6**
Subject Code	**: 18PPHN31**	**Credit**	**: 4**

NANOTECHNOLOGY

Course Outcomes:

CO1: To know about the basic concepts of nanotechnology.
CO2: To study the solid state nature of the crystals.
CO3: To acquire the knowledge of nanotubes and nanowires.
CO4: To describe MEMS basic process and manufacturing technologies.
CO5: To discuss nanocomposites synthesis and applications.

Unit - I Basic Concepts of Nanotecnology:

Origin-Fundamental Concepts: Simple to complex- Molecular nanotecnology. Nanomaterials, Bottom up and top down approaches , Bio materials, Speculative. Tools and Techniques: Implications: Health and environmental concerns-regulations. Energy applications: consumer products, economic benefits. Applications: medicine, chemistry and environment, energy, information and communication, heavy industry, consumer goods.

Unit – II Nano Crystal Structure:

Crystal structure and electronic properties-Quasi crystal: mathematical description-physics and material science of quasi crystals. Spin glass: magnetic behavior-model of Sherrington and Kirkpatrick-non-ergodic behavior and applications. Semiconductor device fabrications: wafer, processing, wafer test, device test, die preparation, packaging, list of steps and hazardous materials.

Fullerene: Prediction and discovery-variations. Buckyball: boron buckyball-variations of buckyball. Carbon nanotubes-Properties of fullerenes: Aromaticity, chemistry, solubility, quantum mechanics, safety and toxicity, superconductivity and fullerite.

Unit – III Nanotubes: Types of carbon nanotubes and related structures-properties-syntheses-potential and current applications-boron nitride nanotubes-optical properties-single walled nanotubes-carbon nanotube chemistry-colossal carbon tubes-silicon nanotubes.

Nanowires: Synthesis of nanowires-physics of nanowires-molecular wires-fabrications of nanowires at surfaces -atom chains and nanowires-solar nanowires-efficiency and low cost-nanowire battery.

Unit – IV Micro and nano electro magnetic system: materials for MEMS manufacturing-MEMS basic processes-MEMS manufacturing technologies-MEMS thermal actuator-micro-opto-electromechanical systems-nano electro mechanical systems.

Nanomaterial Synthesis and Applications: Uniformity of nanomaterials-properties-nanoscale iron particles-magnetic nanoparticles- nanoshell particles-nanotoxicity.

Unit – V Oxide Nanoprecurcers: Synthesis of oxide nanoparticles-size determination of nanoparticles -synthesis of low agglomerated nanoprecursors.

Nanocomposites: Applied condition-processing-properties: mechanical-air permeability-reduction in cost. Novel polymers / Inorganic hybrids-resins for composites.

Text book:

WM Breck, Nanotechnology volume 1, CBS Publications & Distributors Pvt Ltd., Ist Edition, 2016.

Unit – I: Chapter 1
Unit –II: Chapters 3 and 4(up to page 75) except 39 to 44
Unit – III: Chapters 5 and 6
Unit – IV: Chapters 8 and 15
Unit – V: Chapters 16 and 21

Reference Books:

1. Richard Boker and Earl Baysen, Nano technology, Wiley Dreamtech India (p) Ltd., Ist Edition, 2005, Bengaluru.
2. Suryanarayanan.C and Koch. C.C - Nano Crystalline Materials- Current Research and Future Directions, Hyperfine Interactions Journal, Ist Edition,2000.
3. Alian, N., “An Introduction to Nanoscience and Nanotechnology”, First Edition, Wiley India Pvt. Ltd., 2015, New Delhi.

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Programme	**: PG**	**Part III**	**: Core**
Semester	**: IV**	**Hours per week**	**: 6**
Subject Code	**: 18PPHC41**	**Credit**	**: 5**

SOLID STATE PHYSICS - II

Course Outcomes:

CO1: To study the concept of superconductivity in metals.
CO2: To get the knowledge of magnetization in bulk materials.
CO3: To bring the detailed ideas of dielectric and ferro electric crystals.
CO4: To understand about various defects and diffusion in metals.

Unit – I : Superconductivity

Meissner effect - Heat capacity - Energy gap - Microwave and infrared properties and isotope effect - Stabilization energy of a superconductor - London theory of Meissner effect - Coherence length - BCS theory - Single particle tunneling DC and AC Josephson effects - Macroscopic quantum interference - High temperature super conductors .

Unit – II : Magnetisation:

Langevin diamagnetism equation and quantum theory of diamagnetism - Quantum theory of para magnetism - Hund's rules - Crystal splitting factor - Van Vleck temperature independent para magnetism.

ferromagnetism: Curie point, Weiss molecular field theory, saturation magnetization - Quantization of spin waves (magnons) and thermal excitation of domain walls and origin of domains - Coercivity and hysteresis.

Unit – III : Plasmas Polaritons Polarons and Exictons:

Longitudinal plasma oscillation - Plasmons - Electrostatic screening - Screened Coulomb potential Mott transition - Screening and phonons in metals - Polaritons and LST relation – Electron - electron interaction - Electron - phonon interaction and polarons - Peierls instability.
Optical process and Excitons: Kramers-Kronig Dispersion - Frenkel and Mott-Wannier excitons - Exciton condensation - Raman Effect in crystals.

Unit – IV : **Dielectrics and Ferro-electrics**

Maxwell's equations- Polarization- Macroscopic electric field- Depolarization field(E_1)- local electric field at an atom –Lorentz field (E_2)- Field of dipoles inside cavity (E_3) – Dielectric

constant and polarizability – Structural phase transitions – Ferro electric crystals – Displacive transitions – Soft Optical phonons – Landau theory of phase transitions – First and Second order– Antiferro electricity – ferro electric domains – Piezo electricity.

Unit – V : Dislocations:

Phenomenon of slip - Edge and screw dislocations - Burgers vectors - Stress fields of dislocations - Strength of alloys - Substitutional solid solutions - Hume - Rothery rules - Elementary theory of order - Kondo effect.

Text book:

Charles Kittel, Introduction to Solid State Physics, JohnWiley & Sons,VIII Edition, 2015, New Delhi.

Unit – I Chapter 10

Unit – II Chapters 11&12

Unit – III Chapters 14&15

Unit – IV Chapter 16

Unit – V Chapters 21 & 22

Reference Book:

1. Philip Phillips, Advanced Solid State Physics, Second Edition, Cambrige University Press, 2012, New York.
2. Singh.R.J, Solid State Physics, First Edition, Pearson, 2012, Chennai.
3. Rudden.M.N and Wilson.J, Elements of Solid State Physics, Second Edition, Wiley Publishers, 1993, New Delhi.

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Programme	**: PG**	**Part III**	**: Core**
Semester	**: IV**	**Hours per week**	**: 6**
Subject Code	**: 18PPHC42**	**Credit**	**: 5**

NUCLEAR PHYSICS

Course Outcomes:

CO1: To acquire the knowledge about the constituents of nucleus.
CO2: To know about detectors for nuclear particles.
CO3: To study the activities of nuclear fission and fusion processes.
CO4: To understand the concepts of Elementary particles.

Unit – I Physical tools and Nuclear reaction:

Detectors for nuclear particles: Proportional counter- Geiger counter- Scintillation counter- Semiconductor detectors-Compton Suppressed Germanium detectors-Cloud and bubble chambers. Particle accelerators: Van de Graaff Generators- Cyclotron-Synchrotron- Betatron. Beta ray Spectrometer.

The Q Equation: Types of nuclear reaction - The balance of mass and energy in nuclear reactions - The Q equation - Solution of the Q equation -Centre of mass frame in nuclear physics.

Unit – II Nucleus and Radioactive decays:

Rutherford scattering and estimation of the nuclear size - Measurement of nucleus radius - Constituents of the nucleus and their properties - Nuclear spin - Moments and statistics.

Alpha Rays: Range of alpha particles - Disintegration energy of spontaneous alpha decays- Alpha decay paradox - Barrier penetration.

Beta Rays: Continuous beta - Ray spectrum - Difficulties encounter to understand it- Pauli's neutrino hypothesis - Fermi's theory of beta decay - The detection of neutrino- Parity non - Conservation in beta decay.

Introduction to Gamma Emission: Gamma - ray emission - Selection rules - Internal conversion - Nuclear isomerism.

Unit – III The liquid drop of Nucleus and Nuclear fission:

Binding energies of nuclear - Plot of B/A against A - Weizsachers semi - Empirical mass formula - Mass parabolas: Prediction of stability against β decay for members of an isobaric family - Stability limits against spontaneous fission - Barrier penetration - Decay probabilities for spontaneous Fission - Nucleon emission.

Nuclear Energy: Neutron induced fission - Asymmetrical fission - Mass yield - Emission of delayed neutrons by fission fragments - Energy released in the fission of 235 U - Fission of lighter nuclei - Fission chain reaction -Neutron cycle in a thermal nuclear reactor - Nuclear reactors.

Unit – IV Shell Model of Nucleus:

The evidence that led to the shell model - Main assumptions of the single particle shell model - Spin-orbit coupling of an electron bound in an atom – Spin - orbit coupling in nuclei for a single particle shell model – Parabolic potential – The single-particle shell model - Square well potential - Prediction of the shell model - The collective model of a nucleus.

Unit – V Elementary Particles :

Classification of elementary particles - Particle interactions (Gravitational, electromagnetic, strong, weak) - Conservation laws - Invariance under charge, parity , C.P, C.P.T - Electrons and positrons - Protons and anti- protons - Neutrons and anti- neutrons - Neutrinos and anti- neutrinos - Meson: muons, Pions, K- meson ,η - mesons, Hyperons : Λ -, Ξ, ∑, Ω- hyperons. Quarks.

Text books:

1. Patel. S.B, Nuclear Physics - An Introduction, II Edition, New Age International (P) Limited, 2008, Chennai.
2. Tayal, D.C, Nuclear Physics, Revised and Enlarged Edition, Himalaya Publishing House, 2008, New Delhi.

Unit – I (From Text book – 1)

Chapter 1(Section 1.1.1 to 1.1.5)

Chapter 3(Section 3.1 to 3.6)

Unit – II (From Text book – 1)

Chapter 4 (Section 4.I.1 to 4.II.3, 4.IV.1 to 4.IV.4)

Unit – III (From Text book – 1)

Chapter 5 (Section 5.1 to 5.7)

Chapter 6 (Section 6.1 to 6.9)

Unit – IV (From Text book – 1)

Chapter 7 (Section 7.1 to 7.9).

Unit – V (From Text book – 2)

Chapter 18 (Section 18.1 to 18.15 & 18.19).

Reference Books:

1. Roy. R.R and Nigam. B.P, Nuclear Physics (Theory and experiment), Third Edition, Wiley Eastern Ltd, 2006.
2. Pandya. M.L, Yadav. R.P.S and Amiya Dash, Elements of Nuclear Physics, Eighth Edition, Kedar nath Ram nath, 2018, Meerut.
3. Devanathan.V, Nuclear Physics, Second Edition, Narosa publishing House Pvt, Ltd., 2011, New Delhi.

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Programme	**: PG**	**Part III**	**: Core**
Semester	**: IV**	**Hours per week**	**: 6**
Subject Code	**: 18PPHC43**	**Credit**	**: 5**

MOLECULAR SPECTROSCOPY

Course Outcomes:
CO1: To study the experimental methods for various spectroscopy
CO2: To get the knowledge of spectrum analysis
CO3: To know about the applications of molecular spectroscopy
CO4: To understand spin resonance spectroscopy.

Unit – I Microwave spectroscopy:

Classification of molecules – Interaction of radiation with rotating molecule – Rotational spectra of rigid diatomic molecules – Isotope effect – Intensity of rotational lines – Non – rigid rotator – Linear polyatomic molecules – Symmetric top molecules – Asymmetric top molecules – Stark effect – Quadrupole hyperfine interaction Microwave Spectrometer - Information derived from rotational spectra.

Unit – II Infrared spectroscopy:

Vibration energy of a diatomic molecule – Infrared selection rules – Vibrating diatomic molecule – Diatomic vibrating rotator – Asymmetry of rotational – vibrational band – Vibrations of polyatomic molecules – Hydrogen bonding – Rotational –Vibrational spectra of polyatomic molecule – IR Spectrometer – Sample handling technique – FTIR Spectroscopy -Applications.

Unit – III Raman spectroscopy:

Theory of Raman scattering – Rotational Raman spectra – Vibrational Raman spectra – Mutual Exclusion Principle – Raman spectrometer – Sample handling techniques – Structure determination using IR and Raman spectroscopy – Industrial applications – Resonance Raman scatteting – Raman microscopy.

Unit – IV Electronic spectra of molecules:

Vibrational coarse structure – Vibrational analysis of band systems – Progressions and sequences – Information derived from vibrational analysis – Franck – Condon Principle – Rotational fine structure of Electronic Vibration spectra – The FortratParabolae – dissociation – Predissociation – Photoelectron spectroscopy.

Unit – V Spin – resonance spectroscopy:

Nuclear Magnetic Resonance: Magnetic properties of nuclei – Resonance condition – NMR Instrumentation – Relaxation process – Bloch equations – Chemical shift – Indirect Spin – Spin Interaction – Interpretation of certain NMR Spectra - Electron Spin Resonance: Principle of ESR – ESR Spectrometer – Hyperfine structure.

Text book:

G. Aruldhas, Molecular Structure and Spectroscopy, II Edition, PHI Learning Pvt Limited, New Delhi, 2011.

Unit – I
Chapter 6(Section 6.1 to 6.6, 6.8 to 6.12, 6.14, 6.15)
Unit – II
Chapter 7 (Section 7.1, 7.3 to 7.7, 7.10, 7.11, 7.16 to 7.19)
Unit – III
Chapter 8 (Section 8.1 to 8.7, 8.12, 8.15 to 8.17)
Unit – IV
Chapter 9 (Section 9.1 to 9.12).
Unit – V
Chapter 10(Section10.1 to 10.3, 10.5 to 10.9, 10.20).
Chapter 11 (Section 11.1 to 11.3, 11.5)

Reference Books:

1. Michael, H. J., Modern Spectroscopy , Fourth Edition , Wiley India Pvt. Ltd., 2014, New Delhi.
2. Yadav. M. S, A Text book of Spectroscopy, Anmol Publications Pvt. Ltd., 2008, New Delhi.
3. Sindhu. P. S , Molecular Spectroscopy, First Edition , PMH, 1988, New Delhi.

MANNAR THIRUMALAI NAICKER COLLEGE(Autonomous)
DEPARTMENT OF PHYSICS
(For those who joined in 2018-2019 and after)

Programme	**: PG**	**Part III**	**: Elective**
Semester	**: IV**	**Hours per week**	**: 6**
Subject Code	**: 18PPHE41**	**Credit**	**: 4**

ASTRO PHYSICS

Course Outcomes:

CO1: To acquire the knowledge about the Classification of Stars.
CO2: To know about Sun and Atmosphere of Stars.
CO3: To study about the Multiple Stars.
CO4: To understand the classification of Variable Stars.

Unit – I Spectral Classification of Stars

Bolzmann's formula – Saha's Equation of thermal ionization. Harvard system of spectral classification: Hendry draper (HD) Catalogue luminosity effect on stellar spectra – Importance of ionization theory in Astrophysics – Spectroscopic Parallax – Hertzsprung – Russell diagram.

Unit – II The Sun-

Sun – A Typical Star. The Photosphere: Limb-darkening – Solar Granulation – Faculae – The chromospheres – Solar Corona – Prominences – The eleven year solar cycle and Sun spots – the solar Magnetic fields – Theory of Sun spots – Solar Flares – Radio emission from the Sun – solar wind - the Solar Neutrino puzzle.

Unit – III Atmosphere of Stars

Some important definitions **–** The equation of transfer – The solution of the equation of the transfer – Process of absorption in Stellar Atmosphere – Continuous absorption by the negative hydrogen ion in cooler stars – Analysis of spectral line Broadening – The curve of growth – Stellar Temperatures – The chemical composition of Stars.

Unit – IV Binary and multiple Stars

Visual Binary – spectroscopic Binary – Eclipsing binary – Multiple Stars – Origin of binary stars – Stellar masses and mass luminosity relation – mass transfer in close binary systems.

Unit – V Variable stars

Classification of variable stars – The Cepheid group of variables – Period luminosity relations of Cepheid Group of variables – RV Tauri Variables – Long Period Variables (Mira – Type Variables) Red Irregular and semi regular variables –Beta Canis Majoris Variables (β Cephei Stars) – U Geminorum Stars –(SS Cygni or Dwarf Novae) – Flare Stars – A Survey of variable stars as a whole – The Pulsation theory of variable stars.

Text book:

1. Baidyanath Basu, Tanuka Chattopadhyay, Sudhindra Nath Biswas, An Introduction to Astro Physics, Second Edition Asoke K. Ghosh, PHI Learning PVT Ltd, New Delhi – 110001, 2011.

Unit –I : Chapter 4

Unit –II : Chapter 5

Unit –III: Chapter 6

Unit –IV : Chapter 7

Unit –V: Chapter 8

Reference Books

1. Jean Dufay, Introduction to Astro Physics, Dover Publications, INC, 2012, New Delhi.
2. Badmanabhan, Theoratical Astro Physics, Volume - I, Cambridge University Press, 2010. Chennai – 600031.
3. Abhyankar. K. D, Astro Physcis: Stars and galaxies, Universities Press, 2001, Hyderabad – 500 029,

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Programme	**: PG**	**Part III**	**: Elective**
Semester	**: IV**	**Hours per week**	**: 6**
Subject Code	**: 18PPHE42**	**Credit**	**: 4**

NETWORK AND COMMUNICATIONS

Course Outcomes:
CO1: To know the concepts of network topology
CO2: To understand the Internet and data communications systems
CO3: To study the Microwave Communication process
CO4: To familiarize tele Communication through Satellite.

Unit – I New technologies in IT:

E-Commerce and E-Business-Web design: creating web site-web hosting-web promotion. Web Technologies: HTML-XHTML-CSS-JAVA script-PHP-data base on the web. Computer security: Types of computer crimes- physical access restrictions- passwords- Fire wells, codes, shields and Audits through authorized and unauthorized access. Cryptography: Computer virus, bombs and worms, multimedia applications- Virtual reality.

Unit – II: Internet and Data communication

Introduction to Internet – World Wide Web – advantages of Internet – Internet Protocal– Internet software – Bowsers – TCP, FTP, HTTP, and WAIS. communication network architecture – Standard organisations - Data communication circuits - netwoks – serial, plarallel data transfer.

Unit – III Microwave Communications:

Microwave Communication – Advantages and Disdavantages of microwave transmission – Analog versus Digital microwave – Propagation of Microwaves –Diversity– Production switching arrangements– FM microwave radio stations– Line of sight path Characteristics

Unit –IV: Telecommunications:

Communication processors: Modems-multiplexers, concentrators and controllers. Communication Media- Twisted-pair wires- Coaxial cables-fiber optics cables-microwaves systems- communications satellites. Tele communication Softwares: Functions. Types of Newtorks

: LAN,WAN.Network topologies: Star ,ring, Linear bus tree. Network Protocals-network architecture.

Unit – V : Satellite communications:

Satellite Communication – Kepler's law- Satellite orbits – orbital patterns– Geo stationary Satellites –Antenna look angels – orbital spacing – satellite systems – link modules.

Text books

1. Alexis Leon & Mathews Leon, Fundamentals of Information Technology, Second Edition, Vikas Publishing House Pvt Ltd, 1999, Noida.
2. Wayne Tomasi, Advanced Electronic Communications system, VI Edition, Prentice Hall of India Pvt Ltd, 2004, New Delhi.

Unit I-(From text book 1)

Chapter-27-36(all sections)
Unit -2-(From text book 1)
Chapter-21(all sections)
(From text book 2)
Chapter – 3(3.1-3.10)
Unit- 3 (From text book 2)
Chapter -13(13.1-13.11)
Unit-4 (From text book 1)
Chapter -18(all sections)
Unit-5(From text book 2)

Chapter -14(14.1-14.9)

Reference Books:

1. Rajaraman.V, Fundamentals of computers, II Edition, Prentice Hall of India Pvt Ltd, 1998, New Delhi.
2. Behrouz A.Forouzan, Data Communications and Networking, Fourth Edition, McGraw Hill Higher Education, 2007, New Delhi.
3. Brijendra Singh, Data Communications and Computer Networks, Fourth Edition, Prentice Hall India Learning Private Ltd., 2014, New Delhi.

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Programme	**: PG**	**Part III**	**: Elective**
Semester	**: IV**	**Hours per week**	**: 6**
Subject Code	**: 18PPHE43**	**Credit**	**: 4**

ADVANCED OPTICS

Course outcomes:

CO1: To acquire the knowledge about the magneto and electro optic effects.
CO2: To know about laser principles and types.
CO3: To study the holographic formation and applications.
CO4: To understand the principles and applications of fiber and non-linear optics and their applications.

Unit – I : Magneto – optics and Electro – optics :

Determination of magnetic rotation – Classical theory of Faraday effects - Electro-optic effect – Kerr electro – optic effect – Determination of speed of light by Kerr cell – Significance of the velocity of light.

Unit – II: Lasers

Absorption and emission of radiation by matter – Einstein's theory : A and B co-efficient —– Population inversion : different methods – Basic laser system : Main components _ Optical resonator : Q- value – Threshold condition for laser action – An alternative expression for threshold condition – Typical lasers: Pulsed Ruby laser – Continuous He-Ne laser – CO_2 laser – Nd :YAG laser – Semiconductor laser – Properties and uses of a laser beam.

Unit – III :Holography

Basic principle of holography – Recording of a hologram – Reconstruction of image from hologram – Theory of holography: A short mathematical note – Features of hologram – Some advances in holography – Applications of holography.

Unit – IV : Fibre Optics : Basic principle of fibre optics

Structure and classification – Acceptance angle and numerical aperture – Fractional index change – Skip distance : Number of internal reflections – Ray path in a graded – index (GRIN) fibre – Dispersion: Intermodal dispersion – Intramodal dispersion - Fibre optic sensors – Losses in optical fibre – Mechanisms of attenuation – Fibre optics communication system – Advantages of optical fibre communication – Applications of fibre optics.

Unit – V : **Non- linear optics**

Linear and non-linear optics – Harmonic generation – Wave propagation and momentum conservation – Momentum mismatch: Phase matching condition, angle tuning – Sum and difference of frequency generation – Self-focusing phenomenon of light – Stimulated Raman scattering.

Text book:

1. B. Gupta, Modern Optics, Third Edition, Arunabha sen Books & Allied (P) Ltd., New Delhi 2012.

Reference Books

1. Grant R. Fowles, Introduction to Modern optics, Second Edition, Dover Publications, INC., 2012, New York.
2. Guenther. B.D, Modern optics, Second Edition, Oxford University Press, 2015, New York.
3. S.He. Guang, Non- linear optic and Photonics, Oxford University Press, 2014, New York.

Unit I- (Chapter - 19)
Unit -2-(Chapter – 21.1 to 21.14)
Unit- 3 (Chapter – 21.18 to 21.21)
Unit-4 Chapter -22.1 to 22.11)
Unit-5 Chapter –(24.1 to 24.8)

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
DEPARTMENT OF PHYSICS
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Programme	**: PG**	**Part III**	: **Practical**
Semester	**: III & IV**	**Hours per week**	**: 03**
Subject Code	**: 18PPHCP3**	**Credit**	**: 04**

PRACTICAL - III

ANY 12 EXPERIMENTS

1. IC 555 Timers – Square wave generation, Scimit trigger or triangle wave generation
2. Solving simultaneously equations (Two variables only) using IC 741.
3. Half adder and Full adder circuits using ICs.
4. Optimizations of Boolean functions – Karnaugh Map Method.
5. Microprocessor based experiments – Addition, Subtraction and Mulplication.
6. Microprocessor based experiments- Ascending and Desending order
7. Study of basic the characteristics of op-amp
8. Construction of op-amp inverting & non-inverting amplifiers and study of their frequency response curves.
9. Construction of op-amp differentiator and integrator and study of their frequency response curves.
10. Construction and study of schematic trigger and its hysteresis.
11. Determination of Boltzmann Constant (K) and error estimation.
12. Laser based diffraction experiments
13. Refractive index of liquids using LASER
14. Refractive index of liquids using Newton's rings
15. Measurement of conductivity of thin film using four probe method.

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
DEPARTMENT OF PHYSICS
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Programme	**: PG**	**Part III**	: **Project**
Semester	**: III & IV**	**Hours per week**	**: 3**
Subject Code	**: 18PPHPR1**	**Credit**	**: 4**

PROJECT WORK AND VIVA-VOCE

Course Outcomes:

CO1: To develop the ability of the students to prepare a project.

CO2: To get clear idea about the new concepts in our field apart from the syllabus.

CO3: To discuss the analytical instrumentations used.

CO4: To analyse the social use of the project.

Regulations for the Project Report

- Evaluation method for project:

	Max Marks		Credits
	Internal	External	
Project Evaluation	40	40	
Viva Voce		20	
Total	100		4

- Internal examiners are the respective supervisors.
- Viva voce examination to be evaluated by the external examiner.
- The report of the project must be in the prescribed form. It should be typed neatly in MS word with the equation editor or using Latex. The font size of the letter should be 13 or points with double space.
- The format of the project should have the following components.

First page should contain:

Title of the project report.

Name of the candidate

Register number.

Name of the supervisor.

Address of the institution

Month and year of submission.

1. Contents.
2. Declaration by candidate
3. Certificate by supervisor
4. Acknowledgement
5. Preface
6. Chapter 1 – Preliminaries.
7. Other chapters
8. References

The number of pages in the project may be 40 to 50

Each page should contain atleast 18 lines.

Four copies of the project report with spiral binding should be submitted.