# VELLALAR COLLEGE FOR WOMEN (AUTONOMOUS)

**"College with Potential for Excellence"**

**(Reaccredited with 'A' Grade by NAAC & Affiliated to Bharathiar University)**

**Erode-12**

# Department of Physics

## M.Sc Physics

**CBCS PATTERN**

**Course Contents**

**Scheme of Examinations and Credits**

**Question Paper Pattern**

**Syllabus**

**Submitted to the Board of Studies**

**20.04.2018**

## PG DEPARTMENT OF PHYSICS

## VISION

To build a creative and vibrant environment for the future generations of women Physicists to acquire domain knowledge and acumen.

## MISSION

- To provide a quality education, facilitating the learners' cognition towards the latest development in the subject
- To stimulate the learners' scientific temperament so as to gain a thorough understanding of the theory and practicals
- To encourage and ingrain the culture and ethics of research for the betterment of society
- To provide gateway and resources for executing interdisciplinary research
- To generate the graduates who would cater the demands of academia, industry and public sectors
- To establish the required infrastructure to accommodate the advanced Teaching-Learning methodology and research

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

**PEO1:** To build technology rich interactive environment, thereby enabling the learners to gain subject competencies and efficiency.

**PEO2:** To prepare the learners to have a smooth sail during their employment in industry and in technical/research/teaching institute.

**PEO3:** To enhance the ability to work in teams on multi-disciplinary projects in industry and research organizations.

**PEO4:** To develop awareness on ethical, professional and environmental implications, thereby developing holistic outlook on the society.

**PEO5:** To encourage, enhance and enrich the students' skills in research.

## PROGRAMME OUTCOMES (POs)

Our programme will help the graduates to

**PO1:** Gain mastery in the field of Physics and be able to effect a constructive impact in multi-disciplinary areas.

**PO2:** Plan, execute and report the results of an extended experimental/theoretical physics based project in a research environment.

**PO3:** Apply theoretical knowledge of physical principles and mathematical techniques to practical problems

**PO4:** Be adept in the usage of the techniques, skills and modern physics tools for sustained professional development.

**PO5:** Compete in competitive examinations to take up assignment in public/private sectors.

| Vellalar College for Women (Autonomous) Erode-12 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Master of Science in Physics** | | | | | | | | |
| **2018-2019 Onwards** | | | | | | | | |
| **Course Content and Scheme of Examination (CBCS & OBE Pattern)** | | | | | | | | |
| **Semester-I** | | | | | | | | |
| **Study component** | **Subject code** | **Title of the paper** | **Inst. Hrs./ Week** | **Exam. Dur. Hrs.** | **Max. marks** | | | **Credits** |
| | | | | | **CIA** | **ESE** | **Total** | |
| Core | 18PHPC101 | Classical Mechanics | 5 | 3 | 25 | 75 | 100 | 4 |
| | 18PHPC102 | Mathematical Physics-I | 5 | 3 | 25 | 75 | 100 | 4 |
| | 18PHPC103 | Computational Methods and Programming | 5 | 3 | 25 | 75 | 100 | 4 |
| | 18PHPC104 | Quantum Mechanics-I | 5 | 3 | 25 | 75 | 100 | 4 |
| | 18PHPCP01 | Core Practical-I General Experiments | 3 | - | - | - | - | - |
| | 18PHPCP02 | Core Practical-II Electronics | 4 | - | - | - | - | - |
| Non-Major Elective | | | 3 | 3 | 25 | 75 | 100 | 5 |
| Total | | | | | | | 500 | 21 |
| **Semester-II** | | | | | | | | |
| **Study component** | **Subject code** | **Title of the paper** | **Inst. Hrs./ Week** | **Exam. Dur. Hrs.** | **Max. marks** | | | **Credits** |
| | | | | | **CIA** | **ESE** | **Total** | |
| Core | 18PHPC205 | Mathematical Physics-II | 6 | 3 | 25 | 75 | 100 | 4 |
| | 18PHPC206 | Advanced Electronics | 6 | 3 | 25 | 75 | 100 | 4 |
| | 18PHPC207 | Quantum Mechanics-II | 6 | 3 | 25 | 75 | 100 | 4 |
| | 18PHPCP01 | Core Practical-I General Experiments | 4 | 4 | 40 | 60 | 100 | 4 |
| | 18PHPCP02 | Core Practical-II Electronics | 4 | 4 | 40 | 60 | 100 | 4 |
| Skill Based Subject-I | 18PHPS201 | Advanced Multi Skill Paper | 3 | 2 | 40 | 60* | 100 | 5 |
| | | Library | 1 | - | - | - | - | - |
| Total | | | | | | | 600 | 25 |

| Semester-III | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Study component** | **Subject code** | **Title of the paper** | **Inst. Hrs./ Week** | **Exam. Dur. Hrs.** | **Max. marks** | | | **Credits** |
| | | | | | **CIA** | **ESE** | **Total** | |
| Core | 16PHPC308 | Condensed Matter Physics | 5 | 3 | 25 | 75 | 100 | 4 |
| | 16PHPC309 | Electromagnetic Fields and Waves | 5 | 3 | 25 | 75 | 100 | 4 |
| | 16PHPCP03 | Core Practical-III Advanced Experiments | 4 | - | - | - | - | - |
| | 16PHPCP04 | Core Practical-IV Special Electronics | 4 | - | - | - | - | - |
| Elective-I | 17PHPE301 | Introductory Astronomy, Astrophysics & Cosmology | 5 | 3 | 25 | 75 | 100 | 4 |
| Skill Based Subject-II | | | 3 | 3 | 25 | 75 | 100 | 5 |
| Skill Based Subject-III | | | 3 | 3 | 25 | 75 | 100 | 5 |
| | | Library | 1 | - | - | - | - | - |
| Total | | | | | | | 500 | 22 |
| **Semester-IV** | | | | | | | | |
| **Study component** | **Subject code** | **Title of the paper** | **Inst. Hrs./ Week** | **Exam. Dur. Hrs.** | **Max. marks** | | | **Credits** |
| | | | | | **CIA** | **ESE** | **Total** | |
| Core | 16PHPC410 | Nuclear and Particle Physics | 6 | 3 | 25 | 75 | 100 | 4 |
| | 16PHPC411 | Molecular Spectroscopy | 6 | 3 | 25 | 75 | 100 | 4 |
| | 16PHPCP03 | Core Practical-III Advanced Experiments | 4 | 6 | 40 | 60 | 100 | 4 |
| | 16PHPCP04 | Core Practical-IV Special Electronics | 4 | 6 | 40 | 60 | 100 | 4 |
| Elective-II | 17PHPE402 | Thermodynamics and Statistical Mechanics | 6 | 3 | 25 | 75 | 100 | 4 |
| | 09PHPC4PV | Project and Viva Voce | 3 | - | - | 100 | 100 | 2 |
| | | Library | 1 | - | - | - | - | - |
| Total | | | | | | | 600 | 22 |

| SKILL BASED SUBJECTS | | |
|---|---|---|
| Subject | Subject Code | Title of the Paper |
| 1 | 18PHPS201 | Advanced Multi Skill Paper* |
| 2 | 11PHPS302 | Nano Science and Technology (Cafeteria) |
| 3 | 11PHPS303 | Laser in Chemical and Biological Sciences (Cafeteria) |
| **NON MAJOR ELECTIVE** | | |
| Subject | Subject Code | Title of the Paper |
| 1 | 18PHPN101 | Atmospheric Physics |
| **SELF LEARNING PAPER** | | |
| Subject | Subject Code | Title of the Paper |
| 1 | 13PHPSL03 | Oceanography |
| *Online examination for three units for a maximum of 60 marks. Units IV & V are CIA for a maximum of 40 marks. | | |

**Components of CIA Marks (Theory)**

| Tests (I & II) | Assignment / Seminar / Subject Viva | Model Examination | Total |
|---|---|---|---|
| 10 | 5 | 10 | 25 |

**Components of CIA Marks (Practicals)**

| Tests (I & II) | Record | Performance | Model Examination | Total |
|---|---|---|---|---|
| 10 | 5 | 15 | 10 | 40 |

**CIA**

| Bloom's Category | Section | Choice | Marks | Total |
|---|---|---|---|---|
| K2 | A | Compulsory | 2 x 2 = 4 | 30 |
| K3, K4 | B | Either / Or | 2 x 5 = 10 | |
| K4, K5 | C | Either / Or | 2 x 8 = 16 | |

**Model and End Semester Examination**

| Bloom's Category | Section | Choice | Marks | Total |
|---|---|---|---|---|
| K2 | A | Compulsory | 5 x 2 = 10 | 75 |
| K3, K4 | B | Either / Or | 5 x 5 = 25 | |
| K4, K5 | C | Either / Or | 5 x 8 = 40 | |

**NON MAJOR ELECTIVE**

**Components of CIA**

Test - 10 Marks — Assignment / Seminar / Subject Viva - 5 Marks

Model Examination- 10Marks — Total - 25 Marks

| Section | Choice | Marks | Total |
|---|---|---|---|
| | Open Choice (5 out of 8) | 5 x 15 | 75 |

**SEMESTER – I**

| CODE | COURSE TITLE |
|---|---|
| 18PHPC101 | CLASSICAL MECHANICS |

| Category | CIA | ESE | L | T | P | Credit |
|---|---|---|---|---|---|---|
| Core | 25 | 75 | 71 | 4 | - | 4 |

## Preamble

The aim of this subject is to acquire in-depth knowledge in classical mechanics by introducing conservation laws for studying the dynamics of particle systems. It also helps to provide practice in using mathematical techniques pertaining to the development of Lagrangian and Hamiltonian formulations.

## Course Outcomes

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

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand the Newton's laws of motion to solve problems involving the dynamic motion of classical mechanical systems | K2 |
| CO2 | Analyze the kinematics of Elastic and Inelastic scattering and to explore the dynamics of rigid body | K4 |
| CO3 | Realize the elementary concepts of mechanics, and attain profound knowledge in the principles of Lagrangian and Hamiltonian | K2 |
| CO4 | Evaluate the different types of generating functions by means of Canonical transformation | K5 |
| CO5 | Build the mechanics of small oscillations applicable to different systems | K3 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | M | M | S | S |
| **CO2** | S | M | M | M | S |
| **CO3** | L | M | S | S | S |
| **CO4** | S | S | M | S | M |
| **CO5** | S | S | M | M | S |

S-Strong; M-Medium; L-Low

## Syllabus

**Unit – I** **(15 Hrs.)**

**Mechanics of Single and Systems of Particles:**

Newton's laws of motion - Mechanics of a particle - Equation of motion of a particle - Motion of a particle under constant force and alternating force - Mechanics of systems of particles - Angular momentum of the system - Potential and kinetic energies of the system - Motion in a central force field - Motion of two particles equivalent to single particle - Equation of motion of centre of mass with respect to centre of force - Motion in an inverse-square law force field - Classification of orbits

**Unit – II** **(15 Hrs.)**

**Collisions of Particles and Motion of Rigid Body :**

Elastic and inelastic scattering - Laboratory and centre of mass systems - Relations between different quantities in the laboratory and centre of mass systems - Kinematics of elastic scattering in the laboratory system - Inelastic scattering in the laboratory frame - Motion of a rigid body -Euler's theorem - Angular momentum and kinetic energy - Inertia tensor - Euler's equation of motion - Torque Free Motion - Euler's angles.

**Unit – III** **(15 Hrs.)**

**Lagrangian and Hamiltonian Formulations:**

Hamilton's variational principle - Lagrange's equations of motion - Conservation theorems and symmetry properties - Cyclic coordinates - Application of Lagrange's equation; Linear harmonic oscillator, particle moving under a central force, Atwood's machine - Hamilton's equations of motion - Application of Hamiltonian's equations of motion; Particle moving in an electromagnetic field - Phase space - Principle of least action

**Unit – IV** **(15 Hrs.)**

**Canonical Transformations and Poisson Brackets :**

Canonical transformations - Generating function - Properties of canonical transformations - Poisson brackets – Properties of Poisson brackets - Constant of motion using Poisson brackets - Poisson brackets of canonical variables - Poisson's Theorem - Invariance of Poisson bracket under canonical transformation - Motion as successive canonical transformation (Infinitesimal generators) - Liouville's theorem - The Hamilton–Jacobi equation - Action and angle variables

**Unit – V** **(15 Hrs.)**

**Small Oscillations:**

Small oscillations - Stable and unstable equilibrium - Lagrange's equation of motion for small oscillations - Normal coordinates and normal frequencies - Small oscillations of particles on string - Free vibrations of linear tri atomic molecule - Two carts connected with three springs - Triple pendulum - Double pendulum

## Text Books

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | R. G. Takwale and P. S. Puranik | Introduction to Classical Mechanics | Tata McGraw-Hill New Delhi | 2009, 39th Edition |

| | | | | |
|---|---|---|---|---|
| 2 | Charles Poole and John Safko Herbert Goldstein | Classical Mechanics | Pearson Education and Dorling Kindersley, New Delhi | 2011, 3rd Edition |
| 3 | Gupta, Kumar and Sharma | Classical Mechanics | PragatiPrakashan, New Delhi | 2010, 23th Edition |
| 4 | J.C. Upadhyaya | Classical Mechanics | Himalaya Publishing House, India | 2017, 2nd Edition |

**Reference Books**

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | Vimal Kumar Jain | Classical Mechanics | Ane Books PVT LTD | 2009, 1st Edition |
| 2 | R. Douglas Gregory | Classical Mechanics | Cambridge University Press | 2011, 1st Edition |

**Web Resources**

1. http://www.astro.caltech.edu/~golwala/ph106ab/ph106ab_notes.pdf
2. http://www.iitg.ac.in/physics/fac/saurabh/ph101/Lecture13.pdf
3. http://www.macs.hw.ac.uk/~simonm/mechanics.pdf
4. https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/MIT8_09F14_Chapter_4.pdf
5. https://static1.squarespace.com/static/570e7b14e707ebd28d391286/t/57e699cc2e69cf798a554723/1474730449322/classical-5.pdf

**Pedagogy**

- Lecture, PPT, Seminar, Quiz, and Group Discussion

**SEMESTER – I**

| CODE | COURSE TITLE |
|---|---|
| 18PHPC102 | MATHEMATICAL PHYSICS – I |

| Category | CIA | ESE | L | T | P | Credit |
|---|---|---|---|---|---|---|
| Core | 25 | 75 | 71 | 4 | - | 4 |

## Preamble

The aim of this subject is to introduce the basic mathematical topics necessary to realize and appreciate various physical laws of nature. It also provides the ability to formulate, interpret and draw inferences from mathematical solutions and to develop problem solving skills that contributes to innovation and applications of basic research.

## Course Outcomes

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

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Analyze the properties of different types of matrices and utilizing the idea of matrices and determinants to solve sets of simultaneous linear equations arising out of physical problems | K4 |
| CO2 | Apply to solve ordinary second order differential equations essential in physical problems | K3 |
| CO3 | Acquires Knowledge about different special mathematical functions | K3 |
| CO4 | Relate Laplace transform methods to solve elementary differential equations of interest in physics and engineering | K2 |
| CO5 | Expand periodic functions using Fourier series under a valid condition | K2 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | S | L | S |
| **CO2** | M | S | S | S | S |
| **CO3** | S | M | S | M | S |
| **CO4** | M | S | M | S | M |
| **CO5** | S | M | S | S | S |

S- Strong; M-Medium; L-Low

## Syllabus

**Unit-I** **(15 Hrs.)**

**Matrices and Determinants :**

Properties of matrix addition and multiplication - different type of matrices and their properties - Rank of a Matrix and some of its theorems - Solution to linear homogeneous and non homogeneous equations - Cramers rule – eigen values and eigenvectors of matrices - differentiation and integration of matrix.

**Unit-II** **(15 Hrs.)**

**Solving of differential equations :** Homogeneous linear equations of second order with constant coefficients and their solutions - ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods - extended power series method for indicial equations.

**Unit-III** **(15 Hrs.)**

**Special differential equations and their solutions :**

Legendre's differential equation: Legendre polynomials - Generating functions - Recurrence Formulae– Rodrigue's formula - orthogonality of Legendre's polynomial;Bessel's differential equation: Bessel's polynomial - generating functions - Recurrence Formulae - orthogonal properties of Bessel's polynomials - Hermite differential equation - Hermite polynomials - generating functions - recurrence relation.

**Unit-IV** **(15 Hrs.)**

**Laplace Transform :**

Laplace transforms: Linearity property, first and second translation property of LT - Derivatives of Laplace transforms - Laplace transform of integrals - Initial and Final value theorems; Methods for finding LT:direct and series expansion method, Method of differential equation; Inverse Laplace transforms: Linearity property, first and second translation property, Convolution property - Application of LT to differential equations and boundary value problems.

**Unit-V** **(15 Hrs.)**

**Fourier series and integrals :**

Fourier series definition and expansion of a function x - Drichlet's conditions - Assumptions for the validity of Fourier's series expansion and its theorems - Complex representation of Fourier series - problems related to periodic functions - graphical representation of FS - Fourier integrals - convergence of FS - some applications of Fourier transforms.

**Text Books**

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | B.D.Gupta | Mathematical Physics | Vikas Publishing House Pvt ltd. | 2006, 3rd Edition |
| 2 | Dass.H.K, Rama Verma | Mathematical Physics | S. Chand & Sons, New Delhi | 2015, 7th Edition |
| 3 | G. Arfken | Mathematical methods for physics | Elsevier | 2010, 6th Edition |
| 4 | Sathya Prakash | Mathematical Physics | S. Chand & Sons, New Delhi | 2014, 6th Edition |

**Reference Books**

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | Rajput | Mathematical Physics | PragatiPrakasam, Meerut | 2004, 17th Edition |
| 2 | Erwin Kreyszig | Advanced Engineering mathematics | Wiley Eastern Limited Publications | 1993, 7th Edition |
| 3 | George.E Andrews Richard Askey Ranjan Ray | Special Function | Cambridge University | 2010, 1st Edition |

**Web Resources**

1. http://www.pbte.edu.pk/text%20books/dae/math_113/Chapter_09.pdf
2. http://home.iitk.ac.in/~sghorai/TEACHING/MTH203/ode14.pdf
3. http://www.egyankosh.ac.in/bitstream/123456789/12543/1/Unit-3.pdf
4. http://www.vyssotski.ch/BasicsOfInstrumentation/LaplaceTransform.pdf
5. http://olewitthansen.dk/Mathematics/Fourier_series.pdf

## Pedagogy

- Lecture, PPT, Seminar, Quiz, and Assignment

## SEMESTER I

| CODE | COURSE TITLE |
|---|---|
| 18PHPC103 | COMPUTATIONAL METHODS AND PROGRAMMING |

| Category | CIA | ESE | L | T | P | Credit |
|---|---|---|---|---|---|---|
| Core | 25 | 75 | 71 | 4 | - | 4 |

### Preamble

The aim of this subject is to introduce various numerical and computational techniques useful to handle complex problems and to concentrate on logically intractable problems in physics using computational tools. It also enhances the various computational techniques with programming basic in MATLAB.

### Course Outcomes

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

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand the basic idea about finding solutions using computational methods | K2 |
| CO2 | Explore the concepts involved in eigen values and interpolation and learn how to interpret and analyze data visually | K4 |
| CO3 | Employ the tools needed to formulate numerical differentiation and integration | K3 |
| CO4 | Compute the solution of differential equations and apply it to real-world problems | K3 |
| CO5 | Assess numerical algorithms through MATLAB and visualize the results of the computations | K5 |

### Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | S | S | S |
| **CO2** | S | S | S | S | S |
| **CO3** | S | M | S | S | S |
| **CO4** | S | S | S | S | M |
| **CO5** | S | S | S | S | S |

S- Strong; M-Medium; L-Low

## Syllabus

**UNIT – I** **(15 Hrs.)**

**Roots of equation :**

Bisection method - False position method - Newton Raphson method - Basic Gauss elimination method - Gauss elimination with partial pivoting - Gauss Jacobi iteration method - Gauss Seidal iteration method - Inversion of a matrix using Gauss elimination method

**UNIT – II** **(15Hrs )**

**Curve fitting and interpolation :**

Method of least squares - straight line, parabola , $y = ax^n$ , $y = ae^{bx}$, $y = a+bx^n$ type curves - sum of squares of residuals for straight line and parabola fit-Forward and Backward differences - Gregory Newton forward and backward interpolation formula for equal intervals - Divided difference - properties of divided differences - Newton's divided differences formula - Lagrange's interpolation formula for unequal intervals.

**UNIT – III** **(15 Hrs.)**

**Numerical integration and differences :**

Newton's forward and backward differences formula to get the derivatives (First and Second order) - Divided differences table to calculate derivatives for unequal intervals Newton - cotes formula - (Trapezoidal rule, Simpson's rule, Simpson's 3/8 rule) - Error estimates in trapezoidal and Simpson's rule.

**UNIT – IV** **(15 Hrs.)**

**Differential Equation :**

Basic Euler method - Improved Euler method - Modified Euler method - RungeKutta fourth order method - RK4 Method for first order differential equation – partial differential equation - Difference - quotients - Graphical representations of partial quotients - Classification of partial differential equation of the second order - standard and diagonal five point formula for laplace equations - solution of laplace's equation (Liebmann's iterations process).

**UNIT – V** **(15 Hrs.)**

**Matlab Fundamentals :**

Introduction - Matlab Features - Desktop Windows: Command Hstory, Workspace, Array Editor and Current Directory - Matlab Help and Demos - Matlab Functions, characters, operators and commands. Basic arithmetic in Matlab - Basic Operations with Scalars, Vectors and Arrays - Matrices and matrix Operations - Complex Numbers - Matlab Built in Functions - Illustrative examples Control flow statements: if, else, else if, switch Statements - For, while loop structures - break Statement- Input-Output Commands - Function m files - Script m files - Controlling Output.

**Programming:**

Charging of a capacitor in an RC circuit with three times constant - Plotting input and output characteristics of an NPN transistor.

**Text Books**

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | K. Venkataraman | Numerical methods in science and engineering | National publishing company | 2001, 5th Edition |
| 2 | P. Kandasamy, K. Thilgavathy, K. Gunavathy | Numerical methods | S. Chand & Company Ltd., New Delhi. | 2014, 1st Edition |
| 3 | E. Balagurusamy | Numerical methods | Tata McGraw Hill Publishing Company Ltd | 2001, 1st Edition |
| 4 | Jain M.K, Iyengar S.R.K & Jain R.K | Numerical methods for scientific and engineering computation | New Age International | 2008, 5th Edition |
| 5 | Rudhra Prathab | Getting started with MATLAB | Oxford University Press, New Delhi | 2005, 7th Edition |

**Reference Books**

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | John H. Mathews | Numerical methods for mathematics science and Engineering | Prentice Hall of India Pvt. Ltd., New Delhi | 1992, 2nd Edition |
| 2 | T.Veerarajan & T. Ramachandran | Numerical methods | Tata McGraw Hill, New Delhi. | 2008, 2nd Edition |
| 3 | Brain Hunt, Ronald Lipsman, Jonathan Rosenberg | A Guide to Matlab for Beginners & Experienced Users | Cambridge University Press. | 2006, 2nd Edition |

**Web Resources**

1. http://www.universityofcalicut.info/SDE/BSc_maths_numerical_methods.pdf
2. http://www.egyankosh.ac.in/bitstream/123456789/31291/1/Unit-13.pdf
3. http://drkk.in/wp-content/uploads/2014/04/MAT211_Numerical_Methods_Formulae.pdf
4. https://www.svce.ac.in/departments/maths/CITM/NUMERICAL%20METHODS/unit%205.pdf
5. http://homen.vsb.cz/~lud0016/nm/matlab_guide.pdf

**Pedagogy**

- Lecture, PPT, Seminar, Quiz and Assignment

## SEMESTER I

| CODE | COURSE TITLE |
|---|---|
| 18PHPC104 | QUANTUM MECHANICS – I |

| Category | CIA | ESE | L | T | P | Credit |
|---|---|---|---|---|---|---|
| Core | 25 | 75 | 71 | 4 | - | 4 |

### Preamble

The aim of this subject is to extend the knowledge of solving time-dependent and time-independent Schrödinger equation for simple potentials and helps to understand the approximation methods for many electron system. It also provides the knowledge of role of angular momentum in physical problems.

### Course Outcomes

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

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Familiarize the concept of linear vector space, Hermitian operator and Heisenberg Uncertainty Principle | K2 |
| CO2 | Understand the role of uncertainty in quantum physics and establishing the commutation relationship between components of angular momentum | K2 |
| CO3 | Apply Schrödinger equation to obtain wave functions for some basic, physically important types of potential in one dimension and three dimension | K3 |
| CO4 | Analyze the approximate methods needed to formulate quantum mechanical problems | K4 |
| CO5 | Evaluate the solution of many electron system by integrating the ideas of Central field approximation, Thomas Fermi model and Hartree Folk equation | K5 |

### Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | M | S | S |
| **CO2** | M | S | S | S | S |
| **CO3** | S | M | S | S | S |
| **CO4** | S | S | S | S | M |
| **CO5** | S | S | S | S | S |

S- Strong; M-Medium; L-Low

## Syllabus

**Unit -I** **(15 Hrs.)**

**General formalism of quantum mechanics :**

Linear Vector Space - Linear Operator - Eigen Functions and Eigen Values - Hermitian Operator- Postulates of Quantum Mechanics - Simultaneous Measurability of Observables - General Uncertainty Relation - Dirac's Notation - Equations of Motion; Schrodinger, Heisenberg and Dirac representation- momentum representation.

**Unit -II** **(15 Hrs.)**

**Energy Eigenvalue problems :**

Particle in a box - Linear Harmonic oscillator: Schrödinger method and operator method - Tunnellingthrough a barrier - Particle moving in a spherically symmetric potential - Separation of equation - System of two interacting particles - Rigid rotator - Hydrogen atom – eigenfunction - radial probability density.

**Unit -III** **(15 Hrs.)**

**Angular Momentum :**

Orbital Angular Momentum - Spin Angular Momentum - Total Angular Momentum Operators - Commutation Relations of Total Angular Momentum with Components - Ladder operators - Commutation Relation of $J_z$ with $J_+$ and $J_-$ - Eigenvalues of $J^2$, $J_z$ - Matrix representation of $J^2$, $J_z$, $J_+$ and $J_-$ - Addition of angular momenta - ClebschGordon Coefficients.

**Unit- IV** **(15 Hrs.)**

**Approximate Methods:**

Time Independent Perturbation Theory in Non-Degenerate Case - Degenerate Case-Stark Effect in Hydrogen atom - Spin-orbit interaction - Variation Method - Born-Oppenheimer approximation - WKB Approximation.

**Unit- V** **(15 Hrs.)**

**Many Electron Atoms:**

Indistinguishable particles - Pauli principle- Inclusion of spin - spin functions for two-electrons - The Helium Atom - Central Field Approximation - Thomas-Fermi model of the Atom - Hartree Equation- Hartree -Fock equation.

**Text Books**

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | G.Aruldhas | Quantum Mechanics | Phi Learning Pvt. Ltd. | 2013, 2th Edition |
| 2 | P.M. Mathews &K.Venkatesan | A Text Book of Quantum Mechanics | TataMcGraw Hill | 2004, 1st Edition |
| 3 | David J.Griffiths | Introduction to Quantum Mechanics | Cambridge University Press | 2017, 1st Edition |

**Reference Books**

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | L.I Schiff and Jayendran | Quantum Mechanics | McGraw Hill Education | 2016, 4th Edition |
| 2 | A. Devanathan | Quantum Mechanics | Narosa Publishing | 2006, 1st Edition |
| 3 | R.Shankar | Principles of Quantum Mechanics, | SpringerPvt Ltd | 2007, 1st Edition |

**Web Resources**

1. http://alan.ece.gatech.edu/ECE6451/Lectures/ECE6451L4PostulatesOfQMAndOperatorsVer2.pdf
2. https://www.phas.ubc.ca/~mcmillan/rqpdfs/5_qm_in_one_dimension.pdf
3. http://courses.physics.ucsd.edu/2009/Fall/physics130b/Ang_Mom.pdf
4. https://datagrid.hu/boda/Boda-sajat/Rush/Matek/Math-ChemPhys/Ch12.pdf
5. http://wwwteor.mi.infn.it/~molinari/NOTES/hartree.pdf

**Pedagogy**

- Lecture, PPT, Seminar, Quiz and Group Discussion

## SEMESTER – II

| CODE | COURSE TITLE |
|---|---|
| 18PHPC205 | MATHEMATICAL PHYSICS – II |

| Category | CIA | ESE | L | T | P | Credit |
|---|---|---|---|---|---|---|
| Core | 25 | 75 | 86 | 4 | - | 4 |

### Preamble

The aim of this subject is to acquire basic knowledge of some advanced topics in Mathematical Physics, such as the group theory, tensor analysis and linear vector space and to provide a deeper understanding of the mathematics underpinning different fields of theoretical physics. It also provides the ability to formulate, interpret and draw inferences from mathematical solutions.

### Course Outcomes

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

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Analyze a formal treatment of probability theory and to equip with essential tools for statistical analysis | K4 |
| CO2 | Understand the basic concepts underlying complex analysis | K2 |
| CO3 | Apply group theory and integral transforms to solve mathematical problems of interest in physics | K3 |
| CO4 | Establish the relation for linearly dependent and independent vectors | K4 |
| CO5 | Build up a solid background of tensor analysis required to understand the properties of materials and their structures | K5 |

### Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | S | S | S |
| **CO2** | S | S | S | S | S |
| **CO3** | S | M | S | S | S |
| **CO4** | S | S | S | S | M |
| **CO5** | S | S | S | S | S |

S- Strong; M-Medium; L-Low

## Syllabus

**Unit -I** **(18 Hrs.)**

**Probability :**

Probability-Addition rule of Probability - Multiplication Law of Probability - Probability distribution - Binomial distribution - mean Binomial distribution - Standard deviation of binomial distribution - Poisson distribution - Normal distribution - characteristics of normal distribution - Applications of normal distribution.

**Unit- II** **(18 Hrs.)**

**Complex variables :**

Complex Algebra - Cauchy-Riemann Conditions - Cauchy's Integral Theorem - Cauchy's Integral formula - Laurent expansion – singularities – Mapping - Conformal mapping - Calculus of residues.

**Unit – III** **(18 Hrs.)**

**Group Theory :**

Definition of Group - Subgroup, invariant group, abelian group, orthogonal and unitary groups - Homomorphism, isomorphism - Reducible and irreducible representations - Generators of Continuous groups.

**Unit – IV** **(18 Hrs.)**

**Linear vector spaces :**

Definition and Examples - Real Linear vector space - Uniqueness of Null and Reversed vectors - Scalar Products of Vectors : Definition of Scalar Product of two vectors, Scalar product for real linear vector spaces, Cauchy - Schwartz inequality - Metric Spaces - Linear Independence of vectors and basis for a vector space - Dimension of a vector space - Orthonormal basis - Vector Subspaces - Direct sum decomposition.

**Unit – V** **(18 Hrs.)**

**Tensor Analysis :**

Definition of Tensors - Contravariant, covariant and mixed tensors - addition and subtraction of Tensors - Summation convention - Symmetry and Anisymmmetry Tensor - Contraction and direct product - Quotient rule- Pseudotensors, Levi - Civita Symbol - Dual tensors, irreducible tensors - Metric Tensors - Christoffel symbols - Geodesics.

## Text Books

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | G. Arfken | Mathematical methods for physics | Elsevier | 2010, 6th Edition |
| 2 | S.D. Joglekar | Mathematical Physics | Universities Press Pvt. Ltd. | 2005, 1st Edition |
| 3 | H.K. Dass and R. Verma | Mathematical Physics | S. Chand & Company | 2001, 2nd Edition |
| 4 | Sathya Prakash | Mathematical Physics | S. Chand & Sons, New Delhi | 2014, 6th Edition |

## Reference Books

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | Erwin Kreyszig | Advanced Engineering mathematics | Wiley Eastern | 1993, 7th Edition |
| 2 | B.D. Gupta | Mathematical Physics | Vikas Publishing House Pvt.Ltd | 2006, 3rd Edition |

**Web Resources**

1. http://www.iiserpune.ac.in/~ayan/MTH201/Sahoo_textbook.pdf
2. http://www.math.s.chiba-u.ac.jp/~yasuda/ippansug/CV-bookfi.pdf
3. http://www.matfys.lth.se/education/FYS256/aryasetiawan.pdf
4. http://nptel.ac.in/courses/122106034/quantumphysics.pdf
5. http://nasc.ac.in/nasc/images/StudyMaterials/Physics/MScTensors.pdf

## Pedagogy

- Lecture, PPT, Seminar, Quiz and Assignment

## SEMESTER II

| CODE | COURSE TITLE |
|---|---|
| 18PHPC206 | ADVANCED ELECTRONICS |

| Category | CIA | ESE | L | T | P | Credit |
|---|---|---|---|---|---|---|
| Core | 25 | 75 | 86 | 4 | - | 4 |

**Preamble**

The aim of this subject is to emphasis the basic working of semiconducting devices and to analyze/ design the circuits based on linear integrated circuits for particular applications. It also helps to analyze logic processes and implement logical operations using combinational and sequential logic circuits. It provides the knowledge of the architecture and the instruction set of microprocessors and the basic ideas about microcontroller.

**Course Outcomes**

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

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Know about the current voltage characteristics of semiconductor devices | K2 |
| CO2 | Develop their knowledge in understanding the various parameters of operational amplifiers and their linear applications | K3 |
| CO3 | Explain the combinational and sequential logic circuits | K5 |
| CO4 | Examine the design aspects of I/O and memory interfacing circuits | K4 |
| CO5 | Acquire knowledge of the 8086 instruction set to utilize it in programming and to distinguish the properties of Microprocessors & Microcontrollers | K3 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | S | S | S |
| **CO2** | S | S | S | S | S |
| **CO3** | S | M | S | S | S |
| **CO4** | S | S | S | S | M |
| **CO5** | S | S | S | S | S |

S- Strong; M-Medium; L-Low

## Syllabus

**Unit-I** **(18 Hrs.)**

**Semiconductor Diodes and Devices :**

Varactor diode - Schottky diode - Tunnel Diode - Gunn diode - Optoelectronic diodes - LED and photo diode - Junction Field Effect transistor - Structure and working - I -V Characteristics - CS amplifier design - MOSFET: Depletion and Enhancement type MOSFFT - Structure and working - volt - ampere characteristics - MOSFET as a switch - UJT characteristics - Relaxation oscillator - SCR characteristics - application in power control- DIAC,TRIAC.

**Unit-II** **(18 Hrs.)**

**Operational Amplifier and Applications :**

Operational amplifier characteristics - Parameters of an OP-Amp - inverting and non-inverting amplifier - Sign changer - Scale changer - Adder - Subtractor- Integrator - Differentiator - Solving simultaneous and differential equations - log & antilog amplifiers - Generation of square, triangular and sine waves (Wein's bridge oscillator) - Schmitt trigger - Active filters (Second order Butterworth design) - Timer 555 : Internal architecture and working - Schmitt trigger - Astable and monostable multivibrators.

**Unit-III** **(18 Hrs.)**

**Digital Circuits and Devices :**

Binary adder and Subtractor (using NAND gates) - Decoder/Demultiplexer: BCD to Decimal Decoder-4-to-16 line Demultiplexer; Data Selector/Multiplexer: 16-to-1 Multiplexer; Encoder- clocked SR Flip flops- D-type, JK and M/S JK Flip-Flops - Counters - Asynchronous and Synchronous - BCD counter - Shift registers types - serial register - Ring counter - Johnson counter - Memories: RAM, ROM, PROM, EPROM(qualitative explanation) - D to A conversion: weighted resister DAC - Binary R-2R ladder DAC - A to D conversion: counter type ADC - successive approximation converter - dual slope

**Unit-IV** **(18 Hrs.)**

**Microprocessor 8085 and applications :**

Architecture of 8085 - Pin configuration - Instruction set of 8085- Instruction types - based on number of bytes, based on operation - Addressing modes - Interrupts: Maskable and non-maskable, vectored interrupts- Memory mapped I/O scheme - I/O mapped I/O scheme - Memory and I/O interfacing- Programmable peripheral interface (8255A) - Microprocessor based temperature monitoring systems - block diagram - Digital to analog conversion using DAC 0800 interfacing through PPI 8255 - Block diagram - Analog to digital conversion using ADC 0809 - Block diagram.

**Unit-V** **(18 Hrs.)**

**Microprocessor 8086 and Microcontroller:**

The 8086 microprocessor - Architecture - Instruction classification - Instruction format - Data transfer operation - Arithmetic operations - Logic operations - rotate, compare - Writing assembly language programmes - Addition, Subtraction, Multiplication, Division - Comparison between microcontroller and microprocessors - The 8051 microcontroller - 8051 Architecture - Registers in 8051 - Pin description.

**Text Books**

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | Mill Mann & Hal kais | Integrated Electronics | Tata McGraw Hill, New Delhi. | 2005, 1th Edition |
| 2 | A.P. Malvino and D.P. Leach | Digital Principles and Applications | Tata McGraw-Hill, Publishing Co., New Delhi. | 2007, 4th Edition |
| 3 | Goankar | Microprocessor & architecture programming and application with 8085/8080 | New World International (P) Ltd | 1999, 4th Edition |
| 4 | V.Vijayendran | Fundamentals of Microprocessor - 8086 | S.ViswanathanPvt Ltd. | 2002, 1st Edition |
| 5 | Kenneth J. Ayala | The 8051 Microcontroller | Penram International Publishing | 2004, 3rd Edition |

**Reference Books**

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | Jacob Millman, Christos C Halkins and Chetan | Integrated Electronics Analog and Digital Circuits and Systems | Tata McGraw Hill Educatio Private Limited, New Delhi | 2010, 2nd Edition |
| 2 | Jacob mill Mann, Arvin Grabel | Microelectronics | Tata McGraw Hill, New Delhi. | 2003, 2nd Edition |
| 3 | V.Vijayendran | Fundamentals of Microprocessor - 8085 | S.Viswanathan PVT.,LTD. | 2009, 2nd Edition |
| 4 | Douglas V.Hall | Microprocessors and Interfaces | Tata McGraw Hill Company | 1999, 1st Edition |
| 5 | Floyd | Digital fundamentals | Universal Book Stall, New Delhi. | 2003, 1st Edition |

**Web Resources**

1. http://erzurum.edu.tr/Content/Yuklemeler/Personel/Bulent_CAKMAK/Kitap12570.pdf
2. http://www.ti.com/lit/an/sboa092b/sboa092b.pdf
3. http://mirror.thelifeofkenneth.com/lib/electronics_archive/DigitalElectronicsBook.pdf

4. http://ecehithaldia.in/teaching_material/Pinaki_Microprocessor846806128.pdf
5. http://www.nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/pdf/Lecture_Notes/LNm1.pdf

**Pedagogy**

- Lecture, PPT, Seminar, Quiz and Field visit

## SEMESTER II

| CODE | COURSE TITLE |
|---|---|
| 18PHPC207 | QUANTUM MECHANICS – II |

| Category | CIA | ESE | L | T | P | Credit |
|---|---|---|---|---|---|---|
| Core | 25 | 75 | 86 | 4 | - | 4 |

**Preamble**

The aim of this subject is to build up solid and systematic problem solving skills and to provide the foundations for molecular physics, nuclear physics and solid state physics. It also helps to demonstrate the principles of relativistic quantum mechanics and comprehend basic quantum mechanical applications at the research level.

**Course Outcomes**

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

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Apply the concept of time dependent perturbation theory to develop Fermi Golden Rule | K3 |
| CO2 | Understand the interaction of particles through scattering theory | K2 |
| CO3 | Impart the knowledge of theory of radiations on the basis of semi classical treatment | K2 |
| CO4 | Analyze the behavior of particles at high energies and velocity comparable to the speed of light using relativistic wave equations | K4 |
| CO5 | Focus the dynamics of quantum field theory | K5 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | S | S | S |
| **CO2** | S | S | S | S | S |
| **CO3** | S | M | S | S | S |
| **CO4** | S | S | S | S | M |
| **CO5** | S | S | S | S | S |

S- Strong; M-Medium; L-Low

## Syllabus

**Unit –I** **(18 Hrs.)**

**Time Dependent Perturbation Theory :**

Time Dependent Perturbation Theory-First and Second Order Transitions -Transition to Continuum of States - Fermi Golden Rule - Constant and Harmonic Perturbation – Collision - Adiabatic and Sudden Approximation - A Charged Particle in an Electromagnetic Field.

**Unit -II** **(18 Hrs.)**

**Scattering Theory:**

Scattering Amplitude - Expression in terms of Green's Function - Born Approximation and Its validity - Partial wave analysis - Phase Shifts - Asymptotic behavior of Partial Waves -The Scattering Amplitude in Terms of Phase Shift - Scattering by Coulomb Potential and Yukawa Potential.

**Unit- III** **(18 Hrs.)**

**Theory of Radiation (Semi Classical Treatment) :**

Einstein's Coefficients - Spontaneous and Induced Emission of Radiation from Semi Classical Theory - Radiation Field as an Assembly of Oscillators - Interaction with Atoms - Emission and Absorption Rates - Density Matrix and its *Applications*.

**Unit –IV** **(18 Hrs.)**

**Relativistic Wave Equation :**

Klein Gordon Equation - Plane Wave Equation-Charge and Current Density - Application to the Study of Hydrogen Like Atom - Dirac Relativistic Equation for a Free Particle - Dirac Matrices - Dirac Equation in Electromagnetic Field - Negative Energy States.

**Unit- V** **(18 Hrs.)**

**Quantum Field Theory :**

Quantization of Wave Fields - Classical Lagrangian Equation-Classical Hamiltonian Equation - Field Quantization of the Non-Relativistic Schrodinger Equation - Creation, Destruction and Number Operators - Anti Commutation Relations - Quantization of Electromagnetic Field Energy and Momentum.

## Text Books

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | G Aruldhas | Quantum Mechanics | Phi Learning Pvt. Ltd. | 2013, 2th Edition |
| 2 | P.M. Mathews & K. Venkatesan, | Text Book of Quantum Mechanics | Tata McGraw Hill | 2004, 1st Edition |
| 3 | David J.Griffiths | Introduction to Quantum Mechanics | Cambridge University Press | 2017, 1st Edition |
| 4 | A Devanathan | Quantum Mechanics | Narosa Publishing | 2006, 1st Edition |

**Reference Books**

| Sl.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1 | L.I Schiff and Jayendran | Quantum Mechanics | McGraw Hill Education | 2016, 4th Edition |
| 2 | A. Devanathan | Quantum Mechanics | Narosa Publishing | 2006, 1st Edition |
| 3 | R.Shankar | Principles of Quantum Mechanics, | SpringerPvt Ltd | 2007, 1st Edition |
| 4 | L.I Schiff and Jayendran | Quantum Mechanics | McGraw Hill Education | 2016, 4th Edition |

**Web Resources**

1. http://web.mst.edu/~parris/QuantumTwo/Class_Notes/TDPT.pdf
2. http://www.tcm.phy.cam.ac.uk/~bds10/aqp/lec20-21_compressed.pdf
3. http://folk.ntnu.no/ioverbo/TFY4250/til15eng.pdf
4. http://www.phy.ohiou.edu/~elster/lectures/advqm_3.pdf
5. http://users.physik.fu-berlin.de/~kleinert/b6/psfiles/Chapter-6-qurelfld.pdf

**Pedagogy**

- Lecture, PPT, Seminar, Quiz and Group Discussion

## SEMESTER II

| CODE | COURSE TITLE |
|---|---|
| 18PHPCP01 | CORE PRACTICAL-I<br>GENERAL EXPERIMENTS |

| Category | CIA | ESE | L | T | P | Credit |
|---|---|---|---|---|---|---|
| Core | 40 | 60 | - | - | 105 | 4 |

**Preamble**

The aim of this subject is to gain and enhance the student understanding the basic Physics concepts through hands on experience. It provides the link between theory and practical in Physics and to differentiate between inferences based on theory and the outcomes of experiments. It also helps to develop and improve their experimental and programming skills.

**Course Outcomes**

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

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand the basics of physics involved in experiments and to compare the results with theoretical calculations. | K2 |
| CO2 | Develop the skill of performing experiments accurately. | K3 |
| CO3 | Gain knowledge of new conception in the solution of practical oriented problems and to virtually visualize the experiments through MATLAB programming. | K3 |
| CO4 | Explore the concepts of measurement technology, usage of new instruments and real time application in day to day requirements. | K4 |
| CO5 | Enhance the basic communication skills in the course of performing the laboratory experiments in groups and by interpreting the results | K6 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | S | S | S |
| **CO2** | S | S | S | S | S |
| **CO3** | S | M | S | S | S |
| **CO4** | S | S | S | S | M |
| **CO5** | S | S | S | S | S |

S- Strong; M-Medium; L-Low

**Syllabus**

## CORE PRACTICAL – I
## GENERAL EXPERIMENTS
### (Examination at the end of Second Semester)
### Any Twelve Experiments

1. Young's modulus - elliptical fringes (Cornu's method)
2. Young's modulus - hyperbolic fringes (Cornu's method)
3. Stefan's constant.
4. Thickness of wire by air wedge and diffraction.
5. Thermal conductivity - Forbe's method.
6. Electronic charge 'e' by Millikan's oil drop method.
7. Electronic specific charge 'e/m' by Thomson's method.
8. Thermistor - temperature coefficient and band gap energy distribution.
9. Specific heat of a liquid - Ferguson's method.
10. Biprism on optical bench - determination of wavelength.
11. Determination of Viscosity of Liquid.
12. Diffraction at a prism face - determination of wavelength.
13. Photo Electric Cell - Planck 's constant.
14. e/m of Electron - Helical Method.

**MATLAB Programming**

15. Roots of a quadratic equation, solution of a system of linear equations.
16. Newton-Raphson method and Runge Kutta method .
17. Curve fitting and interpolation.
18. Charging of a capacitor in an RC circuit with three time constants.
19. NPN transistor - Input and Output Characteristics.
20. Frequency response of a low pass filter.

## SEMESTER II

| CODE | COURSE TITLE |
|---|---|
| 18PHPCP02 | CORE PRACTICAL-II<br>ELECTRONICS |

| Category | CIA | ESE | L | T | P | Credit |
|---|---|---|---|---|---|---|
| Core | 40 | 60 | - | - | 120 | 4 |

**Preamble**

The aim of this subject is to familiarize the basic concepts involved in the operation of solid state devices and to give an opportunity to do the experiments individually. It also helps to understand the basic concepts in ICs and digital devices and to acquire hands-on laboratory experience in utilizing modern test equipment.

**Course Outcomes**

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

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Acquire knowledge on the different experimental techniques involved in electronics. | K3 |
| CO2 | Explain the functions of various semiconductor devices and op amps characteristics. | K5 |
| CO3 | Develop the link connecting theory and designing workable circuits | K3 |
| CO4 | Analyze, design, build and troubleshoot the combinational circuits using digital ICs. | K4 |
| CO5 | Think innovatively and also improve the creative skills that are essential for present day requirements. | K4 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | S | S | S |
| **CO2** | S | S | S | S | S |
| **CO3** | S | M | S | S | S |
| **CO4** | S | S | S | S | M |
| **CO5** | S | S | S | S | S |

S- Strong; M-Medium; L-Low

## SEMESTER II

**Syllabus**

### CORE PRACTICAL – II
### ELECTRONICS
**(Examination at the end of Second Semester)**
**Any Twelve Experiments**

1. Regulated and Dual power supply Construction.
2. Parameters of Op - amp.
3. Wave form generators - Op-amp.
4. Wein's bridge oscillator - Op-amp.
5. Phase Shift Oscillator - Op-amp
6. Active filters - Op-amp.
7. Frequency response of an Op - amp
8. Sign, scale changer, adder and Subtractor - Op-amp.
9. Op - Amp : Voltage to current and current to voltage converter
10. Analog computer setup for solving simultaneous equations.
11. UJT relaxation oscillator & Schmitt trigger using IC 555.
12. Construction of Half - Adder and Full - Adder circuits using NAND gates.
13. Construction of Half - Subtractor and full - Subtractor circuits using NAND gates.
14. A.C amplifier-inverting, non-inverting, voltage follower-op-amp.
15. Multiplexer and Demultiplexer.
16. Decode and Encoder
17. Construction of amplitude modulation circuit and to calculate the modulation index.
18. Two stage amplifier
19. SCR - Characteristics and its applications
20. Source Follower- FET.

**SEMESTER - I**
**Non Major Elective**
**ATMOSPHERIC PHYSICS**

**Instructional Hrs.: 45** **Sub. Code: 18PHPN101**

**Max. Marks: CIA -25; ESE -75** **Credits: 5**

**Objective :** To create interest in the basics of atmospheric physics for students of other disciplines.

**UNIT I** **9 Hrs.**

**Basic Concepts:** Evolution of the atmosphere - structure of atmosphere - Energy in the atmosphere - Factors influencing Isolation - Heating and Cooling of the atmosphere - temperature - Evaporation - Condensation - Precipitation - Climatic types of the world - Hydrosphere - nature of water - Ocean water.

**UNIT II** **9 Hrs.**

**Composition and structure of the Atmosphere:** Composition of the atmosphere - Permanent Gases - Minor Gases - Particles in the atmosphere - Structure on the basic of composition - Chemical structure - Ionic structure - The outer atmosphere.

**UNIT III** **9 Hrs.**

**Insolation and heat budget:** Introduction - Nature of radiation - Insolation - factors governing insolation - Transfer of insolation through the atmosphere - Terrestrial radiation - Heat budget of the earth - atmospheric system.

**UNIT IV** **9 Hrs.**

**Temperature and Pressure:** Introduction - Factors controlling temperature distribution - horizontal aspects - Factors controlling pressure - summer and winter pattern of pressure.

**UNIT V** **9 Hrs.**

**Atmospheric Pollution:** Role of Meteorology in Atmospheric Pollution - Atmospheric Boundary Layer - Air Stability - Local Wind Structure - Ekman Spiral - Turbulence & Boundary Layer Scaling - Residence Time and Reaction Rates of Pollutants - Sulphur Compounds - Carbon Compounds - Organic compounds – Aerosols - Toxic Gases and Radio Active Particles - Trace Gases

**Text Books**

1. **Anthes R.A., Panofsky, Cahir H.A., and Rango**, *Atmosphere* ,Columbus,Ohio, 1981, (Unit I and II).
2.**Cole F.W.,** *Introduction to meteorology***,** Wiley., New York, 1980, (Unit IV and V).
3. **Siddhartha K.,** *Atmosphere weather and climate*, Kisalaya Publications Pvt Ltd., New Delhi, 2005, **(** Unit I to V).

**Reference Books**

1. **Berry, Bollay F.A., and Beers**, *Hand book of Meteorology*, Tata Mc Graw Hill , 1985.
2. **Budyoko,** *TheEarths Climate Past & Future***,** Academic Press, 1982.

**SEMESTER II**
**SKILL BASED SUBJECT - I**
**ADVANCED MULTI SKILL PAPER**

**Instructional Hrs: 45** **Sub Code: 18PHPS201**
**Max. Marks: CIA - 40; ESE -60** **Credits: 5**

**Aim**: To equip the students with knowledge on all topics as desirable from the point of view of brilliant success in the competitive examinations.

**Objective:** To familiarize the students with various types of tests that is employed by the diverse examining bodies.

**UNIT I** **9 hrs**

**Communication**: Question tags - Gerund and Infinitives - Spotting the errors-Synonyms - Antonyms - One word substitution - Sentence completion - Prepositions - Articles.
General Awareness and Scientific Aptitude: Socio - Economic - Banking –Basic Sciences.
People and Environment.
Politics and Current Affairs
Higher Education.
Information and Communication Technology.
Teaching Aptitude.
Research Aptitude.

**UNIT II** **9hrs**

**Logical Reasoning:** Syllogism - Statement Conclusions - Statement Arguments - Statement Assumptions – Statement Courses of Action - Inference - Cause and Effect - Visual Reasoning-Direction Sense Test - Blood Relation - Coding and Decoding - Deductive Reasoning.

**UNIT III** **9hrs**

**Numerical Reasoning and Quantitative Aptitude**: Age - speed - Heights and Distance -Time and Distance - Ratio and Proportion - Percentage - Fraction - Profit and Loss - Interest - Average - Calendar - Clocks - Probability - Series - Venn Diagram - Data Interpretation.

**UNIT IV** **9hrs**

**Research Methodology**: Meaning of research- Objective of research - Motivation in research-Types of research - research approaches - Significance of research- Research methods Vs methodology - Research and scientific methods - Importance of knowing how research is done - Research process - Criteria of good research - Problem encountered by researches in India.

**UNIT V** **9hrs**

**Manual for preparation of project report:** General - Size of the project report - arrangement of contents of project report - page dimension and margin - Manuscript Preparation - Typing instructions - Division of chapters - Numbering instruction.

**Reference Books**

1. **Agarwal.R.S,** Quantitative Aptitude, S. Chand and Company, Reprint 2012.

2**. Chopra.J.K,** Bank Probationary Officers' Examination, Unique Publishers, 2010.

3. **Datason. R.P, Manish Arora and Gulati.SW.L,** Clerical Cadre Recruitment in State Bank of India, Newlight Publishers, 2013.

4. **Davinder Kaur Bright,** Railway Recruitment Board, Bright Publications, 2010.

5. **Lal, Jain and Vashishtha**, K.C, UGC NET/JRF/SET Teaching and Research Aptitude, UpkarPrakashan Publishers, 2012.

6. **PratyogitaDarpan**, UGC NET/JRF/SET Teaching and Research Aptitude, Upkar Prakashan Publishers, 2012

7. **Sharma.J.K,** IBPS Recruitment of Bank Clerical Cadre Examination, Unique Publishers, 2013.

8. **Tara Chand**, General Studies for Civil Services Preliminary Examinations,

Paper– I, Tata Mc Graw Hill Education Private Ltd, 2013.

9. **Hari Mohan Prasad and Uma Rani Sinha**. 2011. Objective English for Competitive Examinations. New Delhi: Tata McGraw Hill Education Private Ltd.

10. **Jain T.S**. Upkar's SBI Clerical Cadre Recruitment Examination. Agra: Upkar Prakashan.

11. **Dr.C.R.Kothari**, Research Methodology: Methods and Techniques, New Age International (P) Ltd, New Delhi.

## SEMESTER-III
## ELECTIVE PAPER-I
## INTRODUCTORY ASTRONOMY, ASTROPHYSICS & COSMOLOGY

**Instructional Hrs: 75** **Sub Code: 17PHPE301**
**Max. Marks: CIA -25; ESE -75** **Credits: 4**

**Objective:** To provide the required knowledge on the fundamentals and the concepts of modern astronomy, astrophysics and cosmology

**Unit - I** **15 Hrs.**

**History of Astronomy:** Introductory History of Astronomy - Ptolemy's Geocentric Universe-Copernicus Heliocentric Universe - Tycho Brahe and Galileo's Observations - Kepler's Laws of Planetary Motion - Newtonian Concept Of Gravity - Highlights of Einstein's Special and General Theory of Relativity - Curved Space Time - Evidence of Curved Space Time - *Bending Of Light* - Time Dilation.

**Unit - II** **15 Hrs.**

**Stars & Galaxies:** Stars and Galaxies – Distances - Trigonometric Parallax - Inverse Square Law-Magnitude of Stars - Apparent Magnitude - Absolute Magnitude and Luminosity - Color and Temperature - Composition of Stars - Velocity, Mass and Sizes of Stars - *Types of Stars*-Temperature Dependence-Spectral Types - Hertzsprung-Russell (HR) Diagram - Spectroscopic Parallax.

**Unit - III** **15 Hrs.**

**Lives and death of stars:** Stellar Evolution - Mass Dependence - Giant Molecular Cloud-Protostar - Main Sequence Star- Sub giant, Red Giant, Supergiant - Core Fusion - Red Giant (Or) Supergiant - Planetary Nebula (Or) Supernova - White Dwarfs - Novae And Supernovae - Neutron Stars – Pulsars - Black Holes - Detecting Black Holes -The Sun - Its Size and Composition - Sun's Interior Zones - Sun's Surface - Photosphere - Chromosphere - Corona - Sun's Power Source - *Fusion Reaction Mechanism*.

**Unit -IV** **15 Hrs.**

**Cosmology I:** Introduction to Cosmology - Basic Observations and implications - Olber's Paradox - Expanding Universe - Gravitational Red shift - *Doppler Effect* - Hubble's Law and the Age of the Universe - Cosmological Principle - The Perfect Cosmological Principle - Observation and interpretation of Cosmic Microwave background Radiation (CMBR) - Evidence Supporting the General Big Bang Theory - Salient features of Steady State Theory.

**Unit - V** **15 Hrs.**

**Cosmology II:** Fate of the Universe - Dependence on Mass (Curvature of Space) - Critical density - Open Universe - Closed Universe - Homogenous and Isotropic Freidman – Robertson - Walker Universes - Deriving the Geometry of the Universe from the Background Radiation - Flatness Problem - Horizon Problem - *Inflation and its effect on the universe* -The Cosmological Constant.

**Note: *Italics* denotes Self Study Topics**

**TEXT BOOKS**

1. **K.D. Abhayankar,** Astrophysics of the Solar System, Universities Press, 2002
2. **Kaula. W.M.,** An Introduction to Planetary Physics, Wiley, 1968
3. **Harold Zirin,** Astrophysics of the Sun, Cambridge University Press, 1988

**REFERENCE BOOKS**

1. **Luis A. Anchordoqu,** Lectures on Astronomy, Astrophysics and Cosmology
2. **Milwaukee,** Lecture Notes of Department of Physics, University of Wisconsin

**SEMESTER – IV**

**ELECTIVE PAPER-II**

**THERMODYNAMICS AND STATISTICAL MECHANICS**

**Instructional Hrs. :90** **Sub. Code : 17PHPE402**

**Max. Marks : CIA -25; ESE -75** **Credits: 4**

**Objective :**To introduce the basic concepts of Thermo dynamics. To train the students to prepare for state & national level physics examinations.

**UNIT I** **18 Hrs.**

**Thermodynamics and Radiation :** Second law of thermodynamics - Entropy and Second law of thermodynamics - Entropy and Disorder - Thermodynamic Potential and Reciprocity relation - Thermodynamic Equilibria - Chemical Potential - Blackbody radiation - Planck's Radiation law.

**UNIT II** **18 Hrs.**

**Basic Concepts :** Phase space - Volume in phase space - Number of phase cells in given energy range of harmonic oscillator - Number of phase cell in the given energy range of 3 - dimensional free particle - Concept of ensemble- Micro canonical ensemble - Canonical ensemble - Grand Canonical ensemble - Density distribution in phase space - Liouvilles theorem - Postulate of equal apriori probability - Statistical equilibrium - Thermal equilibrium - Mechanical equilibrium - Particle equilibrium - Connection between Statistical and thermodynamic quantities.

**UNIT III** **18 Hrs.**

**Classical Distribution Law :** Microstates and Macro states - Classical Maxwell-Boltzmann distribution law - Evaluation of constants, $\alpha$ and $\beta$ - Maxwell's law of Distribution of velocities - Principle of equi-partition of energy - Gibbs paradox - Partition function and its correlation with thermodynamics quantities - Partition functions and its properties - Comparison of ensembles- Equipartition theorem - Applications

**UNIT IV** **18 Hrs.**

**Quantum Statistics :** Indistinguishability and quantum statistics - Statistical weight and apriori probability - Identical particles and symmetry requirements - Bose Einstein's Statistics - Fermi Dirac Statistics - Results of three statistics - Thermodynamic interpretation of parameters $\alpha$ and $\beta$ - Blackbody radiation and Planck radiation - Specific heat of solids: Dulong and Pettit's law- Einstein's Theory - Debye theory.

**UNIT V** **18 Hrs.**

**Application of Quantum Statistics:**

Energy and pressure of ideal Bose Einstein gas - Bose Einstein condensation - Liquid helium - Energy and pressure of ideal Fermi Dirac gas - Free electron model and electronic emission - Onsager relations - Fluctuation; Energy, Pressure, Enthalpy - Bragg William Approximation - One dimensional Ising model

**Note: *Italics* denotes Self Study Topics**

**TEXT BOOKS**

1. **Palash B. Pal,** *An Introductory Course of Statistical Mechanics*, Narosa Publishing House (2008), New Delhi

2. **Kamal Singh & S.P. Singh**,*Elements of Statistical Mechanics*, S. Chand & Company, New Delhi.

**REFERENCE BOOKS**

1. **AvijitLahiri**, *Statistical Mechanics An Elementary Outline*, University Press - 2002- Hyderabad