**ANNEXURE 18B05**

# V.V. VANNIAPERUMAL COLLEGE FOR WOMEN

(Belonging to Virudhunagar Hindu Nadars)
An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
*Re-accredited with 'A' Grade (3rd Cycle) by NAAC*
VIRUDHUNAGAR - 626 001

## CHOICE BASED CREDIT SYSTEM
## REGULATIONS AND SYLLABUS
## (with effect from Academic Year 2018 - 2019)

V.V. Vanniaperumal College for Women, Virudhunagar, established in 1962, offers 19 UG Programmes, 14 PG Programmes, 6 M.Phil. Programmes and 3 Ph.D. Programmes. All these programmes, except Ph.D. Programmes, have been framed as per the guidelines given by UGC under Choice Based Credit System (CBCS).

The Departments of Commerce, English and History upgraded as Research Centres offer Ph.D.Programmes as per the norms and regulations of Madurai Kamaraj University, Madurai and do not come under the purview of CBCS.

## CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed Courses. The CBCS is followed as per the guidelines formulated by the UGC. The students' performance will be evaluated based on the uniform grading system. Computation of the Cumulative Grade Point Average (CGPA) is made to ensure uniformity in evaluation system.

## List of Programmes in which CBCS/Elective Course System is implemented

### UG PROGRAMMES

| | | |
|---|---|---|
| Arts & Humanities | : | History (E.M. & T.M.), English, Tamil |
| Physical & Life Sciences | : | Mathematics, Zoology, Chemistry, Physics, Biochemistry, Home Science - Nutrition and Dietetics, Costume Design and Fashion, Microbiology, Biotechnology, Computer Science, Information Technology, Computer Applications. |
| Commerce & Management | : | Commerce, Commerce with Computer Applications, Commerce with Professional Accounting Business Administration |

**PG PROGRAMMES**

| | | |
|---|---|---|
| Arts & Humanities | : | History, English, Tamil |
| Physical & Life Sciences | : | Mathematics, Physics, Biochemistry, Food Processing & Quality Control, Chemistry, Zoology, Computer Science, Information Technology, Computer Applications (MCA*) |
| Commerce & Management | : | Commerce, Business Administration (MBA*)<br>* AICTE approved Programmes |

**PRE-DOCTORAL PROGRAMMES (M.Phil.)**

| | | |
|---|---|---|
| Arts &Humanities | : | History, English, Tamil |
| Physical & Life Sciences | : | Mathematics, Biochemistry |
| Commerce & Management | : | Commerce |

**OUTLINE OF CHOICE BASED CREDIT SYSTEM (PG)**

1. Core Courses
2. Discipline Specific Elective Courses (DSEC)
3. Non Major Elective Course (NMEC)

## List of Non Major Elective Courses (NMEC) Offered

**PG PROGRAMMES**

| Name of the Course | Semester | Department |
|---|---|---|
| History of Freedom Movement in India (A.D. 1885 – 1947) | III | History |
| English for Job Aspirants | III | English |
| தமிழும் பிறதுறைகளும் | III | Tamil |
| Taxation Concepts and Assessment | III | Commerce |
| Entrepreneurship | III | Business Administration |
| Mathematics For Competitive Examinations | III | Mathematics |
| Digital Electronics | III | Physics |
| Industrial Chemistry | III | Chemistry |
| Apiculture | III | Zoology |
| Nutrition and Health | III | Home Science – Nutrition and Dietetics |
| Clinical Biochemistry (Basics) | III | Biochemistry |
| Web Programming | III | Computer Science |
| Fundamentals of Information Technology | III | Information Technology |
| Principles of Information Technology | III | Computer Applications |

## QUALIFICATION FOR ADMISSION

The candidate should have passed in B.Sc. Physics, Applied Physics, Electronics, Electronics and Communication degree of any recognized University.

## DURATION OF THE PROGRAMME

The candidates shall undergo the prescribed Programme of study for a period of two academic years (four semesters).

## MEDIUM OF INSTRUCTION

English

## EVALUATION SCHEME

| Components | Internal Assessment Marks | External Examination Marks | Total Marks |
|---|---|---|---|
| Theory | 40 | 60 | 100 |
| Practical / Project | 40 | 60 | 100 |

**Core Courses, Discipline Specific Elective Courses and Non Major Elective Course**

**INTERNAL ASSESSMENT**
**Distribution of Marks**
**Theory**

| Mode of Evaluation | | Marks |
|---|---|---|
| Periodic Test | : | 25 |
| Assignment | : | 5 |
| Seminar | : | 10 |
| **Total** | **:** | **40** |

Three Periodic Tests - Average of the best two will be considered
Two Assignments - Best of the two will be considered

**Practical**

| Mode of Evaluation | | Marks |
|---|---|---|
| Periodic Test | : | 30 |
| Record | : | 5 |
| Performance | : | 5 |
| **Total** | **:** | **40** |

Three Periodic Tests - Average of the best two will be considered

**Question Pattern for Periodic Tests** **Duration: 2 Hours**

| Section | Types of Question | No. of Questions | No. of Questions to be answered | Marks for each Question | Max. Marks |
|---|---|---|---|---|---|
| A<br>Q.No.(1-5) | Multiple Choice | 5 | 5 | 1 | 5 |
| B<br>Q.No.(6-10) | Internal Choice Either Or Type | 5 | 5 | 5 | 25 |
| C<br>Q.No.(11-13) | Open Choice | 3 | 2 | 10 | 20 |
| **Total** | | | | | **50** |

**EXTERNAL EXAMINATION**
**Question Pattern** **Duration: 3 Hours**

| Section | Types of Question | No. of Questions | No. of Questions to be answered | Marks for each question | Total Marks |
|---|---|---|---|---|---|
| A<br>Q.No.(1-5) | Multiple Choice (Atleast one question from each unit) | 5 | 5 | 1 | 5 |
| B<br>Q.No.(6-10) | Internal Choice Either Or Type (one set from each unit) | 5 | 5 | 5 | 25 |
| C<br>Q.No.(11-15) | Open Choice (one question from each unit) | 5 | 3 | 10 | 30 |
| **Total** | | | | | **60** |

**ON LINE ASSESSMENT** (SET/NET Preparation - General Paper)

Online Test with Multiple Choice Question Pattern for 100 marks will be conducted in III Semester.

## ELIGIBILITY FOR THE DEGREE

1. The candidate will not be eligible for degree without completing the prescribed Courses of study, lab work etc., and a minimum of 50% Pass marks in all the Courses.
2. Attendance, progress and conduct certification from the Head of the Institution will be required for the students to write the examination.
   - No Pass minimum for Internal Assessment.
   - Pass minimum for External Examination is **27** marks out of **60** for Core Courses, Discipline Specific Elective Courses and Non Major Elective Courses.

## MASTER OF PHYSICS

## Programme Code - 7014

### PROGRAMME OUTCOMES

- Empower self-disciplined, self-monitored and self-esteemed thinking.
- Practice intellectual conception of information, analytical observation, intelligent perception, systematic evaluation and active execution.
- Enhance virtual and non-virtual communication, technical and technological bondage with the society.
- Spread scientific temperament to the Nation, while dealing with the various issues of the society.
- Volunteer in the civic life with values, morality, responsibility and justice.
- Preserve nature in its original form amidst all the natural and artificial calamities.
- Develop the self-sustained and infinite learning to meet the challenges of the contemporary socio-technological scenario.

### PROGRAMME SPECIFIC OUTCOMES

- Understand the basic concepts of certain subfields such as Mathematical Physics, Classical Mechanics, Statistical Mechanics, Quantum Mechanics, Electromagnetic Theory, Nuclear Physics, Solid State Physics and Nanophysics to appreciate how diverse phenomena observed in nature follow from a small set of fundamental laws through logical and mathematical reasoning.
- Learn to carry out experiments in basic as well as certain advanced areas of Physics such as Condensed Matter Physics, Lasers and Electronics.
- Contribute to the betterment of society through knowledge in Physics.
- Activate their research minds at higher level.
- Develop their academic knowledge and skills to fulfill the employment needs.

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## MASTER OF PHYSICS

Programme Structure - Allotment of Hours and Credits
For those who join in the Academic Year 2018-2019

| **Components** | **Semester** | | | | **Total Number of Hours/Credits** |
|---|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** | |
| Core Course | 6 (4) | 6 (4) | 6 (4) | 6 (5) | **24 (17)** |
| Core Course | 6 (5) | 6 (5) | 6 (5) | 6 (5) | **24 (20)** |
| Core Course | 6 (5) | 6 (5) | 6 (5) | 6 (5) | **24 (20)** |
| Core Practical | 6 (3) | 6 (3) | 6 (3) | - | **18 (9)** |
| DSEC | 6 (5) | 6 (5) | - | 6 (5) | **18 (15)** |
| NMEC | - | - | 5 (4) | | **5 (4)** |
| Online Course (SET/NET Preparation - General Paper) | - | - | 1 (1) | | **1 (1)** |
| Project | - | - | - | 6 (4) | **6 (4)** |
| **Total** | **30 (22)** | **30 (22)** | **30 (22)** | **30 (24)** | **120 (90)** |

DSEC - Discipline Specific Elective Course

NMEC - Non Major Elective Course

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## MASTER OF PHYSICS

## Programme Code - 7014

## PROGRAMME CONTENT

### M.Sc. Physics - SEMESTER I

| S.No. | Components | Title of the Course | Course Code | Hours per Week | Credits | Exam. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int. | Ext. | Total |
| 1 | Core Course-1 | Mathematical Physics - I | 18PPHC11 | 6 | 4 | 3 | 40 | 60 | 100 |
| 2 | Core Course-2 | Classical Mechanics | 18PPHC12 | 6 | 5 | 3 | 40 | 60 | 100 |
| 3 | Core Course-3 | Advanced Electronics | 18PPHC13 | 6 | 5 | 3 | 40 | 60 | 100 |
| 4 | Core Practical-1 | Electronics and General Physics lab-I | 18PPHC11P | 6 | 3 | 6 | 40 | 60 | 100 |
| 5 | DSEC-1 | DSEC - Numerical Methods & Programming in C++/ Microprocessors | 18PPHE11/ 18PPHE12 | 6 | 5 | 3 | 40 | 60 | 100 |
| **Total** | | | | **30** | **22** | | | | **500** |

DSEC - Discipline Specific Elective Course

## M.Sc. Physics - SEMESTER II

| S.No. | Components | Title of the Course | Course Code | Hours per Week | Credits | Exam. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int. | Ext. | Total |
| 1 | Core Course-4 | Mathematical Physics - II | 18PPHC21 | 6 | 4 | 3 | 40 | 60 | 100 |
| 2 | Core Course-5 | Statistical Mechanics | 18PPHC22 | 6 | 5 | 3 | 40 | 60 | 100 |
| 3 | Core Course-6 | Quantum Mechanics - I | 18PPHC23 | 6 | 5 | 3 | 40 | 60 | 100 |
| 4 | Core Practical-2 | Electronics and General Physics lab-II | 18PPHC21PN | 6 | 3 | 6 | 40 | 60 | 100 |
| 5 | DSEC-2 | DSEC- Nuclear and Particle Physics/ Applied Optics and Laser Physics | 18PPHE21/ 18PPHE22 | 6 | 5 | 3 | 40 | 60 | 100 |
| **Total** | | | | **30** | **22** | | | | **500** |

DSEC- Discipline Specific Elective Course

## M.Sc. Physics - SEMESTER III

| S.No. | Components | Title of the Course | Course Code | Hours per Week | Credits | Exam. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int. | Ext. | Total |
| 1 | Core Course-7 | Solid State Physics - I | 18PPHC31 | 6 | 4 | 3 | 40 | 60 | 100 |
| 2 | Core Course-8 | Electromagnetic Theory | 18PPHC32 | 6 | 5 | 3 | 40 | 60 | 100 |
| 3 | Core Course-9 | Quantum Mechanics - II | 18PPHC33 | 6 | 5 | 3 | 40 | 60 | 100 |
| 4 | Core Practical-3 | Electronics and General Physics lab-III | 18PPHC31P | 6 | 3 | 6 | 40 | 60 | 100 |
| 5 | NMEC | NME - Digital Electronics | 18PPHN31 | 5 | 4 | 3 | 40 | 60 | 100 |
| 6 | Online Course | SET/NET Preparation - General | 18POLS31 | 1 | 1 | - | 100 | | 100 |
| **Total** | | | | **30** | **22** | | | | **600** |

NMEC: Non Major Elective Course

## M.Sc. Physics - SEMESTER IV

| S.No. | Components | Title of the Course | Course Code | Hours per Week | Credits | Exam. Hours | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int. | Ext. | Total |
| 1 | Core Course-10 | Solid State Physics - II | 18PPHC41 | 6 | 5 | 3 | 40 | 60 | 100 |
| 2 | Core Course-11 | Molecular Spectroscopy | 18PPHC42 | 6 | 5 | 3 | 40 | 60 | 100 |
| 3 | Core Course-12 | Electronic Communications | 18PPHC43 | 6 | 5 | 3 | 40 | 60 | 100 |
| 4 | Core Course-13 | Project Viva - voce | 18PPHC41PR | 6 | 4 | 6 | 40 | 60 | 100 |
| 5 | DSEC-3 | DSEC- Nano Physics/<br>Bio Physics | 18PPHE41/<br>18PPHE42 | 6 | 5 | 3 | 40 | 60 | 100 |
| **Total** | | | | **30** | **24** | | | | **500** |

DSEC: Discipline Specific Elective Course

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**M.Sc. PHYSICS (SEMESTER)**
**(2018-2019 onwards)**

| Semester III | **SOLID STATE PHYSICS - I** | Hours/Week: 6 | |
|---|---|---|---|
| Core Course-7 | | Credits: 4 | |
| Course Code **18PPHC31** | | Internal 40 | External 60 |

## COURSE OUTCOMES

On completion of the course, the students will be able to

- gain knowledge about the periodic arrangement of atoms.
- understand the concept of crystal bindings and elastic constants.
- comprehend the influence of lattice vibrations on thermal behavior.
- calculate thermal and electrical properties in the free-electron model.
- analyze the energy bands of semiconductor crystal.
- acquire the knowledge about the Fermi surface.

## UNIT I

**Crystal structure:** Periodic arrays of atoms - Lattice translation vectors - Basis and Crystal structure - Primitive lattice cell - Fundamental types of lattices - Two and three dimensional lattice types - Index system for crystal planes - Simple crystal structures - Sodium Chloride Structure - Cesium Chloride Structure - Hexagonal Close-packed Structure (hcp) - Diamond structure - Cubic Zinc Sulfide structure.

**Reciprocal lattice:** Bragg's law - Reciprocal lattice vectors - Brillouin Zones - Reciprocal lattice to sc, bcc and fcc lattices - Fourier analysis of the basis - Structure factors of bcc and fcc lattices - Atomic form factor. (18 Hours)

## UNIT II

**Crystal Binding and Elastic constants:** Crystals of inert gases - Vanderwaal's London interaction - Repulsive interaction - Cohesive energy - Ionic crystals - Electrostatic or Madelung energy - Evaluation of Madelung constant - Covalent crystals - Metallic crystals - Hydrogen bonds - Analysis of elastic strains - Dilation - Stress components - Elastic compliance and stiffness constants - Elastic energy density - Elastic stiffness constants of cubic crystals - Bulk modulus and compressibility - Elastic waves in cubic crystals - Waves in [1 0 0] direction - Waves in [1 1 0] direction. (18Hours)

**UNIT III**

**Phonons I. Crystal Vibrations:** Vibrations of crystals with monoatomic basis - First Brillouin zone - Group velocity - Two atoms per primitive basis - Quantization of elastic waves - Phonon momentum - Inelastic scattering by phonons.

**Phonons II. Thermal Properties:** Phonon heat capacity - Planck distribution - Density of states in one and three dimensions - Debye model for density of states - Debye $T^3$ law - Einstein model of the density of the states - Anharmonic crystal interactions - Thermal conductivity - Thermal resistivity of phonon gas - Umklapp processes. (18 Hours)

**UNIT IV**

**Free electron Fermi gas:** Energy levels in one dimension - Effect of temperature on the Fermi Dirac distribution - Free electron gas in three dimensions - Heat capacity of the electron gas - Experimental heat capacity of metals - Electrical conductivity and ohm's law - Experimental electrical resistivity of metals - Hall effect - Thermal conductivity of metals - Ratio of thermal to electrical conductivity.

**Energy Bands:** Nearly free electron model - Origin and magnitude of energy gap - Bloch functions - Kronig-penney model - Wave equation of an electron in a periodic potential - Approximate solution near a zone boundary. (18 Hours)

**UNIT V**

**Semiconductor crystals:** Band gap - Equations of motion - Holes - Effective mass - Effective masses in semiconductor - Intrinsic carrier concentration - Intrinsic mobility - Impurity conductivity - Donor states - Acceptor states - Thermal ionization of Donors and Acceptors.

**Fermi Surfaces and Metals:** Reduced and periodic zone schemes - Construction of Fermi surfaces - Electron orbits, Hole orbits and Open orbits - Calculation of energy bands - Tight binding method for energy bands - Wigner-Seitz method - Cohesive energy - Experimental methods in Fermi surface studies - Quantization of orbits in a magnetic field - De Hass-van Alphen effect. (18 Hours)

**TEXT BOOKS**

Charles Kittel (2018), *Introduction to Solid State Physics,* Eighth Edition, John Wiley & Sons Pvt. Ltd, New Delhi.

UNIT I - CHAPTER 1 and 2 (Relevant topics)

UNIT II - CHAPTER 3 (Relevant topics)

UNIT III - CHAPTER 4 and 5 (Relevant topics)

UNIT IV - CHAPTER 6 and 7 (Relevant topics)

UNIT V - CHAPTER 8 and 9 (Relevant topics)

**REFERENCE BOOKS**

1. Pillai.S.O (1997). *Solid State Physics*, New Age International private Limited.
2. Gupta.S. L and Kumar.V (2005). *Solid State Physics*, Meerut: K.Nath & Co., 9$^{th}$ Edition.
3. Saxena Gupta Saxena (1995). *Solid State Physics,* Meerut: Pragati Prakashan, 13$^{th}$ Edition.

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**M.Sc. PHYSICS (SEMESTER)**
**(2018-2019 onwards)**

| Semester III | **ELECTROMAGNETIC THEORY** | Hours/Week: 6 | |
|---|---|---|---|
| Core Course-8 | | Credits: 5 | |
| Course Code | | Internal | External |
| **18PPHC32** | | 40 | 60 |

## COURSE OUTCOMES

On completion of the course, the students will be able to

- acquire wide knowledge of electromagnetic theory.
- appreciate the basic theory of Faraday's induction Law.
- gain knowledge about the Electromagnetic Propagation.
- analyze the nature of Electromagnetic wave propagation in guided medium.
- describe and make calculations of plane Electromagnetic waves in homogeneous media.
- apply Maxwell's equations to determine field waves, potential waves, energy and charge conservation conditions.

## UNIT I

**Electrostatic Fields I:** Electrostatic fields in a Vaccum - The Equations of Poisson and Laplace - Conductors - Calculation of the Electric field produced by a simple charge distribution - The Electric dipole - The Linear electric Quadrapole - Electric multipoles.

**Electrostatic Fields II:** Dielectric Materials - The Electric polarization - Electric field at an exterior point - Electric field at an interior point - Local field - Electric susceptibility - The Divergence of E - The electric displacement D - Calculation of electric fields involving dielectrics - The Clausius Mossotti Equation - Polar Dielectrics - Frequency dependence, Anisotropy and Non Homogeneity - Potential Energy of a Charge distribution in the presence of Dielectrics. (18 Hours)

**UNIT II**

**Electrostatics Fields III:** Continuity of V, D, E at the Interface between two different media - The Uniqueness theorem - Solution of Laplace's Equation in Rectangular Co-ordinates, Solution of Laplace's Equation in spherical Co-ordinates, Legendre's Equation, Legendre Polynomials**.**

**Magnetic Fields I:** Steady current and non magnetic materials - Magnetic forces - The Magnetic Induction B - The Biot savart Law - The Divergence of a point charge moving in a magnetic field - The Divergence of the Magnetic Induction B - The vector potential - The curl of the Magnetic Induction B - Ampere's circuital Law. (18 Hours)

**UNIT III**

**Magnetic Fields:** The Faraday Induction Law - The Induced Electric field Intensity E in terms of the vector Potential A - Induced Electromotance in a moving system - Maxwell's Equations - The conservation of electric charge - The potentials V and A - The Lorentz Condition - The Divergence of E and the Non homogeneous wave equation for A - The curl of B - Maxwell's Equations. (18 Hours)

**UNIT IV**

**Propagation of Electromagnetic Waves:** Plane wave in infinite media - Plane electromagnetic waves in free space - The E and H Vectors in homogeneous, Isotropic, Linear and stationary media - Propagation of plane electromagnetic waves in nonconductors - Propagation of plane electromagnetic waves in good conductors.

**Guided Electromagnetic Waves:** Propagation in a straight line - The coaxial line - The hollow rectangular wave guides. (18 Hours)

**UNIT V**

**Radiation of electromagnetic waves**: Electric Dipole radiation - The scalar potential - The vector potential A and the magnetic field Intensity - The Electric field intensity E -

The Average poynting vector and the radiation power - The Electric and Magnetic lines of force - The Kλ surface - Radiation from a Half-wave Antenna - Electric field intensity - Magnetic field intensity - Average poynting vector and radiated power. (18 Hours)

**TEXT BOOK**

Paul Lorain and Dale R. Corson (Reprint 2003). *Electromagnetic fields and waves*, CBS Publication Ltd.

UNIT I - CHAPTER 2 - 2.6 to 2.11
CHAPTER 3 - 3.1 to 3.11
UNIT II - CHAPTER 4 - 4.1, 4.2, 4.4, 4.5
CHAPTER 7 - 7.1 to 7.7
UNIT III - CHAPTER 8 - 8.1 to 8.3
CHAPTER 10 - 10.1 to 10.7
UNIT IV - CHAPTER 11 - 11.1 to 11.5, 13.1 to 13.3
UNIT V - CHAPTER 14 - 14.1.1 to14.1.6, 14.2.1, 14.2.2, 14.2.3

**REFERENCE BOOKS**

1. Rama Reddy.S, (2002). *Electromagnetic Theory*: Chennai.Scitech Publications (India) Pvt Ltd.
2. Macmillan, (Reprint 1988). *Electromagnetic Theory*, Chennai: S.P. Talwar Macmillan (India) Pvt Ltd.
3. Edward. C. Jordan, Keith. G. balmain, (1995). *Electromagnetic Waves and Radiating Systems*, New Delhi: Prentice Hall of India Private Ltd, 2nd Edition.

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**M.Sc. PHYSICS (SEMESTER)**
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| Semester III | QUANTUM MECHANICS - II | Hours/Week: 6 | |
|---|---|---|---|
| Core Course-9 | | Credits: 5 | |
| Course Code | | Internal | External |
| **18PPHC33** | | 40 | 60 |

**COURSE OUTCOMES**

On completion of the course, the students will be able to

- understand the concept of scattering cross-section.
- acquire knowledge about partial wave analysis.
- understand the concept that the quantum states live in a vector space.
- acquire knowledge about representations, transformations & symmetries.
- master the concepts of angular momentum and spin, as well as the rules for quantization and addition.
- analyse the consequence of relativistic wave equations.

**UNIT I**

**The Scattering Cross Section:** Kinematics of the scattering process: Differential and total cross-sections - Wave mechanical picture of scattering: The scattering amplitude - Green's Functions; Formal expression for scattering amplitude.

**The Born and Eikonal approximation:** The Born approximation - Validity of the Born approximation - The Born series - The Eikonal approximation.

**Partial wave analysis:** Asymptotic behaviour of partial waves: Phase shifts - The Scattering amplitude in terms of phase shifts - The differential and total cross sections; Optical theorem - Phase shifts: Relation to the potential - Low energy Scattering.

(18 Hours)

**UNIT II**

**Representations, Transformations and Symmetries:** Quantum states; state vectors and wave functions - The Hilbert space of state vectors; Dirac notation - Dynamical variables and linear operators - Representations - Continuous basis - The Schrodinger representation - Degeneracy; labeling by commuting observables - Change of basis; Unitary transformations - Unitary transformations induced by change of co-ordinate systems: Translations - Unitary transformation induced by rotation of co-ordinate system - The algebra of rotation generators - Transformation of dynamical variables - Symmetries and conservation laws.

(18 Hours)

**UNIT III**

**Angular Momentum:** The Eigen value spectrum - Matrix representation of J in the |jm> basis - Spin angular momentum - Non relativistic Hamiltonian including spin; Diamagnetism - Addition of angular momenta – Clebsch Gordan coefficients - Spin wave functions for a system of two spin ½ particles - Identical particles with spin. (18 Hours)

**UNIT IV**

**Perturbation theory for time Evolution problems**: Perturbation solutions for transition amplitude - Selection rules - First order Transitions: Constant perturbation - Transitions in the second order: Constant perturbation - Scattering of particle by a potential - Harmonic perturbations - Interaction of an atom with Electromagnetic Radiation - The Dipole Approximation: selection rules - The Einstein coefficients: spontaneous Emission.

**Alternative pictures of time Evolution**: The Schrodinger picture - The Heisenberg picture - The interaction picture. (18 Hours)

**UNIT V**

**The Klein – Gordon Equation:** Plane wave solutions; charge and current densities – Interaction of an atom with Electromagnetic fields; Hydrogen like atom – Non relativistic limit.

**The Dirac equation:** Dirac's Relativistic Hamilton - Position probability density; Expectation values - Dirac matrices - Plane wave solutions of the Dirac equation; energy spectrum - The spin of the Dirac particle - Significance of Negative Energy states; Dirac particle in Electromagnetic fields - Relativistic Electron in a central potential: Total Angular Momentum. (18 Hours)

**TEXT BOOK**

Mathews.P.M & Venkatesan.K (1997). *A text book of Quantum Mechanics*, Tata McGraw Hill Publishing Company Ltd.

UNIT I – CHAPTER 6 - 6.1 – 6.11, 6.13

UNIT II – CHAPTER 7 - 7.1 – 7.12

UNIT III – CHAPTER 8 - 8.1 – 8.8

UNIT IV – CHAPTER 9 - 9.7 – 9.11, 9.14 – 9.19, 9.23

UNIT V – CHAPTER 10 - 10.2 – 10.11

**REFERENCE BOOKS**

1. Aruldhas,G. (2004). *Quantum Mechanics*, New Delhi: Prentice – Hall of India Private Limited.
2. Ajoy Ghatak (1996). *Introduction to Quantum Mechanics,* Macmillan India Ltd. 5th Edition,
3. Gupta Kumar and Sharma (2015). *Quantum Mechanics*, Jai Prakashnath Publications.
4. Leonard.I.Schiff. (1968). Quantum Mechanics, McGraw – Hill International Editions, Physics Series, 3rd Edition.

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**M.Sc. PHYSICS (SEMESTER)**
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| | | | |
|---|---|---|---|
| Semester III | **ELECTRONICS AND GENERAL PHYSICS LAB - III** | Hours/Week: 6 | |
| Core Practical-3 | | Credits: 3 | |
| Course Code | | Internal | External |
| **18PPHC31P** | | 40 | 60 |

**COURSE OUTCOMES**

On completion of the course, the students will

- become professionally trained in the area of Electronics and Nonlinear circuits.
- understand the basic concepts of interfacing devices and programming knowledge about Microcontroller 8051.
- get familiarized with the basics of experimental physics.
- analyse the concepts involved in research.

**CORE PRACTICAL**

1. Construct an Amplitude Modulation and Demodulation circuit and calculate the percentage of modulation & trace the respective waveforms.
2. Construct a Frequency Modulation circuit and calculate the modulation index & trace the respective waveforms.
3. Study Pulse code modulation and demodulation.
4. Write an assembly language program for addition & subtraction of two 8 bit ,16 bit using 8051 microcontroller
5. Write an assembly language program for ADC & DAC interfacing using 8051 microcontroller
6. Determination of susceptibility of a liquid using Quincke's method
7. Determination of dielectric constants of a given liquid.
8. Laser based diffraction experiments.
9. Determination of refractive index of a liquid using Newton's ring.
10. Characteristics of solar cell.

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**M.Sc. PHYSICS (SEMESTER)**
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| Semester III | DIGITAL ELECTRONICS | Hours/Week: 5 | |
|---|---|---|---|
| NMEC | | Credits: 4 | |
| Course Code **18PPHN31** | | Internal 40 | External 60 |

**COURSE OUTCOMES**

On completion of the course, the students will be able to

- get an idea about number based conversion.
- understand the concepts of Boolean algebra.
- gain knowledge in combinational circuits.
- know about the arithmetic circuits.
- apply theory of flip flops in the gadgets of daily use.
- get an insight into counters and registers.

**UNIT I**

**Number system:** Number system - Binary numbers - Decimal to Binary conversion - Octal numbers - Octal to Binary conversion - Hexa decimal numbers -Hexa Decimal to Binary conversion - Hexa Decimal to octal conversion - Arithmetic operation - 1's and 2's complement subtraction.

**Boolean algebra**: Development of Boolean Algebra - Boolean Logic operations - Basic Laws of Boolean algebra - Demorgan's theorem - Sum of products and product of sums - Minterm - Maxterm. (18 Hours)

**UNIT II**

**Logic gates:** Introduction - Positive and negative Logic designation - Logic gates - Karnaugh map.

**Combinational Circuits**: Multiplexer - 4 to 1 Multiplexer - 8 to 1 Multiplexer - 16 to 1 Multiplexer – Demultiplexer - 1 to 4 Demultiplexer - 1 to 8 Demultiplexer - 1 to 16 Demultiplexer - Decoder - 3 to 8 decoder - 4 to 16 decoder - BCD to Decimal decoder - BCD to 7 segment decoder/driver - Encoder - Octal to binary encoder - Decimal to BCD encoder. (18 Hours)

**UNIT III**

**Arithmetic circuits:** Half adder - Full adder - K-Map simplification - Half subtractor - Full subtractor - Parallel Binary adder - Controlled inverter - 4-bit Parallel adder/subtractor - Fast adder - Serial adder - Serial subtraction using 2's complement - 4-bit Serial adder/subtractor - BCD adder - Binary multiplier - Binary Divider . (18 Hours)

**UNIT IV**

**Flip flops:** Types of flip flops - S-R flip flops – D flip flops - JK flip flops - T flip flops - Triggering of flip flops - Master slave flip flops.

**Converters:** D/A converters - R-2R ladder type - A/D converters - Successive approximation type. (18 Hours)

**UNIT V**

**Counters:** Asynchronous counters - Ripple counters with modulus < $2^n$ - Asynchronous Down counter - Up/Down counter - Propagation delay in ripple counter - Synchronous counters - Synchronous Down counter - Synchronous Up/Down counter.

**Registers:** 4 bit shift register - Shift register - Ring counter - Shift counter.

(18 Hours)

**TEXT BOOKS**

Salivahanan.S and Arivazhagan.S (2010). *Digital Circuits and Design,* Vikas Publishing House Pvt. Ltd., 3rd Edition.

UNIT I - CHAPTER 1 - 1.1, 1.2, 1.4 - 1.5.2

CHAPTER 2 - 2.1 - 2.6.2

UNIT II - CHAPTER 3 - 3.1 - 3.3.6

CHAPTER 2 - 2.7

CHAPTER 6 - 6.1 - 6.2.3, 6.4 - 6.5.3, 6.5.6, 6.5.9, 6.7 - 6.7.2.

UNIT III - CHAPTER 5 - 5.1, 5.3-5.17

UNIT IV - CHAPTER 7 - 7.1, 7.3 - 7.8, 7.10

CHAPTER 13 - 13.1, 13.4.2, 13.9.4

UNIT V - CHAPTER 8 - 8.1, 8.2, 8.4, 8.6 - 8.9, 8.11, 8.12

CHAPTER 9 - 9.1, 9.2, 9.2.1, 9.2.3, 9.2.5, 9.2.7, 9.4.1, 9.5

**REFERENCE BOOKS**

1. Albert Paul Malvino, Donald P. Leach (2005). *Digital Principles and Applications,* Tata McGraw Hill Publishing Company Limited, 4th Edition.
2. Moris Mano.M (2001). *Digital Logic and Computer Design,* Prentice Hall of India Private Limited.
3. Somanathan Nair.B (2002). *Digital Electronics and Logic Design*, Prentice Hall of India Private Limited.
4. Samuel C. Lee (2002). *Digital Circuits and Logic Design*, Prentice Hall of India Private Limited. 10th Edition.

# V.V. VANNIAPERUMAL COLLEGE FOR WOMEN

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*Re-accredited with 'A' Grade ($3^{rd}$ Cycle) by NAAC*
VIRUDHUNAGAR - 626 001

**M.Sc. PHYSICS (SEMESTER)**
**(2018-2019 onwards)**

| Semester IV | **SOLID STATE PHYSICS - II** | Hours/Week: 6 | |
|---|---|---|---|
| Core Course-10 | | Credits: 5 | |
| Course Code **18PPHC41** | | Internal 40 | External 60 |

## COURSE OUTCOMES

On completion of the course, the students will be able to

- know the fundamentals of solid state particles such as plasmons, polaritons, polarons and excitons.
- get a basic knowledge in superconductivity.
- understand the concept of dielectrics and ferroelectrics
- comprehend the quantum theory of dia, para, ferro and antiferromagnetism.
- understand the concept of Nuclear Magnetic Resonance
- identify different types of defects and dislocations in crystals.

## UNIT I

**Plasmons, Polaritons and Polarons:** Dielectric function of the electron gas - Definitions of the dielectric function - Plasma optics - Dispersion relation for electromagnetic waves - Transverse optical modes in plasma - Longitudinal plasma oscillations - Plasmons - Electrostatic screening - Screened coulomb potential - Pseudo potential component U(0) - Mott Metal - Insulator transition - Screening and phonons in metals - Polaritons - LST relation - Electron-Electron interaction - Fermi liquid - Electron-Electron collisions - Electron-Phonon interaction - Polarons.

**Optical Processes and Excitions:** Optical reflectance - Kramers Kronig relations - Electronic interband transitions - Excitons - Frenkel excitons - Weakly bound (Mott-Wannier) excitons. (18 Hours)

**UNIT II**

**Superconductivity:** Occurrence of superconductivity - Destruction of superconductivity by magnetic fields - Meissner effect - London equation - Coherence length - BCS theory of superconductivity - BCS ground state - Flux quantization in a superconducting ring - Type II superconductors - Vortex state - Estimation of $H_{c1}$ and $H_{c2}$ - Single particle tunneling - Josephson superconductor tunneling - DC and AC Josephson effects.

**Dielectrics and Ferroelectrics:** Polarisation - Macroscopic electric field - Depolarization field - Local electric field at an atom - Lorentz field - Field of dipoles inside cavity - Dielectric constant and polarizability - Electronic polarizability - Ferro electric crystals - Soft optical phonon - Landau theory of phase transitions- first and second orders. (18 Hours)

**UNIT III**

**Diamagnetism and Paramagnetism:** Langevin diamagnetism equation - Quantum theory of diamagnetism - Paramagnetism - Quantum theory of paramagnetism - Rare earth ions - Hund's rules -Iron group ions - Crystal field splitting - VanVleck Temperature-Independent paramagnetism.

**Ferromagnetism and Antiferromagnetism:** Ferromagnetic order - Curie point and exchange integral - Magnons - Quantization of spin waves - Thermal excitation of magnons - Ferrimagnetic order - Curie temperature and susceptibility of Ferrimagnets - Antiferromagnetic order - Ferromagnetic domains - Anisotropy energy - Transition region between domains - Origin of domains - Coercivity and Hysteresis. (18 Hours)

**UNIT IV**

**Magnetic Resonance:** Nuclear magnetic resonance - Equations of motion - Line width - Motional narrowing - Hyperfine splitting - Knight shift - Ferromagnetic resonance-

Shape effects in FMR - Antiferromagnetic resonance - Electron paramagnetic resonance.

**Point defects:** Lattice vacancies - Schottky defect - Frenkel defect - Diffusion - Color centers - F centers - Other centers in Alkali halides. (18 Hours)

**UNIT V**

**Surface and Interface Physics:** Reconstruction and relaxation - surface crystallography - Work function - Thermionic emission - Surface states - Tangential surface transport - Integral Quantized Hall effects - IQHE in real system - FQHE - p-n junctions - Rectifications - Solar cells and photovoltaic detectors.

**Dislocations:** Slip - Edge and Screw dislocations - Burgers vectors - Stress fields of dislocations. (18 Hours)

**TEXT BOOKS**

Charles Kittel (2018). *Introduction to Solid State Physics*, New Delhi: John Wiley & Sons Pvt. Ltd, 8th Edition.

UNIT I - CHAPTER 14 and 15 (Relevant topics)

UNIT II - CHAPTER 10 and 16 (Relevant topics)

UNIT III - CHAPTER 11 and 12 (Relevant topics)

UNIT IV - CHAPTER 13 and 20 (Relevant topics)

UNIT V - CHAPTER 17 and 21 (Relevant topics)

**REFERENCE BOOKS**

1. Pillai,S.O (1997). *Solid State Physics*, New Age International private limited.
2. Gupta, S. Land Kumar.V. (2005). *Solid state Physics*, Meerut: K.Nath & Co., 9th Edition.
3. Saxena Gupta Saxena (1995). *Solid State Physics*, Meerut: Pragati Prakashan, 13th Edition.

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VIRUDHUNAGAR - 626 001

**M.Sc. PHYSICS (SEMESTER)**
**(2018-2019 onwards)**

| Semester IV | MOLECULAR SPECTROSCOPY | Hours/Week: 6 | |
|---|---|---|---|
| Core Course-11 | | Credits: 5 | |
| Course Code **18PPHC42** | | Internal 40 | External 60 |

## COURSE OUTCOMES

On completion of the course, the students will be able to

- get knowledge about the internuclear distances and bond angles.
- analyze the concepts of pure rotational and vibrational spectra of molecules.
- learn the interaction of spin with an external magnetic field.
- understand and get familiarised with quantized energy levels and introductory spectroscopy.
- explore the electronic spectra of molecules.
- describe electron spin and nuclear magnetic resonance spectroscopy and their applications.

## UNIT I

**Microwave Spectroscopy:** The rotation of molecules - Rotational spectra - Diatomic molecules - The rigid diatomic molecules - The intensities of spectral lines - The effect of isotopic substitution - The non - rigid rotator - The spectrum of non - rigid rotator - Polyatomic molecules - Linear molecules - Symmetric top molecules - Asymmetric top molecules - Techniques and instrumentation. (18 Hours)

**UNIT II**

**Infrared Spectroscopy:** The vibrating diatomic molecule - The energy of a diatomic molecule - The simple harmonic oscillator - The anharmonic oscillator - The diatomic vibrating rotator - The vibrations of polyatomic molecules - Fundamental vibrations and wave symmetry - The influence of rotation on the spectra of polyatomic molecules - Linear molecules - Symmetric top molecules - Techniques and instrumentation.

(18 Hours)

**UNIT III**

**Raman Spectroscopy:** Introduction - Quantum theory of Raman Effect - Classical theory of Raman effect - Molecular polarizability - Pure rotational Raman spectra - Linear molecules - Symmetric top molecules - Spherical top molecules: Asymmetric top molecules - Rule of mutual exclusion - Vibrational Raman spectra - Rotational fine structure - Techniques and instrumentation. (18 Hours)

**UNIT IV**

**Electronic spectra of molecules:** The Born-Oppenheimer approximation - Vibrational coarse structure - Progression - Intensity of vibrational electronic spectra - The Franck-Condon Principle - Dissociation energy and dissociation products - Rotational fine structure of electronic - vibration transition - The Fortrait diagram – Pre-dissociation.

(18 Hours)

**UNIT V**

**Spin Resonance Spectroscopy:** Spin and an applied field - The nature of spinning particles - Interaction between spin and magnetic field - Relaxation times - Fourier transform spectroscopy in NMR - Multiple pulses FT: Spin - spin relaxation - Spin - lattice relaxation.

**Mossbauer Spectroscopy:** Principles of Mossbauer spectroscopy - Applications of Mossbauer spectroscopy - The chemical shift - Quadrapole effects - The effect of a magnetic field. (18 Hours)

**TEXT BOOKS**

Banwell, C.N and Mccash, E.M. (2004), *Fundamentals of Molecular Spectroscopy*, New Delhi: Tata McGraw – Hill Publishing Company Limited, $4^{th}$ Edition.

UNIT I - CHAPTER 2 - 2.1 - 2.5

UNIT II - CHAPTER 3 - 3.1, 3.2, 3.5, 3.6, 3.8

UNIT III - CHAPTER 4 - 4.1 - 4.3, 4.6

UNIT IV - CHAPTER 6 - 6.1.1 - 6.1.7

UNIT V - CHAPTER 7 - 7.1 - 7.1.2, 7.1.5 - 7.1.8

CHAPTER 9 - 9.1, 9.2

**REFERENCE BOOKS**

1. Aruldhas,G. (2004). *Molecular Structure and Spectroscopy,* New Delhi: Prentice Hall of India Private Limited.

2. Gurdeep Chatwal and Sham Anand (1996). *Spectroscopy (Atomic & Molecular),* Bombay: Himalaya Publishing House.
3. Sharma, B.K. (1993). *Spectroscopy*, Meerut: Goel Publishing House.

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VIRUDHUNAGAR - 626 001

**M.Sc. PHYSICS (SEMESTER)**
**(2018-2019 onwards)**

| | | | |
|---|---|---|---|
| Semester IV | **ELECTRONIC COMMUNICATIONS** | Hours/Week: 6 | |
| Core Course-12 | | Credits: 5 | |
| Course Code **18PPHC43** | | Internal 40 | External 60 |

## COURSE OUTCOMES

On completion of the course, the students will be able to

- analyze the performance of a baseband and pass band digital communication system.
- understand the concept of cellular communication.
- acquire the knowledge of GSM mobile communication standard, its architecture, - logical channels, advantages and limitations.
- understand the important and fundamental antenna parameters and terminology.
- gain knowledge about the basics of satellite communication.
- apply the fundamental principles of optics and light wave to design optical fiber communication systems.

## UNIT I

**Digital Communications and Transmission Lines:** Synchronization - Asynchronous Transmission - Probability of Bit Error in Baseband Transmission - Bit - timing recovery Circuits - Differential Phase Shift Keying (DPSK) - Hard and Soft Decision Decoders - Error control coding.

**Transmission lines**: Primary line constants - Phase velocity and Line wavelength - Characteristic Impedance - Propagation Coefficient - Phase and Group velocities - Telephone lines and cables - Radio frequency lines - Micro strip transmission lines - Use of Mathcad in transmission line calculation. (18 Hours)

**UNIT II**

**Waveguides and Antennas :** Rectangular waveguides - Other modes -Antenna Equivalent Circuits - Coordinate Systems - Radiation fields - Polarization - Isotropic Radiator - Power gain of an antenna - Effective area of an antenna - Effective length of an antenna - Hertzian Dipole - Half - Wave Dipole - Vertical Antennas - Folded elements - Loop and ferrite rod receiving antennas - Non resonant Antenna - VHF & UHF antenna - Micro wave antenna. (18 Hours)

**UNIT III**

**Mobile Communication :** Cell Mobile Telephone system - Tuning efficiency - Frequency reuse concept - Co-channel interference reduction - Hand-off mechanism - Frequency spectrum utilization - Cell splitting - Gaussian minimum FSK (GMFSK) - Differential quadrature phase shift keying (DQPSK) - Mobile Radio Propagation - Antennas at cell site - Tilting effect - Parasitic elements - Diversity techniques - Digital speech - Group of special mobile (GSM) - Multiple access techniques (TDMA, FDMA, CDMA) - Advanced systems (GPRS, WAP & UMT). (18 Hours)

**UNIT IV**

**Satellite Communication :** Kepler's laws - Orbits - Geostationary orbit - Power systems - altitude control - Satellite station keeping - Antenna look angles - Limits of visibility - Frequency plans and polarization - Transponders - Uplink, Downlink and Overall power Budget calculations - Digital Carrier Transmission. (18 Hours)

**UNIT V**

**Fiber Optic Communication :** Principles of light transmission in a fiber - Losses in fibers - Dispersion -Light Sources for Fiber Optics - Photo Detectors - Connectors and Splices - Fiber Optic Communication link. (18 Hours)

**TEXT BOOK**

1. Roddy, D & Coolen, J. (2006). *Electronic Communications*, Prentice Hall of India, IV Edition.

   UNIT I - CHAPTER 12 - 12.1 - 12.4, 12.7, 12.11 -12.13

   CHAPTER 13 - 13.1 - 13.6, 13.14 - 13.17

   UNIT II -CHAPTER 14 - 14.1 - 14.3

   CHAPTER 16 - 16.1 - 16.15, 16.18, 16.19

   UNIT IV- CHAPTER 19 - 19.1 - 19.17

   UNIT V - CHAPTER 20 - 20.1 - 20.8

2. Jeyasri Arokiamary.V. (2009). *Mobile Communication*, Pune: Technical Publications, First Edition.

   UNIT III- CHAPTER 1 - 1.2, 1.3, 1.5, 1.6, 1.13

   CHAPTER 2 - 2.2.1 - 2.2.3, 2.6.1 - 2.6.7

   CHAPTER 3 - 3.2.1 - 3.2.4, 3.4.1 - 3.4.4, 3.5, 3.6, 3.7

   CHAPTER 4 - Relevant Sections

**REFERENCE BOOKS**

1. Sam Shanmugam,K. (1996*). Digital And Analog Communication Systems*, Singapore: Prentice - Hall of India Private Limited John Wiley & Sons (Asia) Pvt. Ltd.
2. Richharia.M (2008). *Satellite Communication Systems*, London: Macmillan Press Ltd, 2nd Edition.
3. Gerd Keiser (2000). *Optical Fiber Communications*, McGraw - Hill International Editions. 3rd Edition.

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**M.Sc. PHYSICS (SEMESTER)**
**(2018-2019 onwards)**

| Semester IV | **PROJECT VIVA-VOCE** | Hours/Week: 6 | |
|---|---|---|---|
| Core Course-13 | | Credits: 4 | |
| Course Code<br>**18PPHC41PR** | | Internal<br>40 | External<br>60 |

## COURSE OUTCOMES

On completion of the course, the students will

- gain research experience within a specific field of physics through a supervised project.
- exhibit their intellectual independence with a scientific wave of thinking.
- analyse, interpret and critically evaluate research findings.
- use existing scientific knowledge to innovate other technological advancements of practical use.

- Project will be done by the final year students in the fourth semester under the guidance of respective guides.
- For projects internal marks will be awarded by the respective guide and external marks will be awarded in the external examinations held at the end of the semester.
- Only team project should be allotted. A project team should contain only two student members
- The report of the project must be in the prescribed form. It should be typed neatly in MS word (12 pt, Times New Roman, 1.5 spacing)
- The format of the project report 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 & year of submission

- ❖ Contents
- ❖ Certificate by supervisor
- ❖ Declaration by candidate
- ❖ Acknowledgement
- ❖ Chapter 1 – Preliminaries
- ❖ Other chapters
- ❖ References

- The project report should be written in 30 - 40 pages.
- Four copies of the project report with binding should be submitted.

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**M.Sc. PHYSICS (SEMESTER)**
**(2018-2019 onwards)**

| Semester: IV | **NANO PHYSICS** | Hours/Week: 6 | |
|---|---|---|---|
| DSEC-3 | | Credits: 5 | |
| Course Code **18PPHE41** | | Internal 40 | External 60 |

## COURSE OUTCOMES

On completion of the course, the students will be able to

- understand the properties of materials at the nanometre scale.
- get familiar with various nanofabrication, imaging, manipulation methods.
- know major confinement effects and new phenomena in nanostructured materials and use solid state Physics to describe them.
- understand the various nano applications and nanodevices in Physics.
- learn how basic Physics can be used to describe the behavior of electrons in nano-scale materials.
- analyse the materials and structures in nano scale.

## UNIT I

**Methods of Measuring Properties:** Structure: Atomic structures - Crystallography - Particle size determination - Surface structure - Microscopy: Transmission electron microscopy - Field ion microscopy - Scanning microscopy - Spectroscopy: Infrared and Raman spectroscopy - Photoemission and X-ray spectroscopy - Magnetic resonance.

(18 Hours)

## UNIT II

**Nanopowders and Nanomaterials:** Preparation of Nanomaterials - Plasma arcing - Chemical Vapour deposition - Sol-gels method - Electro depostion- Ball milling - Using natural nanoparticles. (18 Hours)

**UNIT III**

**Properties of Individual Nanoparticles:** Metal nanoclusters: Magic numbers - Theoretical modeling of nanoparticles - Geometric structure - Electronic structure - Reactivity - Fluctuations - Magnetic clusters - Bulk to nano transition - Semiconducting nanoparticles: Optical properties - Photo fragmentation - Coulombic explosion.

(18 Hours)

**UNIT IV**

**Carbon Nanotubes and Nanomachines:** Fabrication and Structure of Carbon nanaotubes - Electrical properties - Vibrational properties - Mechanical properties - Applications of carbon nanotubes: Field emission and shielding - Computers - Fuel cells - Chemical sensors - Catalysis - Mechanical reinforcement.

**Nanomachines and Nanodevices:** Micro Electro Mechanical systems (MEMs) – Nano Electro Mechanical systems (NEMs) - Fabrication - Nanodevices and Nanomachines-Molecular and supermolecular switches. (18 Hours)

**UNIT V**

**Quantum Wells, Wires and Dots:** Preparation of quantum nanostructures - Size and dimensionality effects - Size effects - Conduction electrons and dimensionality - Fermi gas and density of states - Potential wells - Partial confinement - Properties dependent on density of states - Excitons - Single electron tunneling - Applications: Infrared detectors - Quantum dot lasers - Superconductivity. (18 Hours)

**TEXT BOOKS**

1. Charles, P. Poole Jr and Frank J. Owens (2016). *Introduction to Nanotechnology*, John Wiley & Sons, INC.

UNIT I - CHAPTER 3 - 3.1 - 3.4

UNIT III - CHAPTER 4 - 4.1 - 4.3

UNIT IV - CHAPTER 5 - 5.4, 5.5

CHAPTER 13 - 13.1 - 13.3

UNIT V - CHAPTER 9 - 9.1 - 9.7

2. Mick Wilson and Kamali Kannangara Geoff Smith (2008). *Nano Technology*, Overseas Press (India) Private Limited.
UNIT II - CHAPTER 3 - 3.1 - 3.8.

**REFERENCE BOOKS**

1. Pradeep,T. (2008). *Nano The Essentials*, Tata McGraw - Hill Publishing Company Limited.
2. William Illsey Atkinson (2007). *Nanotechnology*, Jaico Publishing House.
3. Chandra Banu, T.K. and Batnagar.V. (2009). *Nanoscience and Technology*, Campus Book International.

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**M.Sc. PHYSICS (SEMESTER)**
**(2018-2019 onwards)**

| | | | |
|---|---|---|---|
| Semester IV | | Hours/Week: 6 | |
| DSEC – 3 | **BIO PHYSICS** | Credits: 5 | |
| Course Code | | Internal | External |
| **18PPHE42** | | 40 | 60 |

## COURSE OUTCOMES

On completion of the course, the students will be able to

- explain selected biological phenomena using physical principles.
- make use of physical concepts and techniques to address problems in biology.
- understand the structure determination of biological molecules such as proteins and DNA using X-ray diffraction or nuclear magnetic resonance.
- gain knowledge about bioenergetics using thermodynamics.
- know more about biomechanism.
- acquire knowledge about radiation biophysics.

## UNIT I

**Physical techniques in structure determination**

**Separation Methods:** Diffusion - Sedimentation - Osmosis - Viscosity - Chromatographic methods - Electrophoretic methods.

**Spectroscopy:** Mass Spectrometry - Mössbauer Spectroscopy. (18 Hours)

## UNIT II

**Physical techniques in structure determination**

**Nuclear Magnetic Resonance:** Multi-dimensional NMR Spectroscopy - Biomedical NMR

**X-ray Diffraction:** Structure Determination - Phase Determination Procedures - Structure Refinement - Structure and Function. (18 Hours)

**UNIT III**

**Bioenergetics**

**Thermodynamics:** Reversible Thermodynamics - The first law of thermodynamics - The second law of thermodynamics - The third law of thermodynamics - Thermal analysis - Free energy - Irreversible Thermodynamics - Isolated states - open systems - Information and Transmission - Information storage and memory. (18 Hours)

**UNIT IV**

**Biomechanics:** Cell contractility - Skeletal muscle - Protein of the contractile apparatus - Bioenergetics of muscle contraction - regulation of muscle contraction - Cytoskeletal motility - Microtubule apparatus – Intermediate and microfilaments - Cellular motion - Dynamics of Aqua- and Aero-motions - The Aquatic environment - Aeroflight - Biostatistics of locomotion. (18 Hours)

**UNIT V**

**Radiation Biophysics:** Ionising Radiation - Interaction of Radiation with Matter - Measurement of Radiation (Dosimetry) - Radioactive Isotopes (Radionucleids) - Biological Effects of Radiation - Radiation Protection and Therapy. (18 Hours)

**TEXT BOOK**

Narayanan,P. (2009). *Essentials of Biophysics*, New Age International Publishers.

UNIT I – Section II – 7.1 to 7.6, 8.10, 8.11

UNIT II – Section II – 9.2, 9.5, 10.2, 10.3, 10.4, 10.5

UNIT III – Section III – 13.1, 13.2, 13.3

UNIT IV – Section IV - 16.1, 16.2, 16.3

UNIT V – Section IV - 18.1 to 18.6

## REFERENCE BOOKS

1. Roy, R.N. (2005). A *Text Book of Biophysics*, New Central Book Agency (P) Ltd.
2. Vasantha Pattabhi & Gautham.N. (2003). *Biophysics*, Narosa Publishing House.
3. Chatwal, G.R. (2011). *Biophysics*, Himalaya Publishing House.