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**1.1.2: The programmes offered by the institution focus on employability / entrepreneurship / skill development and their course syllabi are adequately revised to incorporate contemporary requirements**

## SYLLABUS OF THE COURSES FOCUSING EMPLOYABILITY / ENTREPRENEURSHIP / SKILL DEVELOPMENT

**Colour Coding**

**EMPLOYABILITY**

**ENTREPRENEURSHIP**

**SKILL DEVELOPMENT**

# M.Sc. PHYSICS

| I M.Sc.(PH) | CLASSICAL MECHANICS | PPH11A |
|---|---|---|
| SEMESTER - I | | HRS/WK-5 |
| CORE – I | | CREDIT-4 |

**OBJECTIVES:**

To understand the various formulations in Classical Physics, dynamics of Rigid body and other relativistic mechanical concept of physics

**COURSE OUTCOMES (CO):**

**CO1**:Acquire knowledge of Lagrangian formulations
**CO2:**Understand the concepts Central Force Motion And Small Oscillations
**CO3:**Understand the concept of Hamiltonian Formulations
**CO4**:Study the dynamics of rigid bodies
**CO5:**Understand the concepts of relativistic mechanics

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER - I | COURSE CODE:PPH11A | | | | | COURSE TITLE: CLASSICAL MECHANICS | | | | | Hours: 5 | Credit :4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes Pos | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | |
| CO1 | 3.5 | 2.5 | 4.1 | 3.5 | 3.5 | 2.5 | 3 | 3.5 | 4.2 | 3.2 | 3.2 | 3.33 |
| CO2 | 3.6 | 3.2 | 3.6 | 3 | 3.5 | 2.8 | 4.1 | 3.6 | 3.7 | 2.3 | 3.5 | 3.35 |
| CO3 | 3.5 | 4.3 | 3.5 | 2.8 | 3 | 3.6 | 3.5 | 3.5 | 3.7 | 4.2 | 3.3 | 3.53 |
| CO4 | 3.2 | 3.6 | 3 | 4 | 3 | 3.5 | 3.4 | 2.8 | 3.4 | 3.5 | 3.6 | 3.36 |
| CO5 | 4 | 3.5 | 3.5 | 3.2 | 3.6 | 2.5 | 3.5 | 3.2 | 4 | 3.2 | 3.5 | 3.42 |
| Mean Overall Score | | | | | | | | | | | | 3.40 |

**Result: The Score for this course is 3.40 (High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having **High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Principles and Lagrangian Formulation :** Mechanics of a particle and system of particles – Conservation laws- Co-ordinate systems -Constraints - Generalized co-ordinates-Degrees of freedom -Principle of virtual work– D'Alembert's principle -Lagrangian equation of motion fromD'Alembert's principle - Hamilton's principle - Lagrangian equation of motion from Hamilton's principle –Symmetry properties of Space and Time and Conservation laws.

**UNIT - II** **(15 Hours)**

**Central Force Motion and Small Oscillations:** Reduction of two body problem into one body problem-Central Force and Motion in a Plane –Inverse Square Law of Force- Kepler's Law of Planetary Motion-Deduction of Keplers First Law – RungeLenz vector – Rutherford Scattering cross section- Centre of Mass and Laboratory frames of references - Theory of small oscillations – frequencies of free vibration and normal - coordinates – Linear Di & Tri atomic molecules (HCl, $NO_2$) – a spring pendulum – double pendulum.

**UNIT - III** **(15 Hours)**

**Hamiltonian Formulations:** Hamilton's canonical equation – proof of principle of least action – general equations of canonical transformations -Cyclic Co-ordinates- Hamilton - Jacobi differential equation – Legrange's brackets and Poisson's brackets – Action angle variables – the Kepler problem in action angle variable.

**UNIT - IV** **(15 Hours)**

**Rigid Body Dynamics:** Angular momentum – rotational kinetic energy and moment inertia of a rigid body – Euler's angle – moments and products of inertia – Eulers' equation – Motion of a symmetrical top under the action of gravity.

**UNIT - V** **(15 Hours)**

**Relativistic Mechanics:** Principle of Relativity-Relativistic Kinetic Energy-Lorentz transformations – Lorentz transformations in real four dimensional spaces – covariant four dimensional formulations – force and energy equations in relativistic mechanics – Lagrangian and Hamiltonian formulation of relativistic mechanics.

**TEXT BOOKS:**

1. Rana.N.C&Joag, P.S, Classical Mechanics, Tata McGraw Hill Education. 2015
2. Herbert Goldstein, Classical Mechanics, Narosa Publications.2001
3. David Morin, Introduction to Classical Mechanics, 2008

**REFERENCE BOOKS:**

1. C.R.Mondal, Classical Mechanics, PHI Learning Private Limited.2008
2. R. Douglas Gregory, Classical Mechanics, Cambridge University Press.2006
3. Gupta Kumar Sharma, Classical Mechanics.2010

| I M.Sc. (PH) | MATHEMATICAL PHYSICS I | PPH12A |
|---|---|---|
| SEMESTER - I | | HRS/WK-5 |
| CORE – II | | CREDIT-4 |

**OBJECTIVES:**

To develop the ability to solve Linear and Non-linear differential Mathematical problems.

**COURSE OUTCOMES (CO):**

**CO1:** Give the basic knowledge of vector spaces
**CO2:**Study the complex variables
**CO3:**Understand the Fourier Series And Laplace Transforms
**CO4:**Under various differential equations
**CO5:** Understand the concepts of special functions

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER - I | COURSE CODE: PPH12A | | | | | COURSE TITLE:MATHEMATICAL PHYSICS I | | | | | | Hours: 5 | Credit: 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 3.5 | 2 | 4.1 | 3.4 | 3.5 | 2.5 | 3 | 3.4 | 4 | 3.2 | 3.2 | 3.25 | |
| CO2 | 3.4 | 3 | 3.6 | 3 | 3.5 | 2.8 | 4 | 3.6 | 3.7 | 2.1 | 3.5 | 3.29 | |
| CO3 | 3.5 | 4 | 3.5 | 2.8 | 3 | 3 | 3.5 | 3.5 | 3.4 | 4 | 3.3 | 3.40 | |
| CO4 | 3.4 | 3.6 | 3 | 4.2 | 3.7 | 3.5 | 3.4 | 2.8 | 3.4 | 3.7 | 3.6 | 3.48 | |
| CO5 | 4.3 | 3.6 | 3.5 | 3.2 | 3.6 | 2.8 | 3.5 | 3.2 | 4.2 | 3.5 | 3.7 | 3.55 | |
| Mean Overall Score | | | | | | | | | | | | 3.39 | |

**Result: The Score for this course is 3.39 (High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having **High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Linear Algebra:** Physical examples of Vectors and Matrices - Linear equations - Linear combinations – linear dependence and independence - Vector spaces: real and complex - subspace, basis, dimension - Linear transformations - Inner product, norm, Orthogonality, - Cauchy-Schwarz inequality - Orthonormal basis - Gram-Schmidt orthogonalization–solution of linear equations by determinants (Cramer's rule)-Transformation of vectors and matrices - Similarity of linear transformations- Diagonalization of a matrix - completeness.

**UNIT - II** **(15 Hours)**

**Complex Variables:** Complex variable theory - Single and multivalued functions - The Cauchy-Riemann differential equations - Cauchy's integral theorem and integral formula - Residue and Cauchy's residue theorem - Lioville's theorem – Applications of the evaluation of definite integrals.

**UNIT - III** **(15 Hours)**

**Fourier series:** Fourier series -– Dirichlet conditions – Even function and odd function-Half-wave expansions – arbitrary period—Parseval'stheorem- Application of Fourier series in Harmonic Analysis

**UNIT – IV** **(15 Hours)**

**Integral transforms:** Fourier integral transforms - Fourier Sine and Cosine transformation - Laplace transform –change of scale property- first and second (Heaviside's) shifting theorems - Inverse Laplace transforms –some important formulae- First and second shifting property- Laplace transformation for solving differential equations of a function.

**UNIT - V** **(15 Hours)**

**Differential Equations:** Linear ordinary differential equations of first order and second order – Degree of ordinary differential equations – Linear differential equation - General solution and particular solution – Method of solution – Higher order differential equation – Homogeneous linear differential equation – Linear differential equation of second order.

**TEXT BOOKS:**

1. H.k.dass, Dr Rama Verma, Mathematical Physics.2016
2. Sathyaprakash. R, Mathematical Physics.2014
3. P K Chattopadhyay Mathematical Physics, 2013.
4. Spiegel, Fourier Laplace Transforms, Schaum's Outline Series.2014

**REFERENCE BOOKS:**

1. Kreyszig E, Advanced Engineering Mathematics.2011
2. Howard Anton, Elementary Linear Algebra, John Wiley Sons2000
3. Engineering Mathematics-series, Dr. M. K. Venkataraman- The National publishing company-Madras.1992

| I M.Sc. (PH) | ELECTROMAGNETIC THEORY | PPH13A |
|---|---|---|
| SEMESTER - I | | HRS/WK-5 |
| CORE – III | | CREDIT-4 |

**OBJECTIVES:**

To understand the concepts of Relativistic electromagnetic.

**COURSE OUTCOMES (CO):**

**CO1:** Study electromagnetic waves
**CO2:** Understand the concepts of reflection and transmission of EM waves
**CO3:** Acquire knowledge of wave guides and waves
**CO4:** Study about antenna and wave propagation
**CO5:** Understand the concepts relativistic electrodynamics

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER -I | COURSE CODE: PPH13A | | | | | COURSE TITLE: ELECTROMAGNETIC THEORY | | | | | Hours: 5 | Credit: 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | |
| CO1 | 3.1 | 3.8 | 4.2 | 3.5 | 3.5 | 2.8 | 3.5 | 3.3 | 4.2 | 3 | 3.5 | 3.49 |
| CO2 | 3.8 | 3.2 | 3.6 | 3 | 3.5 | 3.6 | 4.3 | 3.5 | 3.5 | 2.6 | 3.7 | 3.48 |
| CO3 | 3.5 | 4.2 | 3.2 | 2.5 | 3 | 3.7 | 3.2 | 3.5 | 3.5 | 3 | 3.4 | 3.33 |
| CO4 | 3 | 3.8 | 3 | 3.7 | 3 | 4 | 3 | 2.9 | 3.5 | 3.2 | 3.5 | 3.32 |
| CO5 | 4.1 | 2.5 | 3.5 | 3 | 3.5 | 2.2 | 3.5 | 3.2 | 3 | 3.1 | 2.5 | 3.1 |
| Mean Overall Score | | | | | | | | | | | | 3.34 |

**Result: The Score for this course is 3.34(High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having **High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Electrostatics:** Laplace and Poisson equations – Boundary value problems - boundary conditions and uniqueness theorem – Laplace equation in three dimensions– Solution in Cartesian and spherical polar coordinates – Examples of solutions for boundary value problems - Polarization and displacement vectors - Dielectric sphere in a uniform field – Molecular polarisability and electrical susceptibility –Langevin Theory of Polar molecules - Electrostatic energy in the presence of dielectric – Multipole expansion.

**UNIT - II** **(15 Hours)**

**Magnetostatics:** Biot-Savart Law - Ampere's circuital law - Magnetic vector potential and magnetic field of a localised current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magnetostatic energy - Magnetic induction and magnetic field in macroscopic media - Uniformly magnetized sphere.

**UNIT - III** **(15 Hours)**

**Maxwell Equations:** Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations – free space and linear isotropic media - Vector and scalar potentials - Gauge invariance - Wave equation and plane wave solution- Coulomb and Lorentz gauges - Energy and momentum of the field - Poynting's theorem - Lorentz force - Conservation laws for a system of charges and electromagnetic fields.

**UNIT - IV** **(15 Hours)**

**Electromagnetic Waves:** Plane waves in non-conducting media - Linear and circular polarization, reflection and refraction at a plane interface- Fresnel's law, interference, coherence and diffraction - Waves in a conducting medium - Propagation of waves in a rectangular wave guide - Inhomogeneous wave equation and retarded potentials - Radiation from a moving charges - Oscillating electric dipole.

**UNIT -V** **(15 Hours)**

**Relativistic Electrodynamics:** Four vector-Lorentz transformation of space and time in four vector form. - Transformation of electromagnetic potentials - Maxwell's equation in covariant tensor form

**TEXT BOOKS:**

1. David. I. Griffiths, Introduction to electrodynamics, Prentice Hall of India2012
2. Sadiku, Elements of Electromagnetics 2014
3. SatyaPrakash, Electromagnetic Theory & Electrodynamics, ArihantPublishers, 2012.

**REFERENCE BOOKS:**

1. Sengupta P, Classical Electrodynamics, New Age International publishers.2015

2. Andrew Zangwill, Modern Electrodynamics.2013
3. AnupamGarg, Classical Electromagnetism in a Nutshell. 2012

**OBJECTIVES:**

To understand the fabrication and applications of IC and other electronic and microwave devices.

**COURSE OUTCOMES (CO):**

**CO1:** Acquire knowledge of PN junction diode and special diodes
**CO2:** Understand the concepts of various semiconductor transistors & devices
**CO3:** Study microwave devices
**CO4:** Understand the concepts Op-amps and its applications
**CO5:** Apply the knowledge of Oscilloscope and other measuring instruments

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| **SEMESTER –I** | **COURSE CODE: 18EPPH14** | | | | | **COURSE TITLE: ELECTRONIC DEVICES & APPLICATIONS** | | | | | | **Hours: 5** | **Credits: 3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Outcomes COs** | **Programme Outcomes POs** | | | | | **Programme Specific Outcomes PSOs** | | | | | | **Mean Score of CO's** | |
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | | |
| CO1 | 3 | 3.8 | 4 | 3.5 | 3 | 2.6 | 3.4 | 3 | 4 | 3 | 3.2 | 3.31 | |
| CO2 | 3.5 | 3 | 3.2 | 3 | 3 | 3.6 | 4 | 3.4 | 3 | 2.6 | 3.5 | 3.25 | |
| CO3 | 3.7 | 4.1 | 3.2 | 2.6 | 3.2 | 3.2 | 3 | 3.5 | 3.8 | 3.5 | 3.3 | 3.37 | |
| CO4 | 3.4 | 3.8 | 3 | 4.3 | 3.4 | 4 | 3.5 | 2.8 | 3.5 | 3 | 3.8 | 3.5 | |
| CO5 | 4.2 | 3.5 | 3.5 | 3.2 | 3.6 | 2.7 | 3.8 | 3 | 4 | 3.7 | 3.5 | 3.51 | |
| Mean Overall Score | | | | | | | | | | | | 3.39 | |

**Result: The Score for this course is 3.39 (High)**

| **Association** | **1-20%** | **21-40%** | **41-60%** | **61-80%** | **81-100%** |
|---|---|---|---|---|---|
| **Scale** | **1** | **2** | **3** | **4** | **5** |
| **Interval** | **0.0-1.0** | **1.1-2.0** | **2.1-3.0** | **3.1-4.0** | **4.1-5.0** |
| **Rating** | **Very Poor** | **Poor** | **Moderate** | **High** | **Very High** |

| | | |
|---|---|---|
| **I M.Sc. (PH)** | **ELECTRONIC DEVICES &PPLICATIONS** | **18EPPH14** |
| **SEMESTER - I** | | **HRS/WK-5** |
| **ELECTIVE – IA** | | **CREDIT-3** |

This course is having **High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Fabrication of IC and Logic Families:** Fabrication of IC - Monolithic integrated circuit fabrication - IC pressure transducers -Monolithic RMS - Voltage measuring device - Monolithic voltage regulators - Integrated circuit multipliers - Integrated circuit logic - Schottky TTL - ECL - I2L - P and N-MOS Logic - CMOS Logic- Tristate logic circuits – PLA, PLC and PLD.

**UNIT - II** **(15 Hours)**

**Opto Electronic Devices:** Light sources and Displays - Light emitting diodes - Surface emitting LED - Edge Emitting LED -Seven segment display - LDR - Diode lasers - Photo detectors - Basic parameters - Photodiodes - p-i-n Photo diode - Solar cells - Photo transistors - IR and UV detectors.

**UNIT - III** **(15 Hours)**

**Negative Conductance Microwave Devices:** Transit time devices: IMPATT diode – QWITT diode – TRAPATT diode - Gunn diode - The transferred electron mechanism – Formation and drift of space charge domains - modes of operation in resonance circuit - Fabrication and applications.

**UNIT - IV** **(15 Hours)**

**Oscilloscope and Other Measuring Instruments:** Introduction - Cathode Ray Tube - Theory and Construction - Cathode Ray Oscilloscope Operation - Voltage Sweep Operation - Synchronization and Triggering - Multitrace Operation - Measurement Using Calibrated CRO Scales - Special CRO Features - Signal Generators.

**UNIT - V** **(15 Hours)**

**Communication Electronics:** Local Loop, PSTN, ISDN, digital exchanges, satellite communication and VSAT, Wireless communication technologies: spread spectrum techniques, OFDM, Cellular phones, 3G wireless, IP telephony, Bluetooth, IrDA, CDMA.

**TEXT BOOKS:**

1. Liano S.L., Microwave Devices and Circuits, Prentice Hall of India.1990
2. J. Millman, 1979, Digital and Analog Circuits and Systems, McGraw-Hill, London.
3. Electronic Communication systems – Roy Blaks, Thomson –Delmar 2002.

**REFERENCE BOOKS:**

1. Gutpa Y.C., Microwave Electronics, John Wiley.1999

2. P. Bhattacharya, 2002, Semiconductor Optoelectronic Devices, 2nd Edition, Prentice-Hall of India, New Delhi.
3. Modern Electronic Communications – Gray M. Miller Jeffrey Beasley, PHI, 2003.
4. Electronic Communication – Carlson Published 2002 McGraw-Hill.

**COURSE OUTCOMES (CO):**

**CO1:** Understand the basic principles of laser action
**CO2:** Learn the characteristics of laser
**CO3:** Provide solutions to various problems related to laser systems
**CO4:** Apply the laser spectroscopic techniques in various applications
**CO5:** Study the features and parameters of quantum laser

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER-I | COURSE CODE: 18EPPH15 | | | | | COURSE TITLE: LASER PHYSICS | | | | | | Hours: 5 | Credit: 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes Cos | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2.909 | |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3.090 | |
| CO3 | 3 | 4 | 3 | 3 | 2 | 4 | 3 | 3 | 4 | 3 | 3 | 3.181 | |
| CO4 | 4 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 3 | 3 | 3 | 3.272 | |
| CO5 | 4 | 4 | 4 | 3 | 2 | 3 | 3 | 4 | 3 | 4 | 3 | 3.363 | |
| Mean Overall Score | | | | | | | | | | | | 3.163 | |

**Result: The Score for this course is 3.16 (High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

| I M.Sc. (PH) | LASER PHYSICS | 18EPPH15 |
|---|---|---|
| SEMESTER - I | | HRS/WK-5 |
| ELECTIVE – IB | | CREDIT-3 |

**OBJECTIVES:**

To understand the basic principles, features, parameters and characteristics of Laser.

This course is having **High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Principles of Laser Action:** Einstein's theory - Interaction of radiation with matter - Theory of some simple processes.

**UNIT - II** **(15 Hours)**

**Laser Characteristics:** Gaussian beam and its properties - Stable two Minor optical resonators, Longitudinal and Transverse Modes of Laser cavity- Mode selection-gain in a Regenerative Laser cavity-Threshold for 3 and 4 level laser systems- Mode locking pulse shortening-Pico second &femto second operation- Spectral narrowing and stabilization.

**UNIT - III** **(15 Hours)**

**Laser Systems:**Laser systems involving low density gain media- Nitrogen Laser, Carbondioxide Laser and Excimer Laser. Laser systems involving high density gain media- Ruby Laser, Nd-YAG laser, Semiconductor laser, Diode Pumped solid state laser, Dye laser, High power semiconductor diode laser systems.

**UNIT - IV** **(15 Hours)**

**Laser Spectroscopic Techniques and Other Applications:** Laser fluorescence and Raman scattering and their use in Pollution studies, Nonlinear interaction of light with matter, laser induced multi photon processes and their applications, Ultra high resolution spectroscopy with laser and its applications, Propagation of light in a medium with variable refractive index, optical Fibers. Light wave communication - Qualitative treatment of medical and engineering applications of Lasers.

**UNIT - V** **(15 Hours)**

**Quantum Treatment:** Einstein coefficients-Momentum transfer- life time- Possibility of amplification. Quantization of the field- Zero point energy, Coherence and monochromaticity, Kinetics of Optical absorption- Quantum mechanical treatment of line broadening mechanism-Doppler broadening.

**TEXT BOOKS:**

1. OrazioSvelto, Principles of Lasers1991
2. William t. Silfvast, Laser Fundamentals 2004
3. B.B. Laud, Lasers and Non-linear Optics1992

**REFERENCE BOOKS:**

1. Yariv, Optical Electronics 2006
2. Demtroder, Laser and Spectroscopy 1973

3. Latekhor, Non-linear Laser Spectroscopy 1972

| I – M. Sc. (PH) | GENERAL PRACTICAL – I | 18PPHP11 |
|---|---|---|
| SEMESTER - I | | HRS/WK - 4 |
| CORE PRACTICAL-I | | CREDIT - 4 |

**Any 7 out of 10**

1. Determination of Stephan's constant.
2. Young's Modulus by elliptical fringes.
3. Young's Modulus by hyperbolic fringes.
4. Determination of band gap in semiconductor.
5. Hydrogen spectrum – Rydberg's constant.
6. Viscosity of liquid – Meyer's disc.
7. Spectrometer - Specific charge of an electron.
8. Fiber Optics Experiment.
9. Ultrasonic diffraction.
10. Laser- Thickness of the enamel coating on a wire by diffraction.

| I – M. Sc (Physics) | ELECTRONICS PRACTICAL – I | 18PPHP12 |
|---|---|---|
| SEMESTER - I | | HRS/WK - 4 |
| CORE PRACTICAL-I | | CREDIT - 4 |

**Any 7 out of 11**

1. FET Characteristics and amplifier design
2. UJT characteristics and applications
3. Design of a Regulated Power Supply using IC7805.
4. Design full adder and full subtractor and verify its truth table using NAND logic gates.
5. Design full adder and full subtractor and verify its truth table using NOR logic gates.
6. Construct an astablemultivibrator using transistor and to determine the frequency of oscillation.
7. Design an astablemultivibrator using 555 timer.
8. Design 4 bit shift register using JK Flip flop.
9. Design multiplexer/demultiplexer.
10. Op-amp – Inverting, non-inverting amplifier – Voltage follower- summing, difference, average amplifier – differentiator and integrator.
11. Application of op-amp as an integrator/differentiator amplifier.

| I M.Sc. (PH) | STATISTICAL MECHANICS | 18PPH21 |
|---|---|---|
| SEMESTER - II | | HRS/WK-5 |
| CORE – IV | | CREDIT-4 |

**OBJECTIVES:**

To understand the concepts of various ensembles and quantum statistics in detail.

**COURSE OUTCOMES (CO):**

**CO1:** Study the nature of statistical mechanics
**CO2:** Understand the concepts of various ensembles
**CO3:** Study statistics of systems of independent particles
**CO4:** Understand the concepts quantum statistics
**CO5:** Understand the fluctuations and Transport Properties of materials

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER –II | COURSE CODE: 18PPH21 | | | | | COURSE TITLE: STATISTICAL MECHANICS | | | | | | Hours: 5 | Credit: 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 3.5 | 3 | 3 | 3.5 | 3.5 | 4 | 3.5 | 3 | 3.5 | 3.5 | 3.5 | 3.41 | |
| CO2 | 3.5 | 3 | 4 | 3.5 | 3.5 | 4 | 3.5 | 3.5 | 2.5 | 4 | 3.5 | 3.50 | |
| CO3 | 3.5 | 3.5 | 3 | 3 | 3.5 | 3.5 | 4 | 3.5 | 4 | 3.5 | 3.5 | 3.50 | |
| CO4 | 4 | 3.5 | 2.5 | 3 | 3.5 | 3.5 | 3.5 | 4 | 3.5 | 4 | 4 | 3.55 | |
| CO5 | 3.5 | 4 | 3.5 | 4 | 4 | 3.5 | 3.5 | 4 | 3.5 | 4 | 3 | 3.68 | |
| Mean Overall Score | | | | | | | | | | | | 3.53 | |

**Result: The Score for this course is 3.53 (High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having **High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Foundations of Statistical Mechanics:** Phase space- States of a system- Micro canonical ensemble- Density of states- Liouville's theorem- Statistical equilibrium- Relation between statistical and thermo dynamical quantities- Boltzmann entropy relation- Classical ideal gas- Entropy of mixing- Gibb's paradox.

**UNIT - II** **(15 Hours)**

**Partition Function:** Ensemble-canonical, Micro canonical and grand canonical ensembles - Partition function - Relation between partition function and thermo dynamical quantities - Entropy – Helmholtz free energy – Total energy – Enthalpy - Gibb's potential – pressure - specific heat $C_V$.

**UNIT - III** **(15 Hours)**

**Statistics of Systems of Independent Particles:** Quantum picture – Maxwell Boltzmann, Bose Einstein and Fermi Dirac statistics - Limit of applicability of the three distribution laws - MB ideal gas - Equipartition law of energy - Classical real gas - Maxwell's law of distribution of velocities – most probable speed, mean speed, root mean square speed.

**UNIT - IV** **(15 Hours)**

**Quantum Statistics:** Ideal BE gas - Gas degeneracy - BE condensation – Photon gas - Plank's law of radiation - Phonon gas - Einstein and Debye's models for specific heat of solids. Ideal FD gas - Gas degeneracy - Electron gas – Pauli's theory of paramagnetism - White dwarfs

**UNIT - V** **(15 Hours)**

**Fluctuations and Transport Properties:** Fluctuations in Energy, pressure, volume & enthalpy - density fluctuation- Correlation of space-time dependent fluctuation- Fluctuation dissipation theorem - Transport properties – Boltzmann transport equation-Random walk-Brownian motion.

**TEXT BOOKS:**

1. Agarwal B.K. and Melvin Eisner, Statistical Mechanics, New Age International Publishers. 2015
2. Kerson Huang, Statistical Mechanics, Wiley Eastern Ltd.1987
3. Gupta and Kumar, Elements of Statistical Mechanics, Meerut, PragathiPrakasham 1995

**REFERENCE BOOKS:**

1. Gupta M. C, Statistical Thermodynamics, New Age International Publishers 1995
2. Gopal ESR, Statistical Mechanics & Properties of Matter, The Macmillan Co. of India Ltd. 1976

3. Laud B.B, Fundamentals of statistical Mechanics, New Age International Publishers 1951

| I M.Sc. (PH) | MATHEMATICAL PHYSICS - II | PPH22A |
|---|---|---|
| SEMESTER – II | | HRS/WK-5 |
| CORE – V | | CREDIT-4 |

**OBJECTIVES:**

To understand the advanced concept of group theory, partial differential equations, probability and statistics.

**COURSE OUTCOMES (CO):**

**CO1:** To give the basic knowledge of tensors
**CO2:** Get the acquire knowledge of group theory
**CO3:** Understand the concepts partial differential equation
**CO4:**Study numerical analysis
**CO5:**Understand the concepts of probability and statistics

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER –II | COURSE CODE: PPH22A | | | | | COURSE TITLE: MATHEMATICAL PHYSICS- II | | | | | | Hours: 5 | Credit: 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4.818 | |
| CO2 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4.818 | |
| CO3 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4.818 | |
| CO4 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4.818 | |
| CO5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4.818 | |
| Mean Overall Score | | | | | | | | | | | | 4.818 | |

**Result: The Score for this course is 4.81 (Very High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having **VeryHigh association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Tensors:** Tensors Under Generalized Coordinate Transformations - Definition of tensor; rank, symmetric tensors, contraction, quotient rule; tensors with zero components, tensor equations, metric tensors and their determinants; pseudo tensors; transformation of $\varepsilon^{ijk}/(g)^{1/2}$

**UNIT - II** **(15 Hours)**

**Group Theory:** Definition of groups, subgroups and conjugate classes - Symmetry elements, Transformation, Matrix representation - Point groups - representation of a group - Reducible and irreducible representations - Orthogonality theorem - character of a representation - character Table C2v and C3v – Application to IR and Raman active vibrations of XY3 molecules - Symmetry rotations SO(2) and SO(3) groups - Symmetry Unitary SU(2) and SU(3) groups.

**UNIT - III** **(15 Hours)**

**Partial Differential Equation:** Formation of Partial differential equations – elimination of arbitrary constants – elimination of arbitrary functions –Singular integral – General integral - Standard types of first order equations – Linear Partial Differential equation of Second and higher order with constant coefficients. One dimensional wave equations, heat equation

**UNIT - IV** **(15 Hours)**

**Special Functions:** Gamma and beta functions - Legendre, Bessel, Hermite and Laguerre equations - Generating functions - Series solutions and recurrence relations for Legendre, Bessel, Hermite and Laguerre equations - Physical applications.

**UNIT - V** **(15 Hours)**

**Probability and Statistics:** Events - Sample Space - Mathematical and Statistical definitions of Probability - Random variables – Distribution function – Discrete random variable – Continuous random variable – Continuous distribution function –Mathematical expectation and variance- Poisson distribution - Normal distribution – Properties of normal distribution – Mean, Median, Mode.

**TEXT BOOKS:**

1. Engineering Mathematics, M.K.Venkataraman, National Publications , Chennai (2009)
2. Fundamentals of Mathematical Statistics by S.C.Gupta, V.K.Kapoor, Sultan Chand and Sons , 11th edition 1982
3. Statistical methods by S.P.Gupta – Sultan Chand.2011
4. Statistics (Theory and Practice) by R.S.N.Pillai& V. Bagavathy -S.Chand& Co.

**REFERENCE BOOKS:**

1. Kreyszig E, Advanced Engineering Mathematics.2011
2. Reily K.F Hobson M.P. and Bence S.J, Mathematical methods 2006

| I M.Sc. (PH) | QUANTUM MECHANICS – I | 18PPH23 |
|---|---|---|
| SEMESTER - II | | HRS/WK-5 |
| CORE – VI | | CREDIT-4 |

**OBJECTIVES:**
To understand the concepts of eigen values, 1D problems and related approximation methods.

**COURSE OUTCOMES (CO):**
**CO1:** Study the postulates of quantum mechanics
**CO2:** Understand the concepts one dimensional problems
**CO3:** Understand the concepts of angular momentum operators & Eigen values.
**CO4:** Understand the various approximation methods
**CO5:** Acquire knowledge of relativistic quantum mechanics

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER -II | COURSE CODE: 18PPH23 | | | | | COURSE TITLE: QUANTUM MECHANICS – I | | | | | | Hours: 5 | Credit: 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 2.1 | 3.5 | 2.2 | 3.3 | 3.5 | 3.6 | 4.3 | 3.6 | 4.2 | 4.3 | 1.1 | 3.24 | |
| CO2 | 3.2 | 3.8 | 2.3 | 3.5 | 2.8 | 3.4 | 4.4 | 3.2 | 4.6 | 4.7 | 1.2 | 3.43 | |
| CO3 | 1.1 | 3.6 | 1.2 | 3.1 | 3.3 | 3.8 | 4.1 | 3.8 | 4.4 | 4.4 | 1.5 | 3.11 | |
| CO4 | 4.0 | 3.4 | 1.4 | 2.6 | 3.5 | 3.8 | 4.6 | 3.3 | 4.3 | 4.1 | 1.2 | 3.29 | |
| CO5 | 2.4 | 4.0 | 1.3 | 3.7 | 3.6 | 4.0 | 4.4 | 4.3 | 4.3 | 4.0 | 1.1 | 3.37 | |
| Mean Overall Score | | | | | | | | | | | | 3.304 | |

**Result: The Score for this course is 3.30(High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having **High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Basic Formalism:** Postulates of quantum mechanics - Equation of continuity – Erhenfest's theorem- Operator formalism - Linear operators, self adjoint operators - expectation value - stationary state - Hermitian operators for dynamical variables - eigen values and functions- orthonormality - commutation relations.

**UNIT - II** **(15 Hours)**

**Applications:** One dimensional problems – Wells; Infinite square well and finite square well and barriers; Rectangular barrier - Harmonic Oscillator by Schrödinger equation and operator method (I&III D) - Rigid rotator - Hydrogen Atom.

**UNIT - III** **(15 Hours)**

**Angular Momentum :** Angular momentum operator - commutation rules - Eigen value spectrum - Ladder Operators - Momentum Eigen values and Eigen function - L2 Operators Eigen values and Eigen function - Spin matrices and wave function- combination of two angular momentum - Clebsch Gordon coefficients.

**UNIT - IV** **(15 Hours)**

**Approximation Methods:** Perturbation theory - Non degenerate and degenerate cases- removal of degeneracy - application to ground state of anharmonic oscillator - Variation method - Hydrogen Molecule - Zeeman and Stark effects - WKB approximation.

**UNIT - V** **(15 Hours)**

**Relativistic Quantum Mechanics:** The Klein-Gordon equation- probability density and current density- The Dirac's equation and Dirac's matrices- Plane wave solutions of the Dirac's equation- Spin as an inherent property of an electron- Covariant form of Dirac's equation- Gamma matrices and their properties- Positive and negative energy states and Dirac's explanation.

**TEXT BOOKS:**

1. Introduction to Quantum Mechanics, David J. Griffiths.2005
2. Satya Prakash and Singh C.K, Quantum Mechanics.2014
3. Gupta S.L, Kumar V, Sharma R.C and Sharma H.V, Quantum Mechanics, Jai Nath& Co. 2007

**REFERENCE:**

1. Feynmann Lectures, Quantum Mechanics, Vol. - III. 2013
2. Gupta S.L. and Gupta I.D, Advanced Quantum Mechanics and Field, S. Chand & Co.2004

| I M.Sc. (PH) | PHYSICS OF NANOMATERIALS | EPPH24A |
|---|---|---|
| SEMESTER - II | | HRS/WK-5 |
| ELECTIVE – IIA | | CREDIT- 3 |

**OBJECTIVES:**

To understand the principle, synthesis and applications of nanomaterials and gain knowledge over various characterization methods.

**COURSE OUTCOMES (CO):**

**CO1:**Classify nanoparticles based on various factors.
**CO2:** Use the different methodologies for synthesis and characterization of nanomaterials
**CO3:** Differentiate between pure and composite nanoparticles and their uses
**CO4:** Select a particular methodology and material for synthesis, characterization and analysis.
**CO5:** Design or develop sensors for different applications. Catering to the needs of the recent developments.

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER-II | COURSE CODE: EPPH24A | | | | | COURSE TITLE: PHYSICS OF NANOMATERIALS | | | | | | Hours: 5 | Credit: 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 1.4 | 3.3 | 1.1 | 3.1 | 2.3 | 4.2 | 4.2 | 4.1 | 3.8 | 4.7 | 2.3 | 3.13 | |
| CO2 | 1.2 | 3.5 | 1.3 | 3.2 | 2.6 | 4.4 | 4.3 | 4.1 | 3.9 | 4.2 | 2.1 | 3.16 | |
| CO3 | 1.6 | 3.8 | 1.4 | 3.2 | 2.6 | 4.8 | 4.6 | 3.9 | 3.8 | 4.0 | 2.4 | 3.28 | |
| CO4 | 1.8 | 3.8 | 1.4 | 3.2 | 2.4 | 4.5 | 4.1 | 3.9 | 4.2 | 3.5 | 2.1 | 3.17 | |
| CO5 | 1.2 | 3.6 | 1.1 | 3.3 | 2.9 | 4.1 | 4.4 | 4.0 | 4.1 | 4.3 | 2.1 | 3.19 | |
| Mean Overall Score | | | | | | | | | | | | 3.186 | |

**Result: The Score for this course is 3.18(High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having**High association** with Programme Outcome and Programme Specific

Outcome.

**UNIT – I** **(15 Hours)**

**Introduction to Nanoparticles:** Introduction – Historical perspective of nanoparticles Zero Dimension, 1D, 2D & 3D nanostructured materials - time and length scale in structures- Influence of nano over micro /macro, size effects, and crystals- mechanical -physical and chemical properties- Energy landscapes basic intermolecular forces – inter dynamic aspects of intermolecular forces.

**UNIT – II** **(15 Hours)**

**Classification of Nanomaterials:**

**Metal Nanoparticles:** Definition of a Nanosystem- classification of nanocrystals; quantum dots, nanowires, and nanotubes, 2D films; Nano mesopores.

**Magnetic nanomaterials:** Fundamentals of magnetic materials, Dia, Para, Ferro, Ferric, and Super para magnetic materials, Nanostructured Magnetism.

**Semiconductor Nanocomposites:** Types of Nanocomposites (Metal oxides, ceramic, and Glass), Core-Shell nanoparticles - Types of systems - properties of nanocomposites.

**Carbon Nanostructures:**Introduction, Fullerenes, C60, CNT, mechanical, optical properties.

**UNIT - III**

**Synthesis of Nanomaterials** **(15 Hours)**

**Physical methods**:Thermal evaporation, Spray pyrolysis, Molecular beam epitaxy (MBE), Physical vapour deposition (PVD), Microwave heating.

**Chemical methods:** Chemical and co-precipitation, Sol fundamentals - sol - gel synthesis of metal oxides, Microemulsions or reverse micelles, Solvothermal, Sonochemical synthesis, Electrochemical synthesis, Photochemical synthesis, Langmuir - Blodgett (LB) technique, Chemical vapor deposition (CVD).

**UNIT-IV** **(15 Hours)**

**Characterization Techniques**

Powder X-Ray Diffraction, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Scanning TunnellingMicroscope (STM), Atomic Force Microscope (AFM), Scanning Probe Microscopy (SPM), UV - Visible absorption, Impedance measurement. Brunauer - Emmett - Teller (BET) Surface Area Analysis, Energy Dispersive X - ray (EDX), X - ray Photoelectron Spectroscopy (XPS) and Photoluminescence.

**UNIT – V**

**Applications of Nanoscience** **(15 Hours)**

**Nanophotonics and Devices**: Imaging of cancer cells, Biological tags and Targeted nano-drug delivery system. Issues and Challenges of functional Nanostructured Materials for electrochemical Energy Storage Systems.

**Nano sensors:** Sensors based on physical properties - Electrochemical sensors, Sensors for aerospace, defense and Biosensors. Energy: Solar cells, LEDs and photovoltaic device applications. Photocatalytic applications: Environmental Applications: Air purification, Water purifications and Volatile organic pollution degradation. Carbon nanotubes: Field emission, Fuel cells and Display devices.

**TEXTBOOKS:**


1. Viswanathan, B. (2006). *Structure and Properties of Solid-state materials* (2nd ed.). Alpha Science International.
2. Pradeep, T. (2017). *Nano:The Essentials: Understanding Nanoscience and Nanotechnology*. McGraw Hill Education.
3. David.B. Williams and C. Barry Carter (2016) *Transmission Electron microscopy : A Textbook for Materials Science,* Springer International Publishing Switzerland
4. Hellborg, D. Brunt, R. Hellborg H. J. Whitlow O. Hunderi (1992) *SEM Surface characterization A users sourcebook*.
5. David Brandon & Wayne D. Kaplan (2003) Microstructural characterization of materials, John Wiley & sons, 2nd edition.


**REFERENCE BOOKS:**


1. Ajayan, P. M., Schadler, L. S., & Braun, P. V. (2006). *Nanocomposite Science and Technology*. Wiley-VCH.
2. Schmid, G. (2011). *Nanoparticles: From theory to application* (2nd ed.). Wiley.
3. Kulkarni, S. K. (2014). *Nanotechnology: Principles and practices* (3rd ed.). Springer.
4. Viswanathan, B. (2009). *Nanomaterials*. Narosa.
5. Bandyopadhyay, A. K. (2009). *Nanomaterials* (2nd ed.). New Age International.
6. Brundle, C. R., Evans, C. A., & Wilson, S. (1992). *Encyclopedia of materials characterization: Surfaces, interfaces, thin films*. Butterworth Heinemann.
7. Charles P. Poole, J., & Owens, F. J. (2007). *Introduction to Nanotechnology*. Wiley.
8. Schubert, U. S., &Husing, N. (2019). *Synthesis of inorganic materials* (4th ed.). Wiley.
9. Milani, P., &Iannotta, S. (2012). *Cluster beam synthesis of Nanostructured materials*. Springer

| I M.Sc. (PH) | MEDICAL PHYSICS | 18EPPH25 |
|---|---|---|
| SEMESTER – II | | HRS/WK-5 |
| ELECTIVE – IIB | | CREDIT- 3 |

**OBJECTIVES:**

To know about the principle and usage of various physical instrumentation in Medical field.

**COURSE OUTCOMES (CO):**

**CO1:** Get the knowledge of production of X-ray images and applications
**CO2:** Acquire knowledge about vitro and in vivo testing
**CO3:** Aware of knowledge of ultrasound in medicine
**CO4:** Get the knowledge about the radiotherapy
**CO5:** Get the basic ideas of neuroelectrics and neuromagnetics

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER -II | COURSE CODE: 18EPPH25 | | | | | COURSE TITLE: MEDICAL PHYSICS | | | | | | Hours: 5 | Credit: 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 2.1 | 3.8 | 2.0 | 3.5 | 2.2 | 4.6 | 3.2 | 3.4 | 4.3 | 3.4 | 2.1 | 3.14 | |
| CO2 | 2.2 | 3.6 | 2.2 | 3.4 | 2.1 | 4.1 | 3.4 | 3.8 | 4.4 | 3.2 | 2.1 | 3.13 | |
| CO3 | 2.3 | 2.2 | 2.4 | 3.3 | 2.2 | 4.4 | 3.4 | 3.7 | 4.6 | 3.3 | 2.1 | 3.08 | |
| CO4 | 2.4 | 2.4 | 2.0 | 3.1 | 2.1 | 4.3 | 3.2 | 3.6 | 4.4 | 3.5 | 2.3 | 3.02 | |
| CO5 | 2.6 | 2.4 | 2.4 | 2.8 | 2.4 | 4.7 | 3.3 | 3.8 | 3.1 | 3.8 | 2.1 | 3.18 | |
| Mean Overall Score | | | | | | | | | | | | 3.11 | |

**Result: The Score for this course is 3.11 (High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having**High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**X-Ray Imaging:** Production of X-ray images, attenuation coefficients, choice of suitable energy, contrast, hardware; digital imaging X-ray computed tomography, five generations of scanners, reconstruction methods, CT number, contrast Stretching-Optical Chromatography.

**UNIT - II** **(15 Hours)**

**Nuclear Medicine:** In vitro and in vivo testing, gamma rays for imaging, radiopharmaceuticals, the gamma camera, SPECT, PET, examples of clinical use.

**UNIT - III** **(15 Hours)**

**Ultrasound in Medicine:** Ultrasound imaging, generation and detection of ultrasound, ultrasound propagation, choice of frequency, A-scan, B-scan, M-mode imaging and echo cardiography. Use of Doppler techniques for blood flow etc. Use of ultrasound in therapy

**UNIT - IV** **(15 Hours)**

**Radiotherapy:** Effect of radiation on normal and malignant tissue, cell survival Types of radiotherapy unit: low voltage, orthovoltage, megavoltage, electron beam, brachytherapy Dosimetry: calculation and measurement of dose, % depth dose, isodose lines, scattering effects Treatment planning, fractionation, conformal radiotherapy- Photodynamic Therapy.

**UNIT - V** **(15 Hours)**

**Neuroelectrics and Neuromagnetics:** Basic electrophysiology, genesis of electric and magnetic signals Techniques for measurement and imaging of EEG, ECG, MEG and MCG.

**TEXT BOOKS:**

1. Webb. S (Ed), The Physics of Medical Imaging, Hilger 1988
2. Dendy. P.P and B Heaton, Physics of Diagnostic Radiology, IOPP 2012
3. Brown. B.H et. al., Medical Physics and Biomedical Engineering IOPP 1999

**REFERENCE BOOKS:**

1. HedrickW.R, DL Hykes, and DE Starchmann, Ultrasound Physics and Instrumentation, Mosby 1995
2. Steele. G, Basic Clinical Radiobiology, Arnold 2002
3. Carlton. R and A. Adler, Principles of Radiographic Imaging, Delmar 2005

| I – M. Sc. (PH) | GENERAL PRACTICAL -II | 18PPHP21 |
|---|---|---|
| SEMESTER – II | | HRS/WK – 4 |
| CORE – PRACTICAL-II | | CREDIT –4 |

**Any 7 out of 10**

1. Electrical resistance of a metal / alloy by four probe's method.
2. F. P etalon using spectrometer.
3. Determination of Planck's constant.
4. Cauchy's dispersion constant.
5. Determination of dielectric constant of solids.
6. Ultrasonic interferometer - Viscosity and Compressibility of liquids.
7. Hall effect experiment - Determination of charge carrier density.
8. Polarisibility of Liquids using hollow prism.
9. Susceptibility of a liquid by Quincke's method.
10. Michelson's interferometer.

| I – M. Sc (PH) | ELECTRONICS PRACTICAL – II | 18PPHP22 |
|---|---|---|
| SEMESTER - II | | HRS/WK – 4 |
| CORE – PRACTICAL -II | | CREDIT – 4 |

**Any 7 out of 10**

1. Op-amp solving simultaneous equations
2. Up-down counters – Design of modulus counters
3. IC 555 – Monostablemultivibrator, frequency divider
4. Op-amp I to V and V to I converters
5. D/A converter using comparator R-2R ladder network.
6. Shift registers
7. Schmitt trigger
8. Wein bridge oscillator using Op-amp.
9. Phase shift oscillator using Op-amp.
10. Logic Simplification With Karnaugh Maps

| II – M. Sc. (PH) | MOLECULAR PHYSICS | 18PPH31 |
|---|---|---|
| SEMESTER – III | | HRS/WK – 5 |
| CORE –VII | | CREDIT –4 |

**OBJECTIVES:**

To understand the classification of molecules and know about the principles and applications of various spectroscopy.

**COURSE OUTCOMES (CO):**

**CO1:** Understand the concepts microwave and IR spectroscopy
**CO2:** Understand concept of Raman spectroscopy and its applications
**CO3:** Understand the concepts molecular quantum
**CO4:** Study the electronic spectra of molecules
**CO5:** Acquire the knowledge of nuclear spectroscopy

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER –III | COURSE CODE: 18PPH31 | | | | | COURSE TITLE: MOLECULAR PHYSICS | | | | | Hours: 5 | Credit: 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | |
| CO1 | 4 | 4 | 3.5 | 4 | 3.8 | 3.5 | 3 | 3.5 | 3.5 | 3.5 | 3 | 3.57 |
| CO2 | 2.5 | 4 | 3 | 4 | 4 | 3.5 | 3.5 | 3.5 | 4 | 4 | 3.5 | 3.59 |
| CO3 | 3.5 | 3.5 | 4 | 3.5 | 3.5 | 3.5 | 4 | 4 | 3.5 | 3 | 3.5 | 3.59 |
| CO4 | 3 | 4.5 | 3.5 | 4 | 3.5 | 4 | 3 | 3 | 3.5 | 4 | 3.5 | 3.59 |
| CO5 | 3 | 4 | 2.5 | 4 | 4 | 4 | 3.5 | 3.5 | 4 | 3.5 | 4 | 3.64 |
| Mean Overall Score | | | | | | | | | | | | 3.60 |

**Result: The Score for this course is 3.60 (High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having**High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Microwave (MW) And Infrared (IR) Spectroscopy:** Classification of rotating molecules – rotational spectra of linear and symmetric top molecules - Stark modulation MW spectrometer - IR spectrometer – diatomic molecules as harmonic and anharmonic oscillators- rotation –vibration spectra diatomic molecules – P,O and R branches- analysis of symmetric top molecules – Principle, Instrumentation and applications of FTIR.

**UNIT - II** **(15 Hours)**

**Raman Spectroscopy:** Raman Effect - Molecular polarisability – Quantum theory – Pure rotational Raman spectra of diatomic and poly atomic molecules – Vibration - rotation Raman spectra of diatomic and polyatomic molecules - Application of Raman spectroscopy for the structure determination of $H_2O$ molecule. Laser Raman spectroscopy – Principle, Instrumentation and applications of FTRAMAN spectroscopy.

**UNIT - III** **(15 Hours)**

**UV-Visible Spectroscopy:** Molecular quantum number – coupling of angular momenta - classification of states- electronic spectra of diatomic molecules - Frank Condon principle - Vibrational structure of electronic bands - Rotational fine structure - Fortrat parabola and band head formation- dissociation energy.

**UNIT - IV** **(15 Hours)**

**NMR Spectroscopy:** Concepts of NMR spectroscopy- Chemical shift- spin-spin coupling between two and more nuclei - application to structural determination of molecules- spin - spin and spin lattice relaxation processes - FTNMR – measurement of relaxation times by pulse sequence technique.

**UNIT - V** **(15 Hours)**

**ESR, NQR and Mossbauer Spectroscopy:** Concept of ESR spectroscopy - effect of L-S coupling - Lande splitting factor 'g' – Hyperfine and fine structure.General principles of NQR spectroscopy, Instrumentation and its applications. Mossbauer spectroscopy - recoilless emission and absorption - Mossbauer spectrometer- Isomer shift – Nuclear quadrupole splitting - Zeeman splitting.

**TEXT BOOKS:**

1. Banwell CN and McCash E.M, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw-Hill Publications, New Delhi.
2. Aruldas G, 2001, Molecular structure and spectroscopy, Prentice,-Hall of India Pvt.Ltd., New Delhi.
3. Satyanarayana D.N, 2004, Vibrational spectroscopy and applications, New age international Publications, New Delhi.

**REFERENCE:**

1. Raymond Chang, 1980, Basic Principles of spectroscopy, McGraw- Hill, Kogakusha, Tokyo.
2. Straughan B.P. and Walker, Spectroscopy-Vol 1, Chapman and Hall, London, 1996.

3. Hore P.J, Nuclear Magnetic Resonance – Oxford Science Publications 1995.

| II – M. Sc. (PH) | QUANTUM MECHANICS – II | 18PPH32 |
|---|---|---|
| SEMESTER – III | | HRS/WK – 5 |
| CORE –VIII | | CREDIT –4 |

**OBJECTIVES:**

To understand the basic concepts of transition probability, scattering theory and advanced ideas on quantization of fields.

**COURSE OUTCOMES:**

**CO1:**Study transition under constant perturbation and transition probability
**CO2:** Understand the concepts of scattering theory
**CO3:** Study the identical particles.
**CO4:** Understand the semi classical treatment of radiation
**CO5:** Acquire knowledge of quantization of fields.

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER –III | COURSE CODE: 18PPH32 | | | | | COURSE TITLE: QUANTUM MECHANICS – II | | | | | | Hours: 5 | Credit: 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 4 | 4 | 3.5 | 4 | 3.5 | 4 | 4 | 3.5 | 3.5 | 4 | 3.5 | 3.77 | |
| CO2 | 3.5 | 3.5 | 3.5 | 4 | 4 | 3.5 | 4 | 3.5 | 4 | 4 | 4 | 3.77 | |
| CO3 | 4 | 4 | 4 | 3.5 | 4 | 3.5 | 3.5 | 3.5 | 3.5 | 4 | 4 | 3.77 | |
| CO4 | 4 | 3.5 | 3.5 | 3.5 | 3.5 | 3 | 2.5 | 4 | 4 | 3.5 | 4 | 3.55 | |
| CO5 | 3.5 | 4 | 3.5 | 4 | 3.5 | 3.5 | 4 | 4 | 3.5 | 3.5 | 3.5 | 3.68 | |
| Mean Overall Score | | | | | | | | | | | | 3.71 | |

**Result: The Score for this course is 3.71(High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having**High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Evolution with Time**: Transition under constant perturbation - Transition probability - Fermi Golden Rule- Harmonic perturbation - Adiabatic and sudden approximations - Schrödinger picture - Heisenberg's picture - Interaction picture.

**UNIT - II** **(15 Hours)**

**Scattering Theory:** Collision in three dimension and scattering- laboratory and CM reference frames- Scattering Amplitude- Differential scattering cross section- Total scattering cross section- Scattering by spherically symmetrical potentials- partial waves and phase shifts- Born's approximation and its validity- square well, Yukawa potential and Rutherford's formula

**UNIT - III** **(15 Hours)**

**Identical Particles:** Symmetric and antisymmetric wave functions – collision of identical particles – spin angular momentum – spin functions for a many – electron system – Slater's determinant – HartreeFock Method.

**UNIT - IV** **(15 Hours)**

**Semiclassical Treatment of Radiation:** Spontaneous and induced emission of radiation from semi - classical theory - Einstein's coefficients for induced and spontaneous emission and the relation between them - Electric di-pole and forbidden transition- selection rules

**UNIT - V** **(15 Hours)**

**Quantisation of Fields:** Relativistic Lagrangian and Hamiltonian of a charged particle in an electromagnetic field – Lagrangian and Hamiltonian formulations of fields- Second quantization of Klein Gordon field – creation and annihilation operators – commutation rules – Quantization of electromagnetic and Schrodinger's field.

**TEXT BOOKS:**

1. SatyaPrakash,AdvancedQuantum Mechanics.2008
2. Gupta S.L, Kumar V, Sharma R.C, and H.V Sharma, Quantum Mechanics, Jai Nath& Co 2007
3. Chatwal and Anand, Quantum Mechanics, Himalaya & Co

**REFERENCE BOOKS:**

1. Feynmann Lectures, Quantum Mechanics, Vol.- III 2013
2. Schiff L.I, Quantum Mechanics, McGraw Hill 1968
3. Gupta S.L, Gupta I.D, Advanced Quantum Mechanics and Field, S. Chand & Co.2010

| II – M. Sc. (PH) | CONDENSED MATTER PHYSICS | 18PPH33 |
|---|---|---|
| SEMESTER – III | | HRS/WK – 5 |
| CORE – IX | | CREDIT –4 |

**OBJECTIVES:**

To understand the structure, defects and parameters of crystals and also about the classification of solids and its types in detail.

**COURSE OUTCOMES:**

**CO1:** Acquire knowledge on crystals and to study crystal structure by x-ray diffraction pattern.
**CO2:** Explore the various defects in crystals
**CO3:** Understand the band theory of solids
**CO4:** Acquire knowledge of superconductors
**CO5:**Studythe Ferro electric and magnetic systems

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER –III | COURSE CODE: 18PPH33 | | | | | COURSE TITLE: CONDENSED MATTER PHYSICS | | | | | | Hours: 5 | Credit: 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 3.5 | 4 | 3.5 | 3 | 3 | 3 | 3 | 2.5 | 3.5 | 3 | 3.5 | 3.23 | |
| CO2 | 3.5 | 4 | 4 | 4 | 4 | 2.5 | 2.5 | 4 | 4 | 4 | 4 | 3.68 | |
| CO3 | 3 | 3.5 | 3 | 2.5 | 4 | 4 | 4 | 3.5 | 3.5 | 4 | 4 | 3.55 | |
| CO4 | 3 | 3.5 | 2.5 | 3.5 | 4 | 3.5 | 4 | 3.5 | 4 | 3.5 | 3.5 | 3.50 | |
| CO5 | 4 | 3.5 | 4 | 3.5 | 3.5 | 4 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.64 | |
| Mean Overall Score | | | | | | | | | | | | 3.52 | |

**Result: The Score for this course is 3.52 (High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having**High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Crystal Physics:** Unit cell - two and three dimensional Bravis lattices - Miller indices – reciprocal lattices - interaction of X-rays with matter - absorption of X-rays- elastic scattering from a perfect lattice - X-ray intensity and atomic configuration of unit cell - Diffraction of X-rays by crystals - application of reciprocal lattice in diffraction techniques - The Laue's powder and rotating crystal methods - crystal structure factor and diffraction of neutrons by crystals- temperature dependence of reflection lines – Debye - Waller factor.

**UNIT - II** **(15 Hours)**

**Crystal Defects:** Crystal imperfections - point defects and phonon defects - ionic conductivity and lattice defects –Colourcentres- F-centres - dislocations-dislocation densities - elementary ideas of crystal growth - grain boundaries - dislocations in plastic deformation and crystal growth - X-rays and electron microscope techniques in crystal imperfection studies

**UNIT - III** **(15 Hours)**

**Electrons in Solids:** Electrons in a periodic lattice - Bloch theorem - band theory - Effective mass- Classification of solids – metals - semiconductors and insulators – Phonons - Fermi surface- Brillouin Zones - construction of Fermi surfaces - Experimental methods in Fermi surface studies- Cyclotron resonance – magnetoresistance - De Haas Van Alphen effect.

**UNIT - IV** **(15 Hours)**

**Superconductivity:** Phenomena of superconductivity - Meissner effect - Type I and II superconductors- Thermodynamics of superconducting transitions - London's equation - Cooper pairing - BCS theory of superconductivity- Ginzbung - London theory- Josephson theory - D.C and A.C. Josephson effect - Quantum interference - vortices and Type II superconductors – Introduction to High temperature superconductors.

**UNIT - V** **(15 Hours)**

**Multiferroic Systems:** Polarization – dielectric constants – interval field – electric polarizability – ferroelectric crystals – displacive transitions – antiferroelectricy – ferroelectric domain – piezo electricity – interaction between magnetic ions – Curie Weiss law – exchange interaction – internal field – spin waves – ferromagnetic domains – anti ferromagnetism – behavior of antiferromagnets above and below Neel temperature.

**TEXT BOOKS:**

1. Kittel. C, 1995, Introduction toSolid State Physics, 7th Edition, John Wiley & Sons
2. Pillai S.O, 1997, Solid State Physics, New Delhi, New Age International

**REFERENCE BOOKS:**

1. Blakemore.J.S, 1974, Solid State Physics, 2nd Edition, Philadelphia, W.B Saunders & Co.
2. Chaikin and Lubensky, Principles of Condensed Matter Physics2000

| II – M. Sc. (PH) | MICROPROCESSOR 8086 AND MICROCONTROLLER | 18EPPH34 |
|---|---|---|
| SEMESTER – III | | HRS/WK – 5 |
| ELECTIVE – III A | | CREDIT –3 |

**OBJECTIVES:**

To acquire knowledge of Intel 8086 architecture, modular programming and multiprogramming and the idea of interfacing I/O with memory

**COURSE OUTCOMES:**

**CO1:** Acquire knowledge of Intel 8086 architecture and instruction set
**CO2:** Get basis knowledge of modular programming and multiprogramming
**CO3:** Know the basis of I/o consideration, interrupts and system bus structure
**CO4:** Acquire knowledge about Intel 8051 micro controller
**CO5:** Get the idea of Interfacing I/O and memory with 8051

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER –III | COURSE CODE: 18EPPH34 | | | | | COURSE TITLE: MICROPROCESSOR 8086 AND MICROCONTROLLER | | | | | | Hours: 5 | Credit: 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 1.1 | 3.5 | 1.2 | 3.3 | 2.2 | 4.4 | 4.3 | 4.1 | 4.5 | 3.6 | 2.4 | 3.14 | |
| CO2 | 1.2 | 3.8 | 1.3 | 3.3 | 2.1 | 3.9 | 3.7 | 3.7 | 3.9 | 3.7 | 2.2 | 2.98 | |
| CO3 | 1.6 | 3.8 | 1.2 | 3.1 | 2.3 | 4.8 | 4.1 | 3.8 | 3.8 | 3.9 | 2.5 | 3.17 | |
| CO4 | 1.2 | 3.4 | 1.6 | 3.6 | 2.5 | 3.9 | 4.2 | 4.6 | 4.3 | 4.6 | 2.2 | 2.95 | |
| CO5 | 1.4 | 4.0 | 1.1 | 3.7 | 2.2 | 4.0 | 3.9 | 4.2 | 4.5 | 4.3 | 2.1 | 3.21 | |
| Mean Overall Score | | | | | | | | | | | | 3.09 | |

**Result: The Score for this course is 3.09(High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having**High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Intel 8086 Architecture and Instruction Set:** Internal architecture of 8086 - Software model - Internal registers - Minimum mode and Maximum mode system - Instruction set - Addressing modes – Data transfer, Arithmetic, Logical, Shift and rotate instruction – Compare, Jump, Loop, String, Processor control, CALL - RET and stack instructions - Procedures - Assembler Macros - Assembler directives.

**UNIT - II** **(15 Hours)**

**Modular Programming and Multiprogramming:** Linking and relocation – access to external identifiers – procedures – interrupts and their routines – macros – process management and IRMX86 – semaphore operations – common procedure sharing.

**UNIT - III** **(15 Hours)**

**I/O Consideration, Interrupts and System Bus Structure:** Programmed I/O – Interrupt I/O – block transfer and DMA – basic 8086 bus configuration – minimum and maximum modes – system bus timings – interrupt priority management – single and multiple 8259

**UNIT - IV** **(15 Hours)**

**Intel 8051 Micro Controller:** Introduction – 8 and 16-bit Microcontroller families –Flash series – Embedded RISC Processor – 8051 Microcontroller Hardware – Internal registers – Addressing modes – Assembly Language Programming – Arithmetic, Logic and Sorting operations.

**UNIT - V** **(15 Hours)**

**Interfacing I/O and Memory with 8051:** Interfacing I/O Ports, External memory, counters and Timers - Serial data input/output, Interrupts – Interfacing 8051 with ADC, DAC, LED display, Keyboard, Sensors and Stepper motor

**TEXT BOOKS:**

1. Yu-cheng Liu, Glen A. Gibson, 2006, Microcomputer System 8086/8088 Family, Prentice – Hall of India.
2. Muhammad Ali Mazidi, 2006, the 8051 Microcontroller and Embedded Systems, First Impression, Pearson Prentice Hall.

**REFERENCE BOOKS:**

1. Barry B Brey, 1995, The Intel Microprocessor 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, New Delhi, Prentice Hall of India.
2. Uffrenbeck J, The 8086/8088 Family – Design, Programming and Interfacing, Software, Hardware and Applications, New Delhi, Prentice Hall of India.1994
3. Tribel W.A and Avtar Singh, The 8086/8088 Microprocessors Programming, Interfacing, Software, Hardware and Applications, New Delhi, Prentice Hall of India.1999

| II – M. Sc. (PH) | COMMUNICATION PHYSICS | 18EPPH35 |
|---|---|---|
| SEMESTER – III | | HRS/WK – 5 |
| ELECTIVE – III B | | CREDIT –3 |

**OBJECTIVES:**

To know about the principle, construction and working of various conventional and modern communication systems.

**COURSE OUTCOMES:**

**CO1:** Know the basic of FM, SSB & ISB transmission methods.
**CO2:** Acquire the knowledge of digital modulation and satellite communication.
**CO3:** Understand the concept of transmission and reception of TV signals
**CO4:** Acquire knowledge on modern communication system
**CO5:**Study the basics of fiber optic communication

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER – III | COURSE CODE: 18EPPH35 | | | | | COURSE TITLE: COMMUNICATION PHYSICS | | | | | | Hours: 5 | Credit: 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 1.4 | 3.3 | 1.1 | 3.1 | 2.3 | 4.2 | 4.2 | 4.1 | 3.8 | 4.7 | 2.3 | 3.13 | |
| CO2 | 1.2 | 3.5 | 1.3 | 3.2 | 2.6 | 4.4 | 4.3 | 4.1 | 3.9 | 4.2 | 2.1 | 3.16 | |
| CO3 | 1.6 | 3.8 | 1.4 | 3.2 | 2.6 | 4.8 | 4.6 | 3.9 | 3.8 | 4.0 | 2.4 | 3.28 | |
| CO4 | 1.8 | 3.8 | 1.4 | 3.2 | 2.4 | 4.5 | 4.1 | 3.9 | 4.2 | 3.5 | 2.1 | 3.17 | |
| CO5 | 1.2 | 3.6 | 1.1 | 3.3 | 2.9 | 4.1 | 4.4 | 4.0 | 4.1 | 4.3 | 2.1 | 3.19 | |
| Mean Overall Score | | | | | | | | | | | | 3.186 | |

**Result: The Score for this course is 3.18 (High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having**High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**FM Transmission:** Frequency modulation – FM radio frequency band – Direct frequency modulation – modulation index – FM wave equation – Bandwidth – deviation ratio – voltage distribution – power – reactance modulation – FM radio receiver (Block diagram) - SSB Transmission – Advantages and disadvantages –Balanced Modulators – Separation of sidebands – Filter method – the phase shift method – ISB – ISB receiver.

**UNIT - II** **(15 Hours)**

**Digital Modulation, Multiplexing and Satellite Communication:** Digital Modulation – codes – Data forms – Transmission modes between stations – Modems – Pulse amplitude modulation – Time division multiplexing – pulse width modulation – pulse position modulation – frequency division multiplexing – satellite communication – Geostationary satellites – Communication satellites – satellite subsystems – Earth stations – domestic satellites.

**UNIT - III** **(15 Hours)**

**Television:** Television transmission – television pictures and cameras – Interlaced scanning and picture resolution – Tonal and colour characteristics of pictures – composite B & W and colour video signals – colour TV transmitter – Television reception – colour receiver plan – Electronic tuner – IF subsystem – receiver sound system – Y signal channel – chroma decoder – Raster circuits – EHT generation – receiver picture tubes – remote control of receiver functions.

**UNIT - IV** **(15 Hours)**

**Modern Communication System:** Telephony – Telephone Instruments – Telephone transmitter and receiver – Electronic telephone – Dialler – Ringer –SLIC – advantages and disadvantages of digital transmission – FACSIMILE and cellular radio systems.

**UNIT - V** **(15 Hours)**

**Fiber Optic Communication:** Fiber materials – glass fibers – plastic clad glass fiber – plastic fibers – fiber optic communications – propagation theory – numerical aperture – classification of optical fibers – scalar wave equation and solution to step index fiber – loss mechanism in optical fibers – signal distortion due to dispersion – amount of dispersion in a step index fiber.

**TEXT BOOKS:**

1. Robert. J Schoenbeck, 1999, Electronic communications, Prentice Hall of India (P) Ltd, New Delhi.
2. Gulati R.R, 2000, Composite Satellite and Cable Television, New Age international.

**REFERENCE BOOKS:**

1. Cerin, Introduction to Optical Fibers, McGraw Hill 1982
2. B.B. Laud, Laser and Nonlinear Optics, Wiley Eastern Limited 1991
3. Louis E. Frenzel Principles of Electronic Communication Systems, McGraw Hill; 4th edition, 2015

| | | |
|---|---|---|
| **II – M. Sc. (PH)** | **GENERAL PRACTICAL -III** | **18PPHP31** |
| **SEMESTER - III** | | **HRS/WK - 4** |
| **CORE – PRACTICAL- III** | | **CREDIT - 4** |

**Any 7 out of 10**

1. e- Millikan's oil drop method.
2. Dielectric constant Lecher Wires.
3. Resistivity of semiconductor.
4. Biprism – Wave length and thickness
5. Spectrometer – Refractive index of different liquids using Hollow prism.
6. Test the validity of the Hartmann's prism dispersion formula using the visible region of mercury spectrum
7. Thickness of Mica Sheet Using Edser Butler Method using spectrometer.
8. Measurement of wave length of He-Ne laser light using ruler.
9. Magnetic Susceptibility, Gouy's method.
10. Half shade polarimeter - determination of the specific rotation of sugar solution.

| II – M. Sc. (PH) | MIROPROCESSOR PRACTICAL – I | 18PPHP32 |
|---|---|---|
| SEMESTER - III | | HRS/WK - 4 |
| CORE – PRACTICAL - III | | CREDIT - 4 |

**Experiments may be combined to make 12 out of 25**

1. Program to Increment an 8-bit Number
2. Program to Increment a 16-bit Number
3. Program to Decrement an 8-bit Number
4. Program to Decrement a 16-bit Number
5. Program to Find 1's Complement of an 8-bit Number
6. Program to Find 1's Complement of a 16-bit Number
7. Program to Find 2's Complement of an 8-bit Number
8. Program to Find 2's Complement of a 16-bit Number
9. Program to Add Two 8-bit Numbers
10. Program to Add Two 16-bit Numbers
11. Program to Subtract Two 8-bit Numbers
12. Program to Subtract Two 16-bit Numbers
13. Program to Multiply Two 8-bit Unsigned Numbers
14. Program to Multiply Two 16-bit Unsigned Numbers
15. Program to Multiply Two 8-bit Signed Numbers
16. Program to Multiply Two 16-bit Signed Numbers
17. Program to Divide 16-bit Unsigned Number by an 8-bit Unsigned Number
18. Program to Divide 16-bit Signed Number by an 8-bit Signed Numbers
19. Sum of 'n' consecutive numbers
20. Conversion of BCD number to decimal
21. Separating Odd and Even numbers
22. Curve fitting – Least Square fitting with algorithm, flowchart – C Program.
23. Solution of a Polynomial equation and determination of roots by Newton Raphson Method with algorithm, flowchart – C Program
24. Program for Addition and Subtraction of two numbers using Microcontroller 8051
25. Program for Multiplication and Division of two numbers using Microcontroller 8051

| II – M. Sc. (PH) | NUCLEAR & PARTICLE PHYSICS | 18PPH41 |
|---|---|---|
| SEMESTER - IV | | HRS/WK - 5 |
| CORE - X | | CREDIT - 4 |

**OBJECTIVES:**

To understand the concepts of various nuclear models, types of nuclear reactions and particle physics.

**COURSE OUTCOMES:**

**CO1:** Understand the concepts of various nuclear models
**CO2:** Study the central force and tensor force in the molecular system.
**CO3:** Understand the concepts of nuclear reaction
**CO4:** Study the theory of beta decay
**CO5:** Acquire theknowledge of particle physics

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER – IV | COURSE CODE: 18PPH41 | | | | | COURSE TITLE: NUCLEAR & PARTICLE PHYSICS | | | | | | Hours: 5 | Credit: 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 3.5 | 3 | 3 | 3.5 | 3.5 | 4 | 3.5 | 3 | 3.5 | 3.5 | 3.5 | 3.41 | |
| CO2 | 3.5 | 3 | 4 | 3.5 | 3.5 | 4 | 3.5 | 3.5 | 2.5 | 4 | 3.5 | 3.50 | |
| CO3 | 3.5 | 3.5 | 3 | 3 | 3.5 | 3.5 | 4 | 3.5 | 4 | 3.5 | 3.5 | 3.50 | |
| CO4 | 4 | 3.5 | 2.5 | 3 | 3.5 | 3.5 | 3.5 | 4 | 3.5 | 4 | 4 | 3.55 | |
| CO5 | 3.5 | 4 | 3.5 | 4 | 4 | 3.5 | 3.5 | 4 | 3.5 | 4 | 3 | 3.68 | |
| Mean Overall Score | | | | | | | | | | | | 3.53 | |

**Result: The Score for this course is 3.53(High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having**High association** with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Nuclear Models:** Liquid drop model- Bohr Wheeler theory fission- Experimental evidence for shell effects- Shell Model-Spin orbit coupling- Magic numbers- Angular Momenta and parities of nuclear ground states- Qualitative discussion and estimates of transition rates- magnetic moments and Schmidt lines- Collective model of Bohr and Mottelson- oblate and prolate deformation of Nucleus.

**UNIT - II** **(15 Hours)**

**Nuclear Force:** Central force and tensor forces- Ground state of deuteron- Magnetic and quadrupole moments- Charge independence and spin dependence of nuclear forces-n-p scattering and p-p scattering at low energies-effective range theory- High energy nucleon-nucleon Scattering-Exchange forces- Meson theory of nuclear forces.

**UNIT - III** **(15 Hours)**

**Nuclear Reactions:** Types of reactions and conservation laws- energetics of nuclear reactions-reaction dynamics- Q – value equation- scattering and reaction cross section- compound nucleus- scattering matrix- fission and controlled fission reactions, fission reactors – fission explosives - fusion, solar fusion – thermonuclear reactions and weapons.

**UNIT - IV** **(15 Hours)**

**Nuclear Decay:** Beta decay- Fermi theory of beta decay- Shape of the beta spectrum- Total decay rate- Angular momentum and parity selection rules- Comparative half-lives- allowed and forbidden transitions- Selection rules- Parity violations- Two component theory of neutrino decay- Detection and properties of neutrino- Gamma decay.

**UNIT - V** **(15 Hours)**

**Particle Physics:** Baryons and Mesons- their properties, decay models- Strong, weak and electromagnetic interactions- Hadrons and Leptons, Tau-Theta puzzle- Strangeness- Gellman-Nishijima-relations-SU(3) classifications of Hadrons-Octets and decouplets-elementary ideas of Quarks – New particles.

**TEXT BOOKS:**

1. Tayal D.C, Nuclear Physics, Himalaya Publications.1970
2. Pandya M.L, Elementary Nuclear Physics, KedarNath Ram Nath.
3. Concepts of Nuclear Physics – B.L. Cohen (Wiley-Eastern)1989
4. Griffiths D, Introduction to Elementary Particles, Harper and Row.1987

**REFERENCE BOOKS:**

1. Waghmare Y.R, Introductory Nuclear Physics, Oxford-IBH.1981
2. Kenneth S. Krane, Introductory Nuclear Physics, Wiley-Eastern 1987

| II – M. Sc. (PH) | RESEARCH METHODOLOGY, COMPUTATION METHODS & PROGRAMMING | 18EPPH42 |
|---|---|---|
| SEMESTER - IV | | HRS/WK - 5 |
| ELECTIVE – IV A | | CREDIT - 3 |

**OBJECTIVES:**

To know about the principles of Scientific research and learn about research writing, computational methods and programming used in research.

**COURSE OUTCOMES:**

**CO1:** To understand the Principles of Scientific Research
**CO2:** To Understand Qualitative & Quantitative Analysis
**CO3:** Understanding the Plotting& Analyzing Origin
**CO4:** To Learn the Programming using MATLAB
**CO5:** To study the Python Programming

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER – IV | COURSE CODE: 18EPPH42 | | | | | COURSE TITLE: RESEARCH METHODOLOGY, COMPUTATION METHODS & PROGRAMMING | | | | Hours: 5 | Credit: 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | Mean Score of CO's |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | |
| CO1 | 1.1 | 4.1 | 1.2 | 3.3 | 1.0 | 4.2 | 4.2 | 4.1 | 4.3 | 4.3 | 1.0 | 2.98 |
| CO2 | 1.0 | 3.3 | 1.0 | 3.2 | 1.0 | 4.2 | 4.1 | 4.2 | 4.3 | 4.3 | 1.0 | 2.87 |
| CO3 | 1.0 | 3.4 | 1.0 | 3.6 | 1.1 | 4.4 | 4.4 | 4.6 | 4.4 | 4.5 | 1.1 | 2.65 |
| CO4 | 1.1 | 3.3 | 1.0 | 3.5 | 1.0 | 4.4 | 4.8 | 4.1 | 4.2 | 4.2 | 1.0 | 2.87 |
| CO5 | 1.0 | 4.0 | 1.1 | 3.2 | 1.0 | 4.3 | 4.3 | 4.1 | 1.0 | 4.4 | 1.1 | 2.68 |
| Mean Overall Score | | | | | | | | | | | | 2.81 |

**Result: The Score for this course is 2.81 (Moderate)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having **Moderate** association with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Principles of Scientific Research:** Identification of the problem- Literature survey – Reference collection – Familiarity with ideas and concept of investigation –Internet Browsing –Drawing inference from data

**UNIT - II** **(15 Hours)**

**Analysis and Research Writing:** Art of writing a research paper, Synopsis, Research Project and Thesis - Seminar -Power point presentation.

**UNIT - III** **(15 Hours)**

**Origin Graphing and Analysis:** Linear curve fitting - non-linear curve fitting - model validation - dataset comparison tools - multi-dimensional data analysis- Peak Analysis

**UNIT – IV** **(15 Hours)**

**Starting with MATLAB, Creating Arrays:** Starting with MATLAB, MATLAB Windows – Working in the Command windows –Arithmetic Operations with Scalars – Display formats – Elementary Math Built in functions –Defining Scalar Variable – Creating one dimensional arrays and creating two dimensional arrays.

**UNIT – V** **(15 Hours)**

**Python Programming Environment:** Fundamental python programming techniques such as lambdas, reading and manipulating csv files, and the numpy library - Data manipulation and cleaning techniques

**TEXT BOOK:**

1. Research Methodology – Methods and Techniques (Third Edition) C.R. Kothari and G. Garg 1990

**REFERENCE BOOKS:**

1. NekaneGuarrotxena, Research Methodology in Physics and Chemistry of Surfaces and Interfaces. 2014

| II – M.Sc. (PH) | MATERIALS SCIENCE | 18EPPH43 |
|---|---|---|
| SEMESTER - IV | | HRS/WK –5 |
| ELECTIVE – IV B | | CREDIT – 3 |

**OBJECTIVES:**

To understand the classification of materials and learn about the principle, theory and properties of its types.

**COURSE OUTCOMES:**

**CO1:** To understand the classification of materials.
**CO2:** To study various phase diagrams.
**CO3:** To know the phase transformation and nucleation.
**CO4:** To learn the electron theory of metals
**CO5:** To study the electric and magnetic properties of materials.

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER – IV | COURSE CODE: 18EPPH43 | | | | | COURSE TITLE: MATERIALS SCIENCE | | | | | | Hours: 5 | Credit: 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 1.1 | 4.1 | 1.2 | 3.3 | 1.0 | 4.2 | 4.2 | 4.1 | 4.3 | 4.3 | 1.0 | 2.98 | |
| CO2 | 1.0 | 3.3 | 1.0 | 3.2 | 1.0 | 4.2 | 4.1 | 4.2 | 4.3 | 4.3 | 1.0 | 2.87 | |
| CO3 | 1.0 | 3.4 | 1.0 | 3.6 | 1.1 | 4.4 | 4.4 | 4.6 | 4.4 | 4.5 | 1.1 | 2.65 | |
| CO4 | 1.1 | 3.3 | 1.0 | 3.5 | 1.0 | 4.4 | 4.8 | 4.1 | 4.2 | 4.2 | 1.0 | 2.87 | |
| CO5 | 1.0 | 4.0 | 1.1 | 3.2 | 1.0 | 4.3 | 4.3 | 4.1 | 1.0 | 4.4 | 1.1 | 2.68 | |
| Mean Overall Score | | | | | | | | | | | | 2.81 | |

**Result: The Score for this course is 2.68 (Moderate)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having **Moderate** association with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Classification of Materials:** Engineering materials- Material structure- Types of Bonds and their energies – Bond formation mechanism- Ionic bond-covalent bond examples-ceramics-thermal and electrical properties – Uses-Metallic bond- comparison of bond (dispersion bonds, dipole bonds and hydrogen bonds)-Crystal imperfection –Types of imperfections- Thermal vibrations – point, line and surface imperfections- Frank –Read source.

**UNIT - II** **(15 Hours)**

**Phase Diagrams:** Basic terms- solid solutions- Hume – Rothery's rules- intermediate phase-Gibb's Phase rules- Time – temperatures cooling curves- construction of phase diagrams- the Lever rule- eutectic systems- eutectoid - Systems- peritectic and peritectoidSystem-Ternary equilibrium diagrams.

**UNIT - III** **(15 Hours)**

**Phase Transformation:** Rate of transformation- nucleation (homogeneous and heterogeneous)-nucleation and growth –applications of phase transformations – micro constituent of iron – carbon system –the allotropy of iron – Iron-Carbon equilibrium diagram-formation of Austenite- TTT diagram- transformation Austenite upon continuous cooling.

**UNIT - IV** **(15 Hours)**

**Electron Theory of Metals:** Fundamental theories of electrons (Drude and Lorentz theory and Somerfield free electron theory) –electron energies in a metal- Zone theory of solids- energy gaps – density of states – Zones in conductors, insulators and semiconductors - factors affecting electrical resistance of materials.

**UNIT - V** **(15 Hours)**

**Electrical and Magnetic Properties of Materials:** Resistivity- conductivity- semiconductors –classification of semiconductors on the basis of Fermi energy and Fermi levels- insulators – dielectrics –Ferro electricity –electro strict ion- Piezo electricity –uses of dielectrics –capacitors dielectric strength- magnetic properties of materials –magneto strict ion-magnetic domain – soft and hard magnetic materials.

**TEXT BOOKS:**

1. Saxena B.S, Gupta. R.C and Saxena. P.N, Fundamentals of Solid State Physics
2. Singhal.R.L, 2000-2001, Solid State Physics, KedarNath Ram Nath& Co, Meerut.
3. Kittel C,1992, Introduction to Solid State Physics, New India Publishing House.

**REFERENCE BOOKS:**

1. Raghavan.V, 1990, Materials Science and Engineering a first course, III Ed, PrenticeHall of India.
2. Structural M, 1990, Materials Science, Anuradha Agencies & Publishers
3. Manchandra. V.K, 1992, a Text Book of Materials Science, New India Publishing House.
4. William D. Calister, Fundamentals of Material Science & Engineering, Jr. John William & sons Inc, 2001.

| II – M. Sc. (PH) | ELECTRONIC INSTRUMENTATION | 18EPPH44 |
|---|---|---|
| SEMESTER - IV | | HRS/WK - 5 |
| ELECTIVE – V A | | CREDIT - 3 |

**OBJECTIVES:**

To understand the principle, construction and working of various analytical, digital and electronic instrumentations.

**COURSE OUTCOMES:**

**CO1:** Understand the various transducers
**CO2:** Study digital instrumentation methods
**CO3:** Know the analytical instrumentation techniques
**CO4:** Study the bio medical instrumentation
**CO5:** Apply the knowledge of computer peripherals

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER – IV | COURSE CODE: 18EPPH44 | | | | | COURSE TITLE: ELECTRONIC INSTRUMENTATION | | | | | | Hours: 5 | Credit: 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 3.2 | 2.6 | 4 | 3.5 | 3 | 2.8 | 3.5 | 3 | 4 | 3.1 | 3.2 | 3.26 | |
| CO2 | 3.4 | 3.2 | 3 | 3.1 | 3.5 | 3.6 | 4.1 | 3 | 3 | 2.6 | 3.5 | 3.27 | |
| CO3 | 3.5 | 4 | 3.2 | 2.8 | 3 | 3.2 | 3.1 | 3.5 | 3.4 | 3.5 | 3 | 3.29 | |
| CO4 | 3.2 | 3.4 | 3 | 4 | 3.1 | 3.5 | 3.3 | 2.8 | 3.5 | 3.5 | 3.6 | 3.35 | |
| CO5 | 4.2 | 3.5 | 3.5 | 3.2 | 3.5 | 2.5 | 3.6 | 3 | 4.1 | 3.4 | 3.5 | 3.45 | |
| Mean Overall Score | | | | | | | | | | | | 3.32 | |

**Result: The Score for this course is 3.32 (High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having **High** association with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Transducers:** Classification of transducers –Principle, construction and working of Thermistor, LVDT, Electrical strain gauges and capacitive transducers - Measurement of non –electrical quantities –strain, Displacement, temperature, pressure and force.

**UNIT - II** **(15 Hours)**

**Digital Instrumentation:** Principle, block diagram and working of Digital frequency counter. Digital multimeter, digital pH meter, digital conductivity meter and digital storage oscilloscope

**UNIT - III** **(15 Hours)**

**Analytical Instrumentation:** Principle,block diagram, description,working and application of UV-VIS Spectrometer, IR spectrometer, Flame emission spectrometer and ICP-AES Spectrometer – Basic concept of gas and liquid chromatography.

**UNIT - IV** **(15 Hours)**

**Bio –Medical Instrumentation:** Physiological transducers to measure blood pressure, body temperature. Source of Bio- electric potentials – resting potential action potential, bio-potential, block diagram and operation of ECG an EEG –Records.

**UNIT - V** **(15 Hours)**

**Computer Peripherals:** Printers – Printer mechanism – Classification - Dot matrix, Ink jet and Laser printer.Basic concept of key board and mouse - Mass data storage - floppy disk – Hard Disk -Operation Dick(CD) - Pen drive (thumb drive).

**TEXT BOOKS:**

1. Rajendra Prasad, Electronic Measurement and instrumentation, Khanna Publications.2001
2. Ramambhadran S, Electronic Measurements & Instrumentation, Khanna Publications.1986
3. Dhir S.M, Electronics and instrumentation, Khanna Publications.2009
4. Khandpur, Hand Book of Biomedical Instrumentation, TMH. Publications.

**REFERENCE BOOKS:**

1. Gromwell L, Bio medical instrumentation and measurement, Prentice Hall.2010
2. John R. Cameran and James G. Skofronick, 1978, Medical physics, John Wiley & Sons.
3. Aplen E.L, 1990, Radiation Physics, Prentice Hall.

| II – M.Sc. (PH) | ASTRONOMY AND ASTROPHYSICS | 18EPPH45 |
|---|---|---|
| SEMESTER - IV | | HRS/WK - 5 |
| ELECTIVE – V B | | CREDIT - 3 |

**OBJECTIVES:**

To understand the principle of relativity, Einstein's equations and know about the physical cosmology and early universe.

**COURSE OUTCOMES:**

**CO1:** Understand the principles of relativity.
**CO2:** Know the different frame works of relativity
**CO3:**Study the Einstein's equation and its solutions
**CO4:** Acquire the knowledge of cosmological models
**CO5:**Explore the thermal history of the universe

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER – IV | COURSE CODE: 18EPPH45 | | | | | COURSE TITLE: ASTRONOMY AND ASTROPHYSICS | | | | | Hours: 5 | Credit: 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | |
| CO1 | 4 | 4 | 3.5 | 4 | 3.5 | 4 | 4 | 3.5 | 3.5 | 4 | 3.5 | 3.77 |
| CO2 | 3.5 | 3.5 | 3.5 | 4 | 4 | 3.5 | 4 | 3.5 | 4 | 4 | 4 | 3.77 |
| CO3 | 4 | 4 | 4 | 3.5 | 4 | 3.5 | 3.5 | 3.5 | 3.5 | 4 | 4 | 3.77 |
| CO4 | 4 | 3.5 | 3.5 | 3.5 | 3.5 | 3 | 2.5 | 4 | 4 | 3.5 | 4 | 3.55 |
| CO5 | 3.5 | 4 | 3.5 | 4 | 3.5 | 3.5 | 4 | 4 | 3.5 | 3.5 | 3.5 | 3.68 |
| Mean Overall Score | | | | | | | | | | | | 3.71 |

**Result: The Score for this course is 3.71(High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having **High** association with Programme Outcome and Programme Specific Outcome.

**UNIT - I** **(15 Hours)**

**Principles of Relativity:** Overview of Special Relativity, space time diagrams, Lorentz metric, light cones, electrodynamics in 4 dimensional languages. Introduction to general relativity (GR), equivalence principle, gravitation as a manifestation of the curvature of space time

**UNIT - II** **(15 Hours)**

**Geometrical Framework of General Relativity:** Curved spaces, tensor algebra, metric, affine connection, covariant derivatives, physics in curved space time, curvature - Riemann tensor, Bianchi identities, action principle, Einstein's field equations, energy momentum tensors, energy-momentum tensor for a perfect fluid, connection with Newton's theory.

**UNIT - III** **(15 Hours)**

**Solutions to Einstein's Equations and Their Properties:** Spherical symmetry, derivation of the Schwarzschild solution, test particle orbits for massive and massless particles. The three classical tests of GR, blackholes, event horizon - one way membranes, gravitational waves

**UNIT - IV** **(15 Hours)**

**Cosmological Models:** Cosmological principle, Robertson-Walker metric, cosmological red shift, Hubble's law, observable quantities - luminosity and angular diameter distances, dynamics of Friedmann-Robertson- Walker models: Solutions of Einstein's equations for closed, open and flat universes.

**UNIT - V** **(15 Hours)**

**Physical Cosmology and The Early Universe:** Thermal history of the universe: Temperature-redshift relation, distribution functions in the early universe - relativistic and non-relativistic limits. Decoupling of neutrinos and the relic neutrino background - nucleosynthesis - decoupling of matter and radiation; cosmic microwave background radiation - inflation - origin and growth of density perturbations

**TEXT BOOKS:**

1. General Relativity and Cosmology, J. V. Narlikar, Delhi: Macmillan Company of India Ltd. 1977
2. First Course in General Relativity, B. F. Schutz, Cambridge University Press. 2009
3. Introduction to Cosmology, J. V. Narlikar, Cambridge University Press. 2002

**REFERENCE BOOKS:**

1. Telescopes and Techniques, C.R.Kitchin, Springer. 2014
2. Observational Astrophysics, R.C. Smith, Cambridge University Press. 1995
3. Electronic Imaging in Astronomy, I.S. McLean, Wiley-Praxis. 1997

| | | |
|---|---|---|
| **II – M.Sc. (PH)** | **PROJECT** | **18JPPH46** |
| **SEMESTER - IV** | | **HRS/WK-8** |
| **PROJECT** | | **CREDIT-6** |

**Research Project in Physics**

**FORMAT FOR PREPARING PROJECT REPORT**

**Arrangement of contents**

1. Title Page
2. Bonafide Certificate
3. Acknowledgement
4. Table of contents
5. Abstract
6. Introduction
7. Materials
8. Experimental/Computational Method
9. Results & Discussion
10. Conclusions
11. Bibliography/References
12. Appendices, if any

**BINDING SPECIFICATION**

- Report should be found using flexible cover of thick white art paper.
- The Spine for the bound volume should be 2cms width.
- The Cover should be printed in block letters.

**MARGIN SPECIFICATION**

Top : 4 cm
Bottom : 3 cm
Left : 4.5 cm
Top : 2.5 cm

**FONT**

Text of the thesis should be in Times New Roman Font style with 12 Font size. All Page numbers should be typed without punctuation on the bottom-center portion of the page. The Preliminary pages (table of contents and abstract) should be numbered in lowercase roman literals.

**Reference should be in the format below:**

Schott, D. H., Collins, R. N. &Bretscher, A. Secretory vesicle transport velocity in living cells depends on the myosin V lever arm length. J. Cell Biol. **156**, 35-39 (2002).

| II – M. Sc. (PH) | SCIENTIFIC ANALYSIS | 18PPH48 |
|---|---|---|
| SEMESTER - IV | | HRS/WK-4 |
| CORE | | CREDIT-2 |

**OBJECTIVES:**

To learn the basic concepts and develop the ability to solve problems on various fields of physics.

**COURSE OUTCOMES:**

**CO1:**Solve the problems on Mathematical Methods of Physics and Classical Mechanics
**CO2:** Solve the problems on Electromagnetic Theory and Quantum Mechanics
**CO3:**Solve the problems on Thermodynamic and Statistical Physics, Electronics and Experimental Methods
**CO4:** Solve the problems on Atomic & Molecular Physics,Condensed Matter Physics
**CO5:**Solve the problems on Nuclear and Particle Physics

**Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes**

| SEMESTER – IV | COURSE CODE: 18PPH48 | | | | | COURSE TITLE: SCIENTIFIC ANALYSIS | | | | | | Hours: 4 | Credit: 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes COs | Programme Outcomes POs | | | | | Programme Specific Outcomes PSOs | | | | | | Mean Score of CO's | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | | |
| CO1 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4.818 | |
| CO2 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4.818 | |
| CO3 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4.818 | |
| CO4 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4.818 | |
| CO5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4.818 | |
| Mean Overall Score | | | | | | | | | | | | 4.818 | |

**Result: The Score for this course is 4.818 (Very High)**

| Association | 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |
|---|---|---|---|---|---|
| Scale | 1 | 2 | 3 | 4 | 5 |
| Interval | 0.0-1.0 | 1.1-2.0 | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 |
| Rating | Very Poor | Poor | Moderate | High | Very High |

This course is having**Very High** association with Programme Outcome and Programme Specific Outcome

**Any One Unit Out of Ten (Problems only)**
**Online mode of Examination**

**UNIT - I**

**Mathematical Methods of Physics:** Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem. Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Elements of computational techniques: root of functions, interpolation, extrapolation, and integration by trapezoid and Simpson's rule, Solution of first order differential equation using Runge-Kutta method. Finite difference methods. Tensors. Introductory group theory: SU (2), O (3).

**UNIT - II**

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

**UNIT - III**

**Electromagnetic Theory:** Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation-from moving charges and dipoles and retarded potentials

**UNIT - IV**

**Quantum Mechanics:** Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of

angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time-independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli Exclusion Principle, spin-statistics connection. Spin-orbit coupling, fine structure. WKB approximation. Elementary theory of scattering: phase shifts, partial waves, Born approximation. Relativistic quantum mechanics: Klein-Gordon and Dirac equations. Semi-classical theory of radiation

**UNIT - V**

**Thermodynamic and Statistical Physics:** Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibrium. Phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law. First- and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation. Diffusion equation. Random walk and Brownian motion. Introduction to non-equilibrium processes.

**UNIT - VI**

**Electronics and Experimental Methods:** Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators and similar circuits). A/D and D/A converters. Microprocessor and microcontroller basics

Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting, Linear and nonlinear curve fitting, chi-square test. Transducers (temperature, pressure/vacuum, magnetic fields, vibration, optical, and particle detectors). Measurement and control. Signal conditioning and recovery. Impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding. Fourier transforms, lock-in detector, box-car integrator, modulation techniques. High frequency devices (including generators and detectors)

**UNIT - VII**

**Atomic & Molecular Physics:** Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Back& Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-Condon principle. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers: spontaneous and stimulated emission, Einstein A& B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length

**UNIT - VIII**

**Condensed Matter Physics:** Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity: Type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals

**UNIT - IX**

**Nuclear and Particle Physics:** Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi-empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Rotational spectra. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions. Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics