**SCAA Dated 12/10/2022**

**M. Sc. Physics**

**AFFILIATED COLLEGES**

**2022 - 2023 onwards**

**BHARATHIAR UNIVERSITY**

**Coimbatore - 641 046, Tamil Nadu, India**

**Program Code: 32C**



**Syllabus**

|  |  |
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| **Program Educational Objectives (PEOs)** | |
| **The M.Sc. program in Physics describes accomplishments that graduates are expected to attain within five to seven years after graduation.** | |
| **PEO1** | Become employable with necessary skills and knowledge in industry, research, academics, business, etc. and on par with national and international standards. |
| **PEO2** | Acquired knowledge in physical concepts will facilitate them to recognize, formulate, examine, explore and implement new innovative ideas for overall societal development. |
| **PEO3** | Capable enough to meet challenges as an individual and as a part of team in innovative projects. |
| **PEO4** | Will acquire a strong cognitive base by learning diverse physical phenomena and thus lead and execute inter- and multidisciplinary academic/research. |
| **PEO5** | Will acquire skills to deliver quality, smart and innovative solutions as young entrepreneurs. |
| **PEO6** | Will gain proficiency and elevate themselves as resource persons and consultants in various sectors like Defence/Industrial/Energy/Device fabrication. |

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| **Program Specific Outcomes (PSOs)** | |
| **After the successful completion of M.Sc. Physics program, the students are expected to** | |
| **PSO1** | Be a potential graduate with the substantial knowledge and awareness of various subdivision in Physics especially in Classical Mechanics, Quantum Mechanics, Mathematical Physics, Nuclear Physics, Electronics and Materials Science. |
| **PSO2** | Be a broad-minded inquisitive & person with helping tendency and ready to take intelligent risks to employ the applications of Physics in areas of demand, need and requirement. |
| **PSO3** | Hold competency to clear any competitive exam/test with acquired analytical and technical |
| **PSO4** | Be proficient and updated in the usage of contemporary computational tools to explore new challenges/tasks. |
| **PSO5** | Be curious and alert always to perceive and experiment so as to arrive at a solution to any challengeable task. |
| **PSO6** | Be efficient to employ and apply out-of-the-box results of research findings. |
| **PSO7** | Always ready and able enough to fulfill demands of society and nation with technical skills and proficiency. |

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| **Program Outcomes (POs)** | |
| **On successful completion of the M. Sc. Physics program** | |
| **PO1** | Comprehend the concepts of basic and advanced physics and provide real world solutions to problems. |
| **PO2** | Conceptualize any physics problem with an appropriate models and provide useful and smart solutions. |
| **PO3** | Enhance the application feasibility of Physics to other disciplines with better and clear understanding. |
| **PO4** | Learn valuable experimental skills to carry out new investigations to develop new, smart materials with unique characteristics. |
| **PO5** | Develop computational & software tools by applying the learned concepts in Physics |
| **PO6** | Perceive and adopt novel ideas to facilitate better and in-depth understanding of physical processes. |
| **PO7** | Capable to provide out-of-box solutions to any challenge in academics, education, research and industry. |

# BHARATHIAR UNIVERSITY: COIMBATORE 641 046

**M. Sc. Physics Curriculum (AFFILIATED COLLEGES – OBE PATTERN)**

**(For the students admitted during the academic year 2022 – 23 onwards)**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | **Title of the Course** | **Credits** | **Hours/Week** | | **Maximum Marks** | | |
| **Theory** | **Practical** | **CIA** | **ESE** | **Total** |
| **FIRST SEMESTER** | | | | | | | |
| **13A** | **Paper - I Classical Mechanics** | **4** | **5** | **-** | **50** | **50** | **100** |
| **13B** | **Paper - II Quantum Mechanics** | **4** | **5** | **-** | **50** | **50** | **100** |
| **13C** | **Paper -III Advanced Computational Physics** | **4** | **5** | **-** | **50** | **50** | **100** |
| **13P** | **Practical - I Physics Lab – I** | **2** | **-** | **5** | **25** | **25** | **50** |
| **13Q** | **Practical - II Electronics Lab - I** | **2** | **-** | **5** | **25** | **25** | **50** |
| **1E** | **Elective I :**  **1EA : Non-conventional Energy Resources (Or)**  **1EC : Nano science & Nanotechnology (Or)**  **1EB : Industry (4.0)- Robotics, Artificial Intelligence**  **& Information Theory** | **4** | **5** | **-** | **50** | **50** | **100** |
| **Total** | |  | **20** | **10** |  |  | **500** |
|  | |  |  |  |  |  |  |
| **SECOND SEMESTER** | | | | | | | |
| **23A** | **Paper - IV Mathematical Physics** | **4** | **4** | **-** | **50** | **50** | **100** |
| **23B** | **Paper - V Advanced Quantum Mechanics** | **4** | **4** | **-** | **50** | **50** | **100** |
| **23C** | **Paper - VI Advanced Electronics** | **4** | **4** | **-** | **50** | **50** | **100** |
| **23D** | **Paper - VII Astronomy, Astrophysics & Cosmology** | **4** | **4** | **-** | **50** | **50** | **100** |
| **23P** | **Practical- III Physics Lab – II** | **2** | **-** | **5** | **25** | **25** | **50** |
| **23Q** | **Practical- IV Electronics Lab - II** | **2** | **-** | **5** | **25** | **25** | **50** |
| **2E** | **Elective II :**  **2EA : Atmospheric Physics (Or)**  **2EB : Crystal Growth Methods & Characterization (Or)**  **2EC : Introduction to Data Analytics** | **4** | **4** |  | **50** | **50** | **100** |
| **Total** | |  | **20** | **10** |  |  | **600** |
|  | | | | | | | |
| **THIRD SEMESTER** | | | | | | | |
| **33A** | **Paper - VIII Electromagnetic Theory** | **4** | **5** | **-** | **50** | **50** | **100** |
| **33B** | **Paper - IX Thermodynamics and Statistical**  **Mechanics** | **4** | **5** | **-** | **50** | **50** | **100** |
| **33C** | **Paper - X Condensed Matter Physics** | **4** | **5** | **-** | **50** | **50** | **100** |
| **33P** | **Practical- V Advanced Physics Lab – I** | **2** | **-** | **5** | **25** | **25** | **50** |
| **33Q** | **Practical- VI Advanced Electronics Lab - I** | **2** | **-** | **5** | **25** | **25** | **50** |
| **3E** | **Elective III :**  **3EA : Experimental Techniques & Data Analysis (Or)**  **3EB : Microprocessors & Microcontrollers (Or)**  **3EC : Scientific Computing with Python** | **4** | **5** | **-** | **50** | **50** | **100** |
| **Total** | |  | **20** | **10** |  |  | **500** |
|  | |  |  |  |  |  |  |
| **FOURTH SEMESTER** | | | | | | | |
| **43A** | **Paper -XI Nuclear and Particle Physics** | **4** | **5** | **-** | **50** | **50** | **100** |
| **43B** | **Paper -XII Atomic and Molecular Spectroscopy** | **4** | **5** | **-** | **50** | **50** | **100** |
| **43C** | **Paper -XIII Laser Optics** | **4** | **5** | **-** | **50** | **50** | **100** |
| **43P** | **Practical- VII Advanced Physics Lab – II** | **4** | **-** | **5** | **25** | **25** | **50** |
| **43Q** | **Practical- VIII Advanced Electronics Lab - II** | **4** | **-** | **5** | **25** | **25** | **50** |
| **47V** | **Project or Internship** | **4** | **-** | **3** | **100** | **100** | **200** |
| **47R** | **Technical Skills Enhancement Programme -**  **(Self-Study Mode With Presentation/Viva-Voce only and No Written Examination at the End of Semester)** | **2** |  | **2** | **25** | **25** | **50** |
| **Total** | |  | **15** | **15** |  |  | **650** |
| **Grand Total** | | **90** | **75** | **45** |  |  | **2250** |
|  | | | | | | | |
| **ONLINE COURSES** | | | | | | | |
| **OOC, SWAYAM, NPTEL, Websites etc.** | | | | | | | |

**MARKS DISTRIBUTION (INTERNAL (CIA) AND EXTERNAL)**

**I – THEORY**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **TOTAL MARKS** | **EXTERNAL** | | **INTERNAL** | | **Overall Passing**  **Minimum**  **(Internal +External)** |
| **Max.**  **Marks** | **Passing**  **Minimum** | **Max. Marks** | **Passing**  **Minimum** |
| **100** | **50** | **25** | **50** | **25** | **50** |

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| **S. No.** | **Theory – CIA Breakup** | |
| **Maximum Marks** | **50** |
| 1. | **CIA Tests I / II –Choose Best (2 hours test)** | **20** |
| 2. | **Model Exam – End Semester** | **20** |
| 3. | **Assignment / Seminar/ Quiz** | **10** |

**II – PRACTICALS**

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| --- | --- | --- | --- | --- | --- |
| **TOTAL MARKS** | **EXTERNAL** | | **INTERNAL** | | **Overall Passing**  **Minimum**  **(Internal + External)** |
| **Max.**  **Marks** | **Passing**  **Minimum** | **Max. Marks** | **Passing**  **Minimum** |
| **50** | **25** | **13** | **25** | **12** | **25** |

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| **S. No.** | **Practical – CIA Breakup** | |
| **Maximum Marks** | **25** |
| 1. | **Tests (I / II/ Model-Choose Best)** | **15** |
| 2. | **Record & Observation** | **10** |

**Note: End of Semester Practical Examinations will be of 6 Hours Duration (All Semesters)**

**III – Project/Internship**

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| --- | --- | --- |
| **S. No.** | **Project/Internship - Marks Breakup** | |
| **Total : 200 Marks** | |
| 1. | **Internal**  **(Project Work / Internship + Continuous Review)** | **100 (Passing Minimum : 50)** |
| 2. | **External (Dissertation : 50 marks + Viva-Voce : 50)** | **100 (Passing Minimum : 50)** |

**IV-Technical Skills Enhancement Programme –Self Study Mode**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Technical Skills Enhancement Programme – Marks Breakup** | |
| **Total : 50 Marks ;**  **Internal : 25 (Passing Minimum : 13); External : 25 (Passing Minimum : 12)** | |
| 1. | **Internal (Seminar / Quiz / Test / Debate / Group Discussion / Presentation)** | **25** |
| 2. | **External (Viva-Voce/Presentation)** | **25** |

**First**

**Semester**

|  |  |  |  |  |  |
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| **Course code : 13A** | **Core Paper I**  **CLASSICAL MECHANICS** | L | T | P | C |
| **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 5 | 0 | 0 | 4 |
| **SEMESTER I** | | | |
| **Syllabus Version**  **2022-2023** | | | |

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| **Course Objectives:** | | | | | | |
| The main objective of this course is to familiarize the student to the fundamental concepts of Classical Mechanics, its simplified approach and methods in solving various complex problems thus providing a foundation for the modern understanding of dynamics | | | | | | |
| **Expected Course Outcomes:** | | | | | | |
| On successful completion of the course, the students will be able to : | | | | | | |
| 1 | Get familiarity of basic mathematical tools like Variational principle, Lagrangian and Hamiltonian formalism and able to compute the equations of motion. | | | | | **K2** |
| 2 | Understand the central force problem, phase space and its various applications | | | | | **K3** |
| 3 | Solve problems through canonical transformations and Hamilton’s Jacobi technique | | | | | **K4** |
| 4 | Acquire knowledge of rigid body dynamics as well as normal mode analysis | | | | | **K5** |
| 5 | Understand basic concepts of Relativity theory & Non-linear dynamics | | | | | **K5** |
| **K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create** | | | | | | |
| **Unit I** | | | **VARIATIONAL PRINCIPLE: LAGRANGE’S AND HAMILTON’S EQUATIONS** | | **10 hours** | |
| Newton’s Three Laws of Motion (Review) – Constraints, Degrees of freedom, Generalized Coordinates and  Configuration Space. Variational Principle – Hamilton’s Principle – Derivation of Euler-Lagrangian Equation of Motion – Symmetries and Conservation Laws – Cyclic Coordinates - Phase Space – Hamilton’s Canonical Equation of Motion using Variational Principle – Physical Significance of Hamiltonian - Applications : Lagrangian and Hamilton’s Equation of Motion for Simple Pendulum, Linear Harmonic Oscillator and A Charged Particle in Electromagnetic Fields | | | | | | |
| **Unit II** | | | **CENTRAL FORCE AND NON-INERTIAL FRAME** | | **12 hours** | |
| Motion in a Central Force Field in Lagrangian Formalism – Reduction of Two Body Problem to the Equivalent One Body Problem – Classification of Orbits for Inverse Square Forces – Virial Theorem – Differential Equation for the Orbits – Two Body Collisions - Classical Scattering in Laboratory and Centre of Mass Frames – Non-inertial Frames – Rotating frame of Reference – Pseudo Forces – Coriolis Force and Effects of Coriolis Force on the Moving Bodies | | | | | | |
| **Unit III** | | | **CANONICAL TRANSFORMATION AND HAMILTON JACOBI METHOD** | | **12 hours** | |
| Principle of Least Action : Statement and Proof – Canonical Transformations – Generating Functions and its different forms – Poisson’s Bracket – Properties – Angular momentum Algebra – Liouville’s Theorem (without Proof) – Hamilton Jacobi method – Harmonic Oscillator Problem – Hamilton’s Characteristic Functions – Conservative Systems – Kepler Problem – Action and Angle Variables – Linear Harmonic Oscillator using Action and Angle Variables | | | | | | |
| **Unit IV** | | | **RIGID BODY AND SMALL OSCILLATIONS** | | **12 hours** | |
| Motion of a Rigid Body – Euler Angles – Angular Momentum and Inertia Tensor – Moment of Inertia and Products of Inertia – Principal Axis – Rotational Kinetic Energy - Euler’s Equation of Motion – Torque Free Motion – Free motion of a Symmetric Top – Theory of Small Oscillations – Potential Energy – Stable and Unstable Equilibrium – Eigenvalue Problem – Frequencies of Free Vibrations – Normal Modes – Normal Coordinates – Linear Triatomic Molecule – Double Pendulum | | | | | | |
| **Unit V** | | | **THEORY OF RELATIVITY AND INTRODUCTION TO NON-LINEAR DYNAMICS** | **12 hours** | | |
| Introduction to Relativity -Lorentz Transformations – Mass and Energy Equivalence – Relativistic Kinematics - Force in Relativistic Kinematics and Lorentz Transformation of Force – Lagrangian and Hamiltonian in Relativistic Kinematics – Minkowski space – world point and world line – space time intervals – Dynamical Systems – Autonomous and Non-Autonomous Systems – Phase Portraits – Simple Harmonic Oscillator in One Dimension – Simple Pendulum – Linear Stability Analysis – Classification of Fixed Points | | | | | | |
| **Unit VI** | | | **CONTEMPORARY ISSUES** | **2 hours** | | |
| Expert Lectures, Online Seminars – Webinars | | | | | | |
| **Total Lecture Hours** | | | | **60 hours** | | |
| **Text Book(s)** | | | | | | |
| 1 | | Classical Mechanics – J. C. Upadhyaya, Himalaya Publishing House, 2012. | | | | |
| 2 | | Classical Mechanics – N. C. Rana and P.S. Joag, Tata McGraw Hill, 2001 | | | | |
| **Reference Books** | | | | | | |
| 1 | | Classical Mechanics – H. Goldstein, C.P. Poole and J. Safko, 3rd Edition, Pearson, 2012 | | | | |
| 2 | | Classical Mechanics - Douglas Gregory, , Cambridge University press, 2008, 1stedition | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | | |
| 1 | | https://nptel.ac.in/courses/122/106/122106027/ | | | | |
| 2 | | https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/ | | | | |
| **Mapping with Programme Outcomes( S-Strong, M-Medium, L-Low)** | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** |
| **CO1** | S | S | S | L | L | M | M |
| **CO3** | S | M | M | L | M | S | M |
| **CO3** | S | S | S | L | M | S | M |
| **CO4** | S | S | M | L | M | S | M |
| **CO5** | S | S | M | L | M | M | M |

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| **Course code : 13B** | **Core Paper II**  **QUANTUM MECHANICS** | L | T | P | C |
| **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 5 | 0 | 0 | 4 |
| **SEMESTER I** | | | |
| **Syllabus Version**  **2022-2023** | | | |

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| **Course Objectives:** | | | | |
| The main objectives of this course is to provide a platform for the understanding of the language and formalism of non-relativistic Quantum Mechanics and utilize the Schrodinger Equation in both time-dependent and time-independent modes in solving many real world applications. | | | | |
| **Expected Course Outcomes:** | | | | |
| On successful completion of the course, the students will be able to : | | | | |
| 1 | Get familiarity with using Dirac notation | | | **K2** |
| 2 | Apply Schrodinger equations to solve simple problems | | | **K3** |
| 3 | Learn quantum mechanical angular momentum and spin momentum algebra | | | **K4** |
| 4 | Compute corrections in energy and wave functions using approximation techniques | | | **K5** |
| 5 | Integrate several components of the course like quantum states, symmetries, angular momentum etc., in the context of finding solution to the problems in atomic and molecular physics | | | **K5** |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | | |
| **Unit I** | | | **Basic Formalism** | **8 hours** |
| Postulates of Quantum Mechanics – Max Born Statistical Interpretation of Wave function – Probability Density – Wave function in Position Representation and Momentum Representation – Derivation of Schrodinger Time Independent Wave Equation – Stationary States – Dirac Notation – State Vectors – Hilbert Space – Basis – Orthonormal Basis – Change of Basis – Unitary Transformation – Equation of Motion in Schrodinger Representation – Heisenberg and Dirac Representation. | | | | |
| **Unit II** | | | **APPLICATIONS OF SCHRODINGER WAVE EQUATIONS** | **10 hours** |
| Bound State Problems – One Dimensional Infinite Square Well (0,L) – Three Dimensional Infinite Cubic Well – Concept of Degeneracy – One Dimensional Finite Square Well – Potential Step – Square Potential Barrier – Explanation of Alpha Decay – Solution of Linear Harmonic Oscillator by Schrodinger Approach (Differential Equation Method) and Heisenberg Approach (Creation and Annihilation Operator Method) – Central Potential – Hydrogen Atom (qualitative) | | | | |
| **Unit III** | | | **ANGULAR MOMENTUM ALGEBRA** | **12 hours** |
| Orbital Angular Momentum Algebra – Spin Angular Momentum Algebra – Pauli Spin Matrices – Eigen Values and Eigen Vector of Pauli Spin Matrices – Properties of Pauli Spin Matrices – Total Angular Momentum Algebra – Complete Set Of Compactable Operators – Commutation Relations of **J2, Jz, J+, J-** Eigen Values of of **J2, Jz,** - matrix representation of **J2, Jz, J+, J-** addition of angular momenta Clebsch-Gordon coefficients and its properties – CG Coefficients for Spin Half systems and Spin One systems. | | | | |
| **Unit IV** | | | **STATIONARY APPROXIMATION METHODS** | **12 hours** |
| Time independent Perturbation Theory – Non Degenerate Case – Ground State of Helium Atom – Degenerate Case - Stark Effect in Hydrogen Atom – Variation Method – The Hellmann Feynman Theorem – Estimation of Ground State of Helium Atom – Estimation of Ground State of Deuteron – WKB Approximation – Connection Formula – Validity – Barrier Penetration – Alpha Emission | | | | |
| **Unit V** | | | **TIME DEPENDENT PERTURBATION THEORY** | **12 hours** |
| Time Dependent Perturbation Theory – Formalism – Transition Probability – Transition Probability for a Constant Perturbation - Transition into a continuum of final states – Fermi Golden Rule – Transition Probability for a Harmonic Perturbation – Stimulated Emission – Principle of Detailed Balancing – Selection Rules – Rayleigh Scattering – Raman Scattering | | | | |
| **Unit VI** | | | **CONTEMPORARY ISSUES** | **2 hours** |
| Expert Lectures, Online Seminars – Webinars | | | | |
| **Total Lecture Hours** | | | | **60 hours** |
| **Text Book(s)** | | | | |
| 1 | | Quantum Mechanics – Nouredine Zettili, John Wiley & Sons, Ltd, 2nd Edition, 2009 | | |
| 2 | | Quantum Mechanics – G. Aruldhas, PHI Learning Private Limited, 2nd Edition, 2009 | | |
| 3 | | Introduction to Quantum Mechanics – 2nd Edition – David J. Griffiths – Pearson Education International. | | |
| **Reference Books** | | | | |
| 1 | | Quantum Mechanics – V. Devanathan – Narosa Publishing – New Delhi, 2005 | | |
| 2 | | Quantum Mechanics – L.I. Schiff – McGraw Hill, 3rd Edition, 1968 | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | |
| 1 | | https://nptel.ac.in/courses/122/106/122106034/ | | |
| 2 | | https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/ | | |
| 3 | | Nptel lecture – Quantum Mechanics by Prof. Ajay Ghatak | | |
|  | | | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | |

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| **Mapping with Programme outcomes**  **(**S – Strong; M – Medium; L – Low) | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** |
| **CO1** | S | S | S | L | M | S | M |
| **CO2** | S | S | S | L | S | M | S |
| **CO3** | M | M | S | L | M | M | M |
| **CO4** | M | S | S | L | S | M | M |
| **CO5** | S | S | S | L | M | M | M |

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| **Course code : 13C** | **Core Paper III**  **ADVANCED COMPUTATIONAL PHYSICS** | L | T | P | C |
| **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 5 | 0 | 0 | 4 |
| **SEMESTER I** | | | |
| **Syllabus Version**  **2022-2023** | | | |

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| **Course Objectives:** | | | | |
| The main objective of this course is to enhance the Numerical and Computational problem solving skills of students by learning advanced techniques as well as computer programming with the help of Mat Lab Programming Language. | | | | |
| **Expected Course Outcomes:** | | | | |
| On the successful completion of the course, student will be able to: | | | | |
| 1 | Understand and apply numerical methods to find out solution of algebraic equations | | | **K2** |
| 2 | Apply various interpolation methods and finite difference concepts. | | | **K3** |
| 3 | Utilize numerical differentiation and integration methods | | | **K3** |
| 4 | Familiarize with modern high level programming Language of Mat Lab | | | **K4** |
| 5 | Process, analyze and plot data from a variety of physical phenomena and interpret the results with meaning | | | **K5** |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | | |
| **Unit I** | | **NUMERICAL DIFFERENTIATION** | **12 hours** | |
| Finding Roots of a Polynomial – Bisection Method – Newton Raphson Method – Solution of Ordinary Differential Equation by Euler – Runge Kutta Fourth Order Method for solving first order Ordinary Differential Equations | | | | |
| **Unit II** | | **NUMERICAL INTEGRATION** | **10 hours** | |
| Trapezoidal rule – Simpson’s 1/3 rule – Simpson’s 3/8 rule – Gaussian quadrature method (2 point and 3 point formula) – Giraffe’s root square method for solving algebraic equation. | | | | |
| **Unit III** | | **MAT LAB FUNDAMENTALS** | **12 hours** | |
| Introduction – Mat Lab Features – Desktop Windows: Command, Workspace, Command History, Array editor and Current Directory – Mat Lab Help and Demos – Mat Lab Functions, Operators and commands, Basic Arithmetic in Mat Lab – Basic Operations with Scalars – Vectors and Arrays – Matrices and Matrix Operations – Complex Numbers – Mat Lab Built – In Functions – Illustrative Examples. | | | | |
| **Unit IV** | | **MAT LAB PROGRAMMING** | **12 hours** | |
| Control Flow Statements: if else, else if, Switch Statements – For, While Loop Structures – Break Statement –Input / Output Commands –Script ‘m’Files –Function ‘m’Files –Controlling output | | | | |
| **Unit V** | | **MAT LAB GRAPHICS** | **12 hours** | |
| 2D Plots – Planar Plots, Log Plots, Scatter Plots, Contour Plots – Multiple Figures, Graph of a Function - –Titles, Labels, Text in Graph – Line Types, Marker types, Colors – 3D Graphics - Curve Plots – Mesh and Surface Plots – Illustrative Examples   |  |  |  |  | | --- | --- | --- | --- | | **Unit VI** | | **CONTEMPORARY ISSUES** | **2 hours** | | Expert Lectures, Online Seminars – Webinars | | | | | **Total Lecture Hours** | | | **60 hours** | | **Text Book(s)** | | | | | 1 | Numerical methods in Science and Engineering – M.K. Venkataraman, National Publ. Co. Madras, 1996 | | | | 2 | Getting Started With Mat Lab –Rudra Pratap, Oxford University Press-New Delhi | | | | **Reference Books** | | | | | 1 | Numerical methods using Mat Lab –John Mathews & Kurtis Fink, Prentice Hall, New Jersey 2006 | | | | 2 | Mat Lab Programming – David Kentucky, Prentice Hall | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | 1 | https://onlinecourses.nptel.ac.in/noc20\_ma33/preview | | | | 2 | https://nptel.ac.in/course/103106074/ | | | | 3 | https://nptel.ac.in/course/122106033/ | | | | **Course Designed By: Dr. Haresh M. Pandya & Team** | | | | | | | | |
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| **Mapping with Programme outcomes**  **(**S – Strong; M – Medium; L – Low)   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | | | |

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| **Course code : 13P** | **Core Practical I**  **PHYSICS LAB -I**  **(Examination of 6 Hours Duration at the end of First Semester)** | L | T | P | C |
| **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 0 | 0 | 5 | 4 |
| **SEMESTER I** | | | |
| **Syllabus Version**  **2022-2023** | | | |

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| **Expected Course Outcomes:** | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | |
| 1 | | | | Understand the basics of experimental physics and compare the results with theoretical calculations. | | **K2** | |
| 2 | | | | Gain knowledge of new concepts and visualize the experiment and problem solving through MAT LAB programming. | | **K3** | |
| 3 | | | | Equip the students with basic technical skills in the course of performing the laboratory experiments in groups and by interpreting and communicating the results succinctly | | **K6** | |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | | | | | |
| S. No. | | | **LIST OF EXPERIMENTS (Any Six Experiments)** | | | | |
| 1 | | | Young’s Modulus – Elliptical Fringes (Cornu’s Method). | | | | |
| 2 | | | Viscosity of a Liquid – Mayer’s Oscillating Disc. | | | | |
| 3 | | | Determination of Stefan’s Constant. | | | | |
| 4 | | | Thermal Conductivity-Forbes’s Method. | | | | |
| 5 | | | Electronic Specific Charge e/m by Thomson’s Method. | | | | |
| 6 | | | He Ne Laser – Measurement of Wavelength using reflectance grating. | | | | |
| 7 | | | Geiger Muller Counter – Determination of Half Life period of radioactive element. | | | | |
| 8 | | | Hartmann’s Interpolation formula-spectrometer. | | | | |
| 9 | | | He Ne Laser – Power distribution measurement. | | | | |
| 10 | | | MAT LAB Programming – Roots of a Quadratic Equation. | | | | |
| 11 | | | MAT LAB Programming – Solution of Ordinary Differential Equations. | | | | |
| 12 | | | MAT LAB Programming – Newton – Raphson Method. | | | | |
| 13 | | | MAT LAB Programming – Mean, Median Mode & Standard Deviation. | | | | |
| 14 | | | MAT LAB Programming – Curve Fitting & Linear Interpolation. | | | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 13Q** | **Core Practical II**  **ELECTRONICS LAB -I**  **(Examination of 6 Hours Duration at the end of First Semester)** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 0 | 0 | 5 | 4 | | **SEMESTER I** | | | | | **Syllabus Version**  **2022-2023** | | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | |
| 1 | Acquire hands-on knowledge on usage of semiconductor devices and Operational Amplifiers | | | | | **K2** |
| 2 | Acquire valuable laboratory skills to apply circuit theory to construct multi-purpose electronic devices | | | | | **K3** |
| 3 | Design and develop electronic circuits to create signals and capture responses as well as test the functioning of these circuits | | | | | **K5** |
| 4 | Become a skilful Electronic circuit Designer and thus enhance his employability/entrepreneurial skills | | | | | **K3** |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | | | | |
| **S. No.** | | | | **LIST OF EXPERIMENTS (Any SIX experiments)** | | |
| 1 | | | | Design of Regulated and Dual Power Supply and Construction using fixed voltage regulator IC 723 | | |
| 2 | | | | Construction of Basic Logic Gates using Digital IC’s | | |
| 3 | | | | Op Amp - Determination of Parameters | | |
| 4 | | | | Op Amp - Construction of Sign Changer, Scale Changer, Adder and Subtractor | | |
| 5 | | | | Op Amp - Construction of differentiator and integrator circuit using | | |
| 6 | | | | Op Amp - A.C. Amplifier – Inverting, Non-Inverting, Voltage Follower | | |
| 7 | | | | Op Amp - Design of Wein’s Bridge Oscillator | | |
| 8 | | | | Op Amp - Construction of low pass and high pass filter circuits and study its output performance. | | |
| 9 | | | | Construction of a two stage RC coupled amplifier and study its frequency response | | |
| 10 | | | | Construction of a FET amplifier with common source configuration. | | |
| 11 | | | | Mat Lab Programming – Diode-Forward Characteristics Plot & Load Line Plot-Estimation of Operating Point | | |
| 12 | | | | Mat Lab Programming – Charging of Capacitor in an RC Circuit with three Time Constants | | |
| 13 | | | | Mat Lab Programming - Plot of Voltage and Current of RLC Circuit Under Steady State Conditions | | |
| 14 | | | | Mat Lab Programming – Frequency Response of a Low Pass Op-Amp Filter Circuit | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | | | |

**Second**

**Semester**

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| **Course code : 23A** | **Core Paper IV**  **MATHEMATICAL PHYSICS** | L | T | P | C |
| **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 4 | 0 | 0 | 4 |
| **SEMESTER II** | | | |
| **Syllabus Version**  **2022-2023** | | | |

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| **Course Objectives:** | | | | |
| The main objectives of this course is to make students hone their mathematical skills and get familiarized with the mathematical tools available to approach problems in advanced physics courses. | | | | |
| **Expected Course Outcomes:** | | | | |
| On successful completion of the course, the students will be able to : | | | | |
| 1 | understand vector calculus and also able to write operators in different coordinate system | | | **K2** |
| 2 | apply linear vector space concepts in quantum mechanics | | | **K3** |
| 3 | understand convergence of infinite series, error analysis and curve fitting | | | **K4** |
| 4 | evaluate real integrals appearing in science and engineering problems | | | **K5** |
| 5 | solve differential equations and understand self adjoint operators used in quantum mechanics | | | **K5** |
| **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze, **K5** – Evaluate, **K6** – Create | | | | |
| **Unit I** | | **VECTOR & TENSORS ANALYSIS** | **10 hours** | |
| Line Integral –Surface Integral –Volume Integral- Gauss Divergence Theorem – Stokes Theorem – Green’s Theorem-Orthogonal Curvilinear Coordinates-Definition of Linear Vector Space – Linear Independence of vectors and dimensions – Orthonormal set – Introduction of Tensors – Symmetric and Anti Symmetric Tensors – Kronecker Delta symbol – Metric Tensor. | | | | |
| **Unit II** | | **INFINITE SERIES & COMPLEX VARIABLES** | **10 hours** | |
| Introduction to Sequence and Series– Geometric Series-Absolute Convergence- Comparison Test –Cauchy Ratio Test – Integral Test – Cauchy’s Root Test- Function of a Complex Variables – Analytic Functions – Cauchy Riemann Condition with Proof – Cauchy’s Integral Theorem – Cauchy’s Integral Formula – Taylor Series – Singularities – Cauchy Residue Theorem. | | | | |
| **Unit III** | | **ORDINARY DIFFERENTIAL EQUATION & SPECIAL FUNCTIONS** | **12 hours** | |
| Solutions of Second Order Ordinary Differential Equations with Constant Coefficient- Solution of Differential Equations of – Legendre, Hermite, Laguerre and Bessel Differential Equations – Generating Function, Rodrigues Formula, Recursion Relations, Orthogonality Relations. | | | | |
| |  |  |  | | --- | --- | --- | | **Unit IV** | **FOURIER SERIES & LAPLACE TRANSFORMS** | **12 hours** | | Introduction to Fourier Series – Dirichlet’s Theorem and Dirichlet’s Conditions – Complex Form of Fourier Series – Parseval’s identity – Fourier Sine and Cosine Transform of derivatives – Properties of Fourier Transforms –Fourier Transforms of Derivatives – Introduction to Laplace Transforms- – Properties of Laplace Transform- Laplace Transform of Derivatives of a function – Convolution Theorem. | | | | **Unit V** | **GREEN’S FUNCTION & GROUP THEORY** | **12 hours** | | Introduction to Green’s Function- Dirac Delta Distribution- Green’s Function for Poisson’s Equation and Solution of Poisson’s Equation – Green’s Function for Quantum Mechanical Scattering Problem-Concepts of a Group Theory – Group Multiplication Table – Cyclic Group – Subgroup – Cosets – Homomorphism and Isomorphism – Representation of groups – Reducible and Irreducible Representation. | | | | | | | |

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| **Unit VI** | | **Contemporary Issues** | **2 hours** |
| Expert Lectures, Online Seminars – Webinars | | | |
|  | | **Total Lecture Hours** | **60 hours** |
| **Text Book(s)** | | | |
| 1 | Mathematical Physics with classical Mechanics, Sathya Prakash, Sultan Chand & sons, Edition 2016. | | |
| 2 | Mathematical Physics, H.K Dass, Dr. Rama Verma, Sultan Chand & sons, Edition 2014. | | |
| 3 | Mathematical Physics, B.D Gupta, Vikas Publishing House Private Ltd. Edition 2010. | | |
| **Reference Books** | | | |
| 1 | Advanced Engineering Mathematics – Erwin Kreyszig, Herbert Kreyszig and Edward J. Norminton, John Wiley & Sons, 10th Edition, 2011 | | |
| 2 | Mathematical Methods for Physicists (a comprehensive guide) – George B. Arfken and Hans J. Weber and Frank E. Harris, Elsevier Academic Press, 7th Edition, 2013. | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | |
| 1 | <https://nptel.ac.in/courses/115/106/115106086/> | | |
| 2 | <https://nptel.ac.in/courses/115/103/115103036/> | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |

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| **Mapping with Programme Outcomes** | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** |
| **CO1** | S | S | S | L | L | M | M |
| **CO3** | S | M | M | L | M | S | M |
| **CO3** | S | S | S | L | M | S | M |
| **CO4** | S | S | M | L | M | S | M |
| CO5 | S | S | M | L | M | M | M |

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| **Course code : 23B** | **Core Paper V**  **ADVANCED QUANTUM MECHANICS** | L | T | P | C |
| **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 4 | 0 | 0 | 4 |
| **SEMESTER II** | | | |
| **Syllabus Version**  **2022-2023** | | | |

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| **Course Objectives:** | | | |
| The main objectives of this course is to impart knowledge of advanced quantum mechanics for solving relevant physical problems. | | | |
| **Expected Course Outcomes:** | | | |
| On successful completion of the course, the students will be able to : | | | |
| 1 | Apply concepts of QM to real world microscopic problems like scattering & Atomic Structure | | **K2** |
| 2 | Utilize Schrodinger equation and to apply semi-classical method to treat atom field interactions. | | **K3** |
| 3 | Understand Quantum Mechanical relativistic equations namely Klein-Gordon & Dirac’s Equations | | **K4** |
| 4 | Learn the concepts of semi-classical treatment of radiation and thus understand QM Field theory | | **K5** |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | |
| **Unit I** | | **SCATTERING THEORY** | **8 hours** |
| Scattering Amplitude-Expression in terms of Green’s Function-Born Approximation and its Validity- Partial Wave Analysis-Phase Shifts-Scattering by Coulomb and Yukawa Potential | | | |
| **Unit II** | | **APPLICATION TO ATOMIC STRUCTURE** | **12 hours** |
| Identical Particles – constructing symmetric and antisymmetric wave functions – Slater determinant – Pauli’s Exclusion principle – Central Field Approximation – Thomas Fermi Model – Hartree’s Self Consistent Model – Hartree Fock Equation – Alkali Atoms – Doublet Separation – Intensities | | | |
| **Unit III** | | **RELATIVISTIC WAVE EQUATION** | **12 hours** |
| Klein Gordon Equation – Plane Wave Equation – Charge and Current Density – Application to the study of Hydrogen Like Atoms – Dirac Relativistic Equation for a Free Particle – Dirac Matrices – Dirac Equation in Electromagnetic Field – Negative Energy States | | | |
| **Unit IV** | | **THEORY OF RADIATION (SEMI CLASSICAL TREATMENT)** | **12 hours** |
| Einstein’s Coefficients – Spontaneous and Induced Emission of Radiation from Semi Classical Theory – Radiation Field as an Assembly of Oscillators – Interaction with Atoms – Emission and Absorption Rates – Density Matrix and its Applications | | | |
| **Unit V** | | **INTRODUCTION TO QUANTUM FIELD THEORY** | **14 hours** |
| Elements of Quantum Field Theory – Review of Classical Field Theory – Lagrangian and Hamiltonian Formalism – Classical Fields – Quantization of the Fields – Schrodinger Fields – Quantization – Quantization into Bosons – Quantization into Fermions – Relativistic Fields – Scalar Fields – One Component Real Field – Fourier Decomposition – Quantization of Scalar Fields – Ground State and Normal Ordering – Basic Idea of Dirac Fields (no derivation – only qualitative discussion) | | | |
| |  |  |  |  | | --- | --- | --- | --- | | **Unit VI** | | **Contemporary Issues** | **2 hours** | | Expert Lectures, Online Seminars – Webinars | | | | | **Total Lecture Hours** | | | **60 hours** | | **Text Book(s)** | | | | | 1 | Quantum Mechanics –Nouredine Zettili, John Wiley & Sons, Ltd, 2nd Edition, 2009 | | | | 2 | Relativistic Quantum Mechanics and Quantum field Theory – V. Devanathan –Alpha Science  International Ltd., Oxford, UK | | | | **Reference Books** | | | | | 1 | Quantum Mechanics –G. Aruldhas, PHI Learning Private Limited, 2nd Edition, 2009 | | | | 2 | Quantum Mechanics – L.I. Schiff – McGraw Hill, 3rd Edition, 1968 | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | 1 | https://nptel.ac.in/courses/122/106/122106034/ | | | | 2 | <https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/> | | | | **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |   **Mapping with Programme outcomes (S – Strong; M – Medium; L – Low)**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | | |

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| **Course code : 23C** | **Core Paper VI**  **ADVANCED ELECTRONICS** | L | T | P | C |
| **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 0 | 0 | 5 | 4 |
| **SEMESTER II** | | | |
| **Syllabus Version**  **2022-2023** | | | |

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| **Course Objectives:** | | | | | |
| The main objective of this course is to make the students aware of Semiconductor Analog/Digital Device Characteristics and their applications in day-today lives. | | | | | |
| **Expected Course Outcomes:** | | | | | |
| On the successful completion of the course, student will be able to: | | | | | |
| 1 | | Understand the principle and operation of semiconductor devices | | **K2** | |
| 2 | | Learn the characteristics of an Op-amp and it’s applications | | **K2, K3** | |
| 3 | | Recognize the importance of signal processing devices like Radars/Television | | **K4** | |
| 4 | | Acquire information on Communication related electronic concepts & Antennas | | **K5** | |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | | | |
| **Unit I** | | **SEMICONDUCTOR DEVICES AND IC FABRICATION** | | **12 hours** | |
| Semiconductor Diodes – Characteristics –Ideal Diode – Clipper and clamper circuits. Special diodes: Zener, Schottky and Tunnel diodes - Applications – Junction transistors –JFET, MOSFET, UJT and SCR – applications – Principle of Integrated Circuits – Fabrication process – Linear and Digital Integrated Circuits. | | | | | |
| **Unit II** | | **OPERATIONAL AMPLIFIER** | | **12 hours** | |
| Op Amp characteristics – DC & AC characteristics – Frequency Response - Parameters of an Op Amp – Adder – Subtractor – Sign Changer – Scale Changer – Phase Shifter – Differential Amplifier – Integrator – Differentiator – Analog Computer Setup to Solve Linear Simultaneous Equations – Differential Equations in Physics – Logarithmic & Exponential Amplifiers – Active Filters (Mathematical derivations) | | | | | |
| **Unit III** | | **SIGNAL PROCESSING & DATA ACQUISITION** | | **12 hours** | |
| Wave Form Generators and Wave Shaping Circuits – Sinusoidal Oscillators – Phase Shift Oscillator – Wein Bridge Oscillator – Crystal Oscillator – Multivibrators, Comparators – Schmitt Trigger - Square Wave & Triangular Wave Generators – Pulse Generators – IC 555 Timer and its Application – Signal and Signal Processing – Analog Multiplexer and De-multiplexer – D/A Converters – A/D Converters. | | | | | |
| **Unit IV** | | **RADAR / TELEVISION / MICROWAVES** | | **12 hours** | |
| Elements of a Radar System-Radar Equation-Radar Performance Factors-Radar Transmitting Systems- Radar Antennas-Duplexers - Radar Receivers and Indicators – Pulsed Systems- Colour TV Transmission and Reception. Microwaves: Generation – Multi cavity Klystron-Reflex Klystron – Magnetron – Travelling Wave Tubes (TWT) – MASER – Gunn Diode. | | | | | |
| **Unit V** | | **COMMUNICATION ELECTRONICS** | | **10 hours** | |
| Analog and Digital Signals - Modulation - Types - AM modulation theory – Frequency spectrum of the AM wave – Representation of AM – Power relations in the AM wave – Generation of AM – Basic requirements- Description of frequency and phase modulation – Mathematical representation of FM – Frequency spectrum of FM wave - Antennas & Wave Propagation : Terms and Definitions – Effect of Ground– Grounded λ/4 – Ungrounded antenna-Antenna Arrays-Broadside and End Side Arrays-Antenna Gain- Directional High Frequency Antennas – Sky Wave Propagation – Ionosphere- Eccles & Larmor Theory-Magneto Ionic Theory-Ground Wave Propagation | | | | | |
| **Unit VI** | | | **CONTEMPORARY ISSUES** | | **2 hours** |
| Expert Lectures, Online Seminars – Webinars | | | | | |
| **Total Lecture Hours** | | | | **60 hours** | |
| **Text Book(s)** | | | | | |
| 1 | Electronic Communication System-George Kennedy & Davis –Tata McGraw Hill 4th edition1989 | | | | |
| 2 | Electronics Devices and circuits– Sanjeev Gupta & Santhosh Gupta, Dhanpat Rai Publications. | | | | |
| 3 | Microelectronics, Millman & Grabel, McGraw Hill, Second edition (2017) | | | | |
| 4 | Digital Principles and Applications, Malvino & Leach, McGrawHill, Seventh edition (2011) | | | | |
| **Reference Books** | | | | | |
| 1 | Principles of Communication Systems-Taub Schilling-TMH 1986 | | | | |
| 2 | Communication Systems-Simon Haykin-John Wiley & Sons 2005 | | | | |
| 3 | Integrated Electronics, Millman & Halkias, Tata McGraw Hill, 17th Reprint (2000) | | | | |
| 4 | Electronics Principles & Applications, A.B. Bhattacharya New Central Book Agency (P) Ltd., Kolkata (2007) | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | |
| 1 | https://nptel.ac.in/course.html/electronics/operational amplifier | | | | |
| 2 | [https://nptel.ac.in/course.html/digital circuits/](https://nptel.ac.in/course.html/digital%20circuits/) | | | | |
| 3 | http://nptel.ac.in/courses/108/101/108101112/ | | | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | | |

**Mapping with Programme outcomes**

**(S – Strong; M – Medium; L – Low)**

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** |
| **CO1** | S | M | S | L | M | S | M |
| **CO2** | S | S | M | L | S | M | S |
| **CO3** | S | M | S | S | M | M | M |
| **CO4** | M | S | L | L | S | M | M |
| **CO5** | S | S | S | M | M | M | M |

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| **Course code : 23D** | **Core Paper VII**  **ASTRONOMY, ASTROPHYSICS AND COSMOLOGY** | L | T | P | C |
| **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 4 | 0 | 0 | 4 |
| **SEMESTER II** | | | |
| **Syllabus Version 2022-2023** | | | |

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| **Course Objectives:** | | | | |
| The main objectives of this course is to familiarize the student about the beauty of our magnificent universe and its various portions through understanding of the fields of Astronomy, Astrophysics and Cosmology | | | | |
| **Expected Course Outcomes:** | | | | |
| On the successful completion of the course, student will be able to: | | | | |
| 1 | Comprehend the multitude of celestial objects such as stars, Galaxies, planets, dwarf planets, satellites Red Giants, Super Nova and Black Holes | | | **K3** |
| 2 | Describe the classification and composition of stars, stellar evolution, interstellar matter & galaxies | | | **K5** |
| 3 | Learn theoretical and practical aspects of modern observational astronomy and astrophysics. | | | **K4** |
| 4 | Understand the theories of Creation like Big Bang and Steady State Theory | | | **K5** |
| 5 | Link theoretical concepts with observational evidence like Hubble’s Law and the fate of the Universe | | | **K6** |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | | |
| **Unit I** | | **HISTORY OF ASTRONOMY** | **10 hours** | |
| History of Astronomy – Ptolemy’s Geocentric Universe – Copernicus Heliocentric Universe – Tycho Brahe and Galileo’s Observations – Kepler’s Laws of Planetary Motion – Newtonian Concept of Gravity – Highlights of Einstein’s Special and General Theory of Relativity – Curved Space Time – Evidence of Curved Space Time – Bending of Light – Time Dilation | | | | |
| **Unit II** | | **STARS & GALAXIES** | **12 hours** | |
| Stars and Galaxies – Distances – Trigonometric Parallax – Inverse Square Law- Magnitude of Stars – Apparent & Absolute Magnitude and Luminosity – Color and Temperature – Composition of Stars – Velocity, Mass and Sizes– Types of Stars – Temperature Dependence – Spectral Types – Hertzsprung-Russell (HR) Diagram – Spectroscopic Parallax | | | | |
| **Unit III** | | **LIFE AND DEATH OF STARS** | **12hours** | |
| Stellar Evolution - Mass Dependence – Giant Molecular Cloud – Proto star-Main Sequence Star – Sub giant, Red Giant, Supergiant – Core Fusion – Planetary Nebula (Or) Supernova – White Dwarfs – Neutron Stars – Pulsars – Black Holes – Detecting Black Holes-The Sun- Its Size and Composition- Sun’s Interior Zones – Sun’s Surface –Photosphere- Chromospheres – Corona – Sun’s Power Source-Fusion Reaction Mechanism | | | | |
| **Unit IV** | | **COSMOLOGY – I** | **12 hours** | |
| Introduction to Cosmology – Basic Observations and implications – Olber’s Paradox – Expanding Universe – Gravitational Red shift – Doppler Effect – Hubble’s Law and the age of Universe – Cosmological Principle – The Perfect Cosmological Principle – Observation and interpretation | | | | |
| **Unit V** | | **COSMOLOGY – II** | **12 hours** | |
| Fate of the Universe – Dependence on Mass (Curvature of Space) – Critical density –Open Universe – Closed Universe –Homogenous and Isotropic - Freidman –Robertson – Walker Universes – Deriving the Geometry of the Universe from the Background Radiation –Flatness Problem –Horizon Problem – Inflation and its effect on the universe – The Cosmological Constant. | | | | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Unit VI** | | **Contemporary Issues** | | **2 hours** | | Expert Lectures, Online Seminars – Webinars | | | | | | **Total Lecture Hours** | | | **60 hours** | | | **Text Book(s)** | | | | | | 1 | The Life and Death of Stars, Kenneth R. Lang | | | | | 2 | Physical Foundations of cosmology, Viatcheslav Mukhanov. | | | | | **Reference Books** | | | | | | 1 | Lectures on Astronomy, Astrophysics, And Cosmology, Luis A. Anchordoqu | | | | | 2 | Lecture Notes of Department of Physics, University of Wisconsin-Milwaukee | | | | | 3 | An Introduction to Planetary Physics, Kaula.W.M | | | | | 4 | Astrophysics of the Solar System, K. D. Abhayankar | | | | | 5 | Astrophysics of the Sun, Harold Zirin. | | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | | 1 | <https://nptel.ac.in/courses/115/105/115105046/> | | | | | 2 | <http://www.nptelvideos.in/2012/12/astrophysics-cosmology.html> | | | | | 3 | <https://onlinecourses.swayam2.ac.in/arp19_ap73/preview> | | | | | **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | |   **Mapping with Programme outcomes**  **(S – Strong; M – Medium; L – Low)**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | | | |

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| **Course code : 23P** | **PRACTICAL III**  **PHYSICS LAB - II**  **(Examination of 6 Hours Duration at the end of Second Semester)** | L | T | P | C |
| **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 0 | 0 | 5 | 4 |
| **SEMESTER II** | | | |
| **Syllabus Version 2022-2023** | | | |

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| **Expected Course Outcomes:** | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | |
| 1 | | Develop experimental physics skills and analyze the results with theoretical calculations. | | | **K2** | |
| 2 | | Utilize Computational Mat Lab Programing skills in problem solving and data representation | | | **K3** | |
| 3 | | Become a skillful experimental physicist | | | **K6** | |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | | | | |
| **S. No.** | | | **LIST OF EXPERIMENTS (Any Six experiments)** | | | |
| 1 | | | Determination of Young’s Modulus – Hyperbolic Fringes (Cornu’s Method). | | | |
| 2 | | | Determination of Solar Cell characteristics and Efficiency. | | | |
| 3 | | | Determination of Thickness of thin Wire by Air Wedge method | | | |
| 4 | | | Determination of Polarisability of liquids using spectrometer. | | | |
| 5 | | | Determination of Thickness of the thin wire by diffraction using spectrometer. | | | |
| 6 | | | Determination of Thickness of very thin wire using He Ne Laser | | | |
| 7 | | | Determination of Electronic Charge e by Millikan’s Oil Drop Method. | | | |
| 8 | | | Thermistor – Temperature Coefficient and Band Gap Energy Determination | | | |
| 9 | | | Specific Heat of a Liquid – Ferguson’s Method. | | | |
| 10 | | | Biprism on Optical Bench – Determination of Wavelength. | | | |
| 11 | | | MATLAB Programming –Roots of a Quadratic Equation & Solution of a System of Linear Equations. | | | |
| 12 | | | MATLAB Programming – Matrix Summation, Subtraction and Multiplication. | | | |
| 13 | | | MATLAB Programming- Matrix Inversion and Solution of Simultaneous Equations. | | | |
| 14 | | | MATLAB Programming- Solution of Ordinary Differential Equations – First Order. | | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | | | |
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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 23Q** | **PRACTICAL IV**  **ELECTRONICS LAB - II**  **(Examination of 6 Hours Duration at the end of Second Semester)** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Applied Science** | 0 | 0 | 5 | 4 | | **SEMESTER II** | | | | | **Syllabus Version**  **2022-2023** | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | |
| 1 | | Acquire hands-on knowledge on usage of semiconductor devices and Operational Amplifiers | | | K2 | |
| 2 | | Acquire valuable laboratory skills to construct multi-purpose electronic devices | | | K3 | |
| 3 | | Design and develop electronic circuits as well as test the functioning of these circuits | | | K5 | |
| 4 | | Become a skilful circuit Designer and thus enhance his employability/entrepreneurial skills | | | K3 | |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | | | | |
| S. No. | | | **LIST OF EXPERIMENTS (**Any **SIX** experiments) | | | |
| 1 | | | Design of Wave Form Generators- using Op Amp and Timer 555 | | | |
| 2 | | | Op Amp - Design of Differential Amplifier | | | |
| 3 | | | Op Amp - Solving Simultaneous Equations | | | |
| 4 | | | Design of UJT Relaxation Oscillator | | | |
| 5 | | | Design of Schmitt Trigger using discrete components and Op Amp/Timer 555 | | | |
| 6 | | | Op Amp - Design of Active Filters | | | |
| 7 | | | Construction of Half Subtractor and Full Subtractor using NAND gates | | | |
| 8 | | | Construction of Phase shift oscillator circuit using transistor and its performance study | | | |
| 9 | | | Mat Lab Programming- NPN Transistor – Plotting Input & Output Characteristics | | | |
| 10 | | | Mat Lab Programming –Full Wave Rectifier –Determination (a) Peak –to –Peak Value of Ripple Voltage, (b) DC Output Voltage (c) Discharge Time of the Capacitor (d) Period of Ripple Voltage | | | |
| 11 | | | Mat Lab Programming – Determination of hole concentration in an N-type extrinsic semiconductor | | | |
| 12 | | | Mat Lab Programming – PN Junction diode plot of junction potential versus source voltage. | | | |
| 13 | | | Mat Lab Programming – Plot of breakdown voltage of a PN junction diode | | | |
| 14 | | | Mat Lab Programming – determination of poles, zeros and frequency response of a non-inverting OP-Amp | | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | | | |

**Third**

**Semester**

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 33A** | **CORE PAPER VIII**  **ELECTROMAGNETIC THEORY** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 5 | 0 | 0 | 4 | | **SEMESTER III** | | | | | **Syllabus Version 2022-2023** | | | | | | | | | |
| **Course Objectives:** | | | | | |
| The main objectives of this course is to understand thoroughly about matter, charges, their fields and resultant Electric and Magnetic forces and EM Waves. | | | | | |
| **Expected Course Outcomes:** | | | | | |
| On successful completion of the course, the students will be able to : | | | | | |
| 1 | Get familiarized with concepts of Electric charges at rest in matter and media and Magnetostatics | | | | **K2** |
| 2 | Understand transmission of electromagnetic waves through wave guide. | | | | **K3** |
| 3 | Learn about Dielectric Polarization and Maxwell’s Equations of EM waves | | | | **K4** |
| 4 | Derive formulas to experimentally measurable quantities (like electric and magnetic susceptibility) | | | | **K5** |
| 5 | Evaluate electric, magnetic fields, electric potential and vector potentials for point charge and radiation emitted by charges in motion | | | | **K5** |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | | | |
| **Unit I** | | | **ELECTROSTATICS** | **8 hours** | |
| Coulomb’s law-Gauss law- differential and integral representation – Application of Gauss’ law-Electric field- Electrostatic potential- Method of images – Multiple expansions-Electrostatic Boundary conditions-Electrostatic Energy | | | | | |
| **Unit II** | | | **ELECTROSTATICS IN MACROSCOPIC MEDIA** | **8 hours** | |
| Potential and Field due to an Electric Dipole-Dielectric Polarization-External Field of a Dielectric Medium-Polarization and its types -Gauss’ Theorem in a Dielectric-Electric Displacement Vector (D) –Ampere’s Circuital Law & Faradays’ Law in Differential Form- Linear Dielectrics-Relations connecting Electric Susceptibility Polarization vector (P) – Relation between Displacement vector and Dielectric Constant-Boundary Conditions of Field Vectors-Molecular Field-Clausius-Mosotti Relation for Non-Polar Molecules. | | | | | |
| **Unit III** | | | **MAGNETOSTATICS** | | **10 hours** |
| Biot-Savart Law-Force on a current carrying conductor - Lorentz Force law-Definition of B-Divergence and Curl of B-Magnetic Scalar Potential (derivation of expression only) Equivalence of Small Current Loop and Magnetic Dipole-Magnetic Vector Potential(derivation of expression only). | | | | | |
| **Unit IV** | | | **ELECTROMAGNETICS** | | **16 hours** |
| Equation of Continuity-Displacement Current-Derivation of Maxwell’s Equations-Maxwell’s equation in Free space & Conductors-Physical Significance-Poynting Vector-Momentum in EM field-Electro Magnetic Potentials Maxwell’s Equations in terms of EM Potentials-Lorentz Gauge-Coulomb Gauge. | | | | | |
| **Unit V** | | | **RELATIVISTIC ELECTRODYNAMICS** | | **16 hours** |
| Four Vectors-Lorentz Transformation of space and time in four vector form-Transformation relation for charge and current densities-Transformations of Electromagnetic potential A and –Lorentz condition in covariant form-Invariance (or) Maxwell’s field equation in terms of four vectors-Electromagnetic field tensor-Lorentz force in covariant form – Field Tensor | | | | | |
| **Unit VI** | | | **CONTEMPORARY ISSUES** | | **2 hours** |
| Expert Lectures, Online Seminars – Webinars | | | | | |
| **Total Lecture Hours** | | | | | **60 hours** |
| **Text Book(s)** | | | | | |
| 1 | | Electromagnetic Theory & Electrodynamics-Satyaprakash-Kedarnath Ramnath & Co.-Meerut | | | |
| 2 | | Electromagnetic Theory – Chopra & Agarwal-Nath & Co.1984 | | | |
| 3 | | Introduction to Electrodynamics – David J Griffiths, Pearson Publications, 4th Edition-2012 | | | |
| 3 | | Electrodynamics-Gupta, Kumar & Singh –Pragati Prakashan-Meerut 1600 | | | |
| 4 | | Principles of Electrodynamics-M. Schwartz McGraw Hill | | | |
| 5 | | Introduction to EM Fields & Waves-Carson & Lorrain | | | |
| **Reference Books** | | | | | |
| 1 | | Classical Electrodynamics – J. D. Jackson, Wiley Eastern, 3rd Edition, 2004 | | | |
| 2 | | Classical Electrodynamics – W. Greiner, Spring Verlag New York, Inc. , 1998 | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | |
| 1 | | https://nptel.ac.in/courses/122/106/122106034/ | | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | | |

**Mapping with Programme outcomes**

**(S – Strong; M – Medium; L – Low)**

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** |
| **CO1** | S | S | S | L | S | M | S |
| **CO2** | S | S | S | L | M | M | S |
| **CO3** | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S |
| **CO5** | S | S | S | M | M | M | S |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 33B** | **CORE PAPER IX**  **THERMODYNAMICS & STATISTICAL MECHANICS** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 5 | 0 | 0 | 4 | | **SEMESTER III** | | | | | **Syllabus Version**  **2022-2023** | | | | | | | | | |
| **Course Objectives:** | | | | | |
| The main objectives of this course is to learn the fundamentals of Heat & Thermodynamics and the importance of Classical and Quantum Statistical Physics in the description of macro and microscopic energy systems. | | | | | |
| **Expected Course Outcomes:** | | | | | |
| On successful completion of the course, the students will be able to : | | | | | |
| 1 | | Understand the important concept of thermodynamics and its relation to statistical physics | | | K2 |
| 2 | | Apply the concepts of thermodynamics to study relationship between ensembles, microstates and macrostates and probability | | | K3 |
| 3 | | Analyze and evaluate partition function and compute thermodynamics relations | | | K4 K5 |
| 4 | | Calculate partition function and compute thermodynamics relations | | | K5 |
| 5 | | Understand the applications of thermodynamics to magnetism, black body radiation etc. | | | K6 |
| **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze, **K5** – Evaluate, **K6** – Create | | | | | |
| **Unit I** | | | **THERMODYNAMICS AND RADIATION** | **10 hours** | |
| Introduction – First law of thermodynamics – Second law of thermodynamics – entropy – entropy disorder – Maxwell’s thermodynamic potentials and reciprocity relations – thermodynamic equilibrium – chemical potential – black body radiation – Planck’s radiation law. | | | | | |
| **Unit II** | | | **MICRO CANONICAL, CANONICAL & GRAND CANONICAL ENSEMBLE** | **12 hours** | |
| Phase space - volume in phase space - number of phase cells in a given energy range of harmonic oscillator - number of phase cell in a given energy range of 3 dimensional free particle - concept of ensemble - micro canonical ensemble - canonical ensemble- grand canonical ensemble - density distribution in phase space - Liouville’s theorem- principle of equal apriori probabilities - statistical equilibrium - thermal equilibrium - mechanical equilibrium - particle equilibrium - connection between statistical and thermodynamic quantities. | | | | | |
| **Unit III** | | | **CLASSICAL STATISTICS** | **12 hours** | |
| Microstates and Macro states - Classical Maxwell Boltzmann distribution law- Evaluation of constants (α and β) - Maxwell’s law of Distribution of velocities - Principle of equipartition of energy - Connection between the partition function and thermodynamic quantities – Boltzmann’s entropy relation – Perfect gas in micro canonical Ensembles - Gibbs paradox – Partition function and its correlation with thermodynamics quantities - Partition functions and its properties – Comparison of ensembles. | | | | | |
| **Unit IV** | | | **QUANTUM STATISTICS** | **12 hours** | |
| Indistinguishability and quantum statistics – Statistical weight and a priori probability- Identical particles and symmetry requirements – Bose Einstein’ Statistics (BE) – Fermi Dirac Statistics (FD) –Maxwell Boltzmann’s statistics (MB) – Comparison of M-B, B-E, and F-D statistics – Thermodynamic interpretation of parameters (α and β) – Thermodynamic properties of diatomic molecules – Specific heat of solids: Dulong and Pettit’s law – Einstein’s Theory – Debye theory. | | | | | |
| **Unit V** | | | **APPLICATION OF QUANTUM STATISTICS** | **12 hours** | |
| Ideal Bose Einstein gas: Energy and pressure – Gas Degeneracy – Bose Einstein condensation – Thermal properties of Bose Einstein gas – Liquid helium - Ideal Fermi- Dirac gas: Energy and pressure of ideal Fermi Dirac gas – Weak degeneracy – Strong degeneracy at T = 0 K - Fermi energy - Fermi temperature - Thermodynamic functions of degenerate Fermi Dirac gas – Electron gas – Free electron model and electronic emission. | | | | | |
| **Unit VI** | | | **CONTEMPORARY ISSUES** | **2 hours** | |
| Expert Lectures, Online Seminars – Webinars | | | | | |
| **Total Lecture Hours** | | | | **60 hours** | |
| **Text Book(s)** | | | | | |
| 1 | Statistical Mechanics: A Textbook – S. L. Gupta and V. Kumar, Pragati Prakashan Publication, 20th Edition, 2003. | | | | |
| 2 | An Introductory Course of Statistical Mechanics, P.B. Pal, Narosa Publishing House, 2008 | | | | |
| 3 | Fundamentals of Statistical Mechanics – B. B. Laud, New Age Internationa Publishers – 2nd Edition 2018 | | | | |
| 4 | An introduction to Thermodynamic and Statistical Mechanics, Keith Stowe, Cambridge University Press, 2nd Edition, 2013 | | | | |
| 5 | Elements of Statistical Mechanics, Kamal Singh & S.P. Singh, S. Chand & Company, 2019 | | | | |
| **Reference Books** | | | | | |
| 1 | Statistical Mechanics An Elementary Outline, Avijit Lahiri, University Press, Hyderabad 2002 | | | | |
| 2 | Thermodynamic and Statistical Mechanics (Lectures on the theoretical physics), Arnold Sommerfeld, Levant Books, Kolkatta, 2005 | | | | |
| 3. | Fried, (2010), Fundamentals of Statistical Mechanics and Thermal Physics – McGraw Hill Pub., New Delhi. | | | | |
| 4 | Keiser Huang, (2008), Fundamentals of Statistical Mechanics – Wiley, India. | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | |
| 1 | <https://www.grc.nasa.gov/www/k-12/airplane/thermo.html> | | | | |
| 2 | https://ocw.mit.edu/courses/physics/8-333-statistical-mechanics-i-statistical-mechanics-of-particlesfall-013/lecture-notes/ | | | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | | |

**Mapping with Programme outcomes (**S – Strong; M – Medium; L – Low)

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** |
| **CO1** | S | S | S | M | S | S | S |
| **CO2** | S | S | S | L | S | S | S |
| **CO3** | S | S | S | L | M | S | S |
| **CO4** | S | S | S | L | M | S | M |
| **CO5** | M | S | M | L | M | M | M |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 33C** | **CORE PAPER X**  **CONDENSED MATTER PHYSICS** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 5 | 0 | 0 | 4 | | **SEMESTER III** | | | | | **Syllabus Version 2022-2023** | | | | | | | | | |
| **Course Objectives:** | | | | | |
| The main objectives of this course is to make students aware of the concepts like crystal structure, Thermal Conductivity, Semiconductors and material theories of Magnetism, Electricity, Superconductivity and related phenomena. | | | | | |
| **Expected Course Outcomes:** | | | | | |
| On the successful completion of the course, student will be able to: | | | | | |
| 1 | Understand Crystal structure, symmetry and lattice theory and their relationships | | | | K1 |
| 2 | Apply and Analyze concepts of condensed matter to evaluate thermal conductivity/heat capacity | | | | K5 |
| 3 | Acquire knowledge of the behaviour of electrons in solids based on classical and quantum theories and to become familiar with the different types of magnetism and magnetism based phenomenon | | | | K2 |
| 4 | To develop an understanding of the dielectric properties and ordering of dipoles in solid matter and to get  Familiarized with the different parameters associated with theory of superconductivity | | | | K4 |
| K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create | | | | | |
| **Unit I** | | | **CRYSTAL STRUCTURE** | **12 hours** | |
| Crystal classes and system – 2D, 3D lattices – Bravais lattices – Point groups – Space groups – Reciprocal lattice – Ewald’s sphere construction – Braggs law – Atomic scattering factor – Diffraction – Structure factor – Experimental techniques – Laue, Powder, Rotation methods – Bonding of common crystal structures – NaCl, CsCI, ZnS and Diamond – Packing density – hcp, ccp,- random stacking and polytypism | | | | | |
| **Unit II** | | | **LATTICE VIBRATIONS AND THERMAL PROPERTIES** | **12 hours** | |
| Vibration of monoatomic lattices – Lattices with two atoms per primitive cell – Quantization of lattice vibrations – Phonon momentum – Inelastic scattering of neutrons by phonons – Lattice heat capacity – Einstein model – Density of modes in 1D & 3D – Debye model of the lattice heat capacity – Thermal conductivity – Umklapp process | | | | | |
| **Unit III** | | | **FREE ELECTRON THEORY, ENERGY BANDS AND SEMICONDUCTOR CRYSTALS** | **12 hours** | |
| Energy levels and density of orbitals – FD distribution – Free electron gas in 3D – Heat capacity of the e- gas – Electrical conductivity and Ohms law – Motion in magnetic fields – Hall effect – Thermal conductivity of metals – Nearly free electron model – Electron in a periodic potential – Semiconductors – Band gap – Effective mass – Intrinsic carrier concentration | | | | | |
| **Unit IV** | | | **DIAMAGNETISM, PARAMAGNETISM, FERROMAGNETISM AND ANTI FERROMAGNETISM** | **10 hours** | |
| Langevin classical theory of Diamagnetism and paramagnetism – Weiss theory – Quantum theory of paramagnetism– Demagnetization of a paramagnetic salt – Paramagnetic susceptibility of conduction e- – Hund’s rules – Ferromagnetic order – Curie point and the exchange integral – Temperature dependence of saturation magnetization – Magnons – Anti ferro magnetic order – Ferromagnetic domains – Origin of domains – Coercive force and hysteresis. | | | | | |
| **Unit V** | | | **DIELECTRICS, FERROELECTRICS AND SUPERCONDUCTIVITY** | **12 hours** | |
| Macroscopic electric field – Local electric field at an atom – Dielectric constant and polarizability – Clausius-Mossotti equation – Polarization catastrophe – Ferroelectric domains– Occurrence of Superconductivity – Meissner effect – London equation – Coherence length – BCS theory – Flux quantization – Type I and Type II Superconductors – Josephson superconductor tunneling – DC and AC Josephson effect – SQUID – Applications of superconductors | | | | | |
| **Unit VI** | | | **CONTEMPORARY ISSUES** | **2 hours** | |
| Expert lectures, online seminars – webinars | | | | | |
| **Total Lecture hours** | | | | **60 hours** | |
| **Text Book(s)** | | | | | | |
| 1 | | C. Kittel, Introduction to Solid State Physics, 5th Ed. (Wiley Eastern, New Delhi,1977) | | | | |
| 2 | | N. W. Ashcrof and N. D. Mermin, Solid State Physics(International Edition, Philadelphia, 1976) | | | | |
| 3 | | J. S. Blakemore, Solid State Physics, Second Edition (Cambridge University Press, Cambridge, London, 1974) | | | | |
| 4 | | A. J. Dekker, Solid State Physics (Mac Millan, Madras, 1971) | | | | |
| **Reference Books** | | | | | | |
| 1 | | M. M. Woolfson, An Introduction to X-ray Crystallography (Cambridge University Press, Cambridge, 1991) | | | | |
| 2 | | T. P. Sheahen, Introduction to High-Temperature Superconductors (Plenum press, New York, 1994) | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | |
| 1 | | https://nptel.ac.in/courses/113/104/113104014/ | | | | |
| 2 | | https://www.udemy.com/course/physics-intro-to-electricity-magnetism/ | | | | |
| 4 | | https://nptel.ac.in/courses/115/104/115104088/ | | | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | | | |

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| **Mapping with Programme Outcomes**  (S – Strong; M – Medium; L – Low) | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** |
| **CO1** | S | L | S | M | M | M | S |
| **CO3** | L | S | S | M | M | S | L |
| **CO3** | M | S | S | L | M | M | S |
| **CO4** | L | M | M | S | S | M | S |
| **CO5** | S | S | M | L | M | M | S |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 33P** | **PRACTICAL - V**  **ADVANCED PHYSICS LAB - I**  **(Examination of 6 Hours Duration at the end of Third Semester)** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 0 | 0 | 5 | 4 | | **SEMESTER III** | | | | | **Syllabus Version 2022-2023** | | | | | | | |
| **Expected Course Outcomes:** | | | |
| On the successful completion of the course, student will be able to: | | | |
| 1 | Develop experimental physics skills and analyze the results with theoretical calculations. | | **K2** |
| 2 | Utilize Computational Mat Lab & Python Programing skills in problem solving and data representation | | **K3** |
| 3 | Become a skillful experimental physicist | | **K5** |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | |
| S. No. | | **LIST OF EXPERIMENTS (Any SIX experiments)** | |
| 1 | | Determination of prominent spectral line wavelengths - Arc Spectra-CDS-Copper, Iron& Brass- | |
| 2 | | Determination of Compressibility of a Liquid-Ultrasonic Method | |
| 3 | | Determination of Specific Charge e/m by Zeeman Effect | |
| 4 | | Michelson’s Interferometer - Determination of wavelength and thickness of the given material. | |
| 5 | | Hysteresis B-H Curve-Solenoid | |
| 6 | | Geiger Muller Counter-Determination of Characteristics | |
| 7 | | Kelvin’s Double Bridge-Determination of Very Low Resistance & Temperature Coefficient of Resistance | |
| 8 | | Mat Lab Programming-Numerical simulation of Wave-Functions of Simple Harmonic Oscillator | |
| 9 | | Mat Lab Programming-Simulation of Wave Functions for a Particle in Critical Box | |
| 10 | | Mat Lab Programming-Double Integration | |
| 11 | | Mat Lab Programming-Radioactive Decay | |
| 12 | | Python Programming: Time Evolution of Driven Pendulum | |
| 13 | | Python Programming: Radioactive Decay | |
| 14 | | Python Programming : Find the factorial of a Number | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 33Q** | **PRACTICAL - VI**  **ADVANCED ELECTRONICS LAB - I**  **(Examination of 6 Hours Duration at the end of Third Semester)** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 0 | 0 | 5 | 4 | | **SEMESTER III** | | | | | **Syllabus Version 2022-2023** | | | | | | | |
| **Expected Course Outcomes:** | | | |
| On the successful completion of the course, student will be able to: | | | |
| 1 | Utilize operational amplifiers & Microprocessors to build circuits to carry out various tasks | | **K2** |
| 2 | Acquire valuable laboratory skills to construct multi-purpose electronic devices | | **K3** |
| 3 | Design and develop electronic circuits as well as test/troubleshoot the functioning of these circuits | | **K5** |
| 4 | Become a skilful circuit Designer and thus enhance his employability/entrepreneurial skills | | **K3** |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | |
| S. No. | | **LIST OF EXPERIMENTS** (Any **SIX** experiments) | |
| 1 | | Op-Amp: Simultaneous Addition & Subtraction | |
| 2 | | Op-Amp: Instrumentation Amplifier-Temperature Measurement | |
| 3 | | Op-Amp: Circuits Using Diodes-Half Wave, Full Wave, Clipper (Positive & Negative), Clamper (Positive & Negative). | |
| 4 | | Op-Amp: Log and Antilog Amplifier | |
| 5 | | Op-Amp: Voltage to Current and Current to Voltage Converter | |
| 6 | | Digital to Analog Converters-Binary Weighted and Ladder Methods (Any one Method) | |
| 7 | | Microprocessor: LED Interfacing Name Display (rolling) | |
| 8 | | Microprocessor: Stepper Motor Interfacing | |
| 9 | | Microprocessor: ADC Interface-Wave Form Generation | |
| 10 | | Microprocessor: Musical Tone Generator Interface | |
| 11 | | Microcontroller: DC motor control | |
| 12 | | Python Programming : Conversion of Decimal Numbers to Binary, Octal & Hexadecimal | |
| 13 | | Python Programming : Checking whether a given Number is Even or Not/Positive, Negative or Zero | |
| 14 | | Python Programming : Printing the Fibonacci Sequence | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |

**Fourth**

**Semester**

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| The main objectives of this course is to provide the basics of Nuclear Structure, Models, Reactions and to the complex micro world of High energy Nuclear Particle Physics. | | | | |
| **Expected Course Outcomes:** | | | | |
| On the successful completion of the course, students | | | | |
| 1 | Understand the concepts in nuclear and particle physics. | | | K2 |
| 2 | Apply conservation principles to determine the type of reaction taking place | | | K5 |
| 3 | Analyze the properties of stable nucleus and explore different types of nuclear models | | | K3 |
| 4 | Evaluate the properties of stable nucleus and explore different types of nuclear models | | | K5 |
| 5 | Acquire Understanding of the classification of high energy nuclear particles at the subatomic level. | | | K6 |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | | |
| **UNIT I** | | **NUCLEAR STRUCTURE** | **10 hours** | |
| Distribution of Nuclear Charge-Nuclear Mass-Mass Spectroscopy-Mass Spectrometer- Theories of Nuclear Composition (proton-electron, proton-neutron)- Bound States of Two Nucleons-Spin States- Pauli’s Exclusion Principle-Tensor Force-Static Force- Exchange Forces. | | | | |
| **UNIT II** | | **RADIOACTIVITY** | **12 hours** | |
| Alpha Decay: Properties of α Particles-Gamow’s Theory of α Decay-Geiger Nuttal Law- α Ray Energies-Fine Structure of α Rays- α Disintegration Energy-Long Range α Particles. Beta Decay: Properties of β Particles-General Features of β Ray Spectrum- Pauli‘s Hypothesis - Fermi’s Theory of β Decay – Forms of Interactions and Selection Rules - Gamma Decay: Absorption of γ Rays by Matter-Interaction of γ Rays with Matter- Measurement of γ Ray Energies-Internal Conversion. | | | | |
| **UNIT III** | | **NUCLEAR MODELS** | **12 hours** | |
| Liquid Drop Model: Bohr Wheeler Theory of Fission-Condition for Spontaneous Fission- Activation Energy. Shell Model: Explanation of Magic Numbers-Prediction of Shell Model Prediction of Nuclear Spin and Parity-Nuclear Statistics-Magnetic Moment of Nuclei-Nuclear Isomerism - Collective Model: Explanation of Quadrupole Moments. | | | | |
| **UNIT IV** | | **NUCLEAR REACTIONS** | **12 hours** | |
| Kinds of Reactions and Conservation Laws-Energy of Nuclear Reaction-Iso Spin- Continuum Theory of Nuclear Reactions-Resonance-Breit and Wigner Dispersion Formula - Stages of a Nuclear Reaction- Statistical Theory of Nuclear Reactions-Kinematics of Stripping and Pickup Reaction. | | | | |
| **UNIT V** | | **PARTICLE PHYSICS** | **12 hours** | |
| Leptons-Hadrons-Mesons-Hyperons – Pions - Mesons, Resonances- Strange Mesons and Baryons-Gell-Mann Okuba Mass formula for Baryons - CP Violation in Neutral Kaon (K0) Decay- Symmetry and Conversion Laws-Quark Model-Reaction and Decays. | | | | |
| |  |  |  |  | | --- | --- | --- | --- | | **Unit VI** | | **CONTEMPORARY ISSUES** | **2 hours** | | Expert Lectures, Online Seminars – Webinars | | | | | **Total Lecture Hours** | | | **60 hours** | | **Text Book(s) for Study** | | | | | 1 | Nuclear and Particle Physics-Pandya and Yadav | | | | 2 | Nuclear Physics-J.C. Tayal –Umesh Prakashan- Gujarat | | | | **Text Book(s) for Reference** | | | | | 1 | Nuclear Physics- D.C. Sharma-K. Nath & Co-Meerut1600 | | | | 2 | Concepts of Nuclear Physics-Bernard L. Cohen-Tata McGraw Hill- New Delhi 1600,1978 | | | | 3 | Introductory Nuclear Physics-Kenneth S. Krane-John Wiley & Sons | | | | 4 | Physics of Nucleus and Particles-Volume I& II-B. Nermeir & Sheldon | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | 1 | https://nptel.ac.in/courses/115/104/115104043/ | | | | 2 | https://nptel.ac.in/courses/115/106/115106087/ | | | | 3 | <https://nptel.ac.in/courses/115/103/115103101/> | | | | **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |   **Mapping with Programme outcomes**  **(S – Strong; M – Medium; L – Low)**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 43B** | **Core Paper XII**  **ATOMIC & MOLECULAR SPECTROSCOPY** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 5 | 0 | 0 | 4 | | **SEMESTER IV** | | | | | **Syllabus Version 2022-2023** | | | | | | | | |
| **Course Objectives:** | | | | |
| The main objectives of this course is to learn the fundamentals of Spectroscopy and the various experimental techniques employed to study matter at the microscopic levels. | | | | |
| **Expected Course Outcomes:** | | | | |
| On successful completion of the course, the students will be able to : | | | | |
| 1 | Get familiarity with the basic concepts of electromagnetic radiation and its quantization | | | **K1** |
| 2 | Understand, analyze and evaluate different spectral lines arising from atoms and the interaction as well as measurement of emitted spectral lines. | | | **K2,K3,K4** |
| 3 | Evaluate different spectroscopic tools and techniques to analyze molecular structure, vibrational and rotational motion modes of the molecules and evaluate corresponding energy transitions | | | **K5** |
| K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create | | | | |
| **Unit I** | | **ATOMIC & MICROWAVE SPECTROSCOPY** | **10 hours** | |
| Atomic Spectroscopy – Spectra of Alkali Metal Vapors – Normal & Anomalous Zeeman Effect –Magnetic Moment of Atom and the G Factor – Lande’s ‘g’ Formula – Paschen Back Effect – Hyperfine Structure of Spectral Lines Microwave Spectroscopy – Experimental Methods – Theory of Microwave Spectra of Linear, Symmetric Top Molecules – Hyperfine Structure – Quadrupole Moment – Inversion Spectrum of Ammonia | | | | |
| **Unit II** | | **INFRARED & RAMAN SPECTROSCOPY** | **12 hours** | |
| IR Spectroscopy: Practical Aspects–Theory of IR Rotation Vibration Spectra of Gaseous Diatomic Molecules - Applications–Basic Principles of FTIR Spectroscopy-Raman Spectroscopy: Classical and Quantum Theory–Rotation Vibration Raman Spectra of Diatomic and Polyatomic Molecules–Applications–Laser Raman Spectroscopy | | | | |
| **Unit III** | | **ELECTRONIC SPECTRA: FLUORESCENCE & PHOSPHORESCENCE SPECTROSCOPY** | **12 hours** | |
| Excitation of Diatomic Species – Vibrational Analysis of Band Systems of Diatomic Molecules – Deslandre’s Table – Intensity Distribution – Franck Condon Principle – Rotational Structure of Electronic Bands – Resonance and Normal Fluorescence – Intensities of Transitions – Phosphorescence – Population of Triplet State and Intensity –Experimental Methods – Applications of Fluorescence and Phosphorescence | | | | |
| **Unit IV** | | **NMR & NQR SPECTROSCOPY** | **12 hours** | |
| NMR Spectroscopy: Quantum Mechanical and Classical Description - Bloch Equations - Relaxation Processes - Experimental Technique - Principle and Working of High Resolution NMR Spectrometer - Chemical Shift - NQR Spectroscopy: Fundamental Requirements - General Principle - Experimental Detection of NQR Frequencies – Interpretation and Chemical Explanation of NQR Spectroscopy. | | | | |
| **Unit V** | | **ESR & MOSSBAUER SPECTROSCOPY** | **12 hours** | |
| ESR Spectroscopy: Basic Principles-Experiments – ESR Spectrometer-Reflection Cavity and Microwave Bridge – ESR Spectrum – Hyperfine Structure - Mossbauer Spectroscopy: Mossbauer Effect – Recoilless Emission and Absorption – Mossbauer Spectrum - Experimental Methods - Hyperfine Interaction - Chemical Isomer Shift - Magnetic Hyperfine and Electric Quadrupole Interaction   |  |  |  |  | | --- | --- | --- | --- | | **Unit VI** | | **CONTEMPORARY ISSUES** | **2 hours** | | Expert Lectures, Online Seminars – Webinars | | | | | Total Lecture Hours | | | **60 hours** | | **Text Book(s)** | | | | | 1 | Molecular Structure and Spectroscopy – G. Aruldhas | | | | 2 | Introduction to Atomic Spectra – H. E. White, McGraw-Hill Inc., US (1934). | | | | **Reference Books** | | | | | 1 | Spectroscopy: Volumes I, II and III - B.P. Straugham & S. Walker | | | | 2 | Fundamental of molecular spectroscopy – C. B. Banwell | | | | 3 | Introduction to molecular spectroscopy – G. M. Barrow | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | 1 | https://nptel.ac.in/courses/115/105/115105100/ | | | | 2 | https://onlinecourses.nptel.ac.in/noc20\_cy31/preview | | | | **Course Designed By**: Dr. Haresh M. Pandya & Team | | | | | | | | |
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| **Mapping with Programme outcomes**  **(S – Strong; M – Medium; L – Low)**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | | | |

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| |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **Course code : 43C** | **Core Paper XIII**  **LASER OPTICS** | L | T | P | C | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 5 | 0 | 0 | 4 | 0 | 4 | | **SEMESTER IV** | | | | | **Syllabus Version**  **2022-2023** | | | | | | |
| **Course Objectives:** | | |
| The main objectives of this course is to learn the basics of Lasers, its properties, characteristics and its various applications. | | |
| **Expected Course Outcomes:** | | |
| 1. On the successful completion of the course, student will be able to: | | |
| 1. Understand the process of optical amplification and get familiarized with the properties of different types of lasers and its operation **K2** | | |
| 1. Apply the theoretical concepts of laser optics for industrial purposes **K2** | | |
| 1. Explore the significance of Surface Plasmons in optical phenomena and its applications **K3** | | |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | |
| **Unit I LASERS – FUNDAMENTALS AND TYPES** | | **10 hours** |
| Basic Construction and Principle of Lasing –Einstein Relations and Gain Coefficient –Creation of a Population Inversion – Three Level System–Four Level System –Threshold Gain Coefficient for Lasing – Laser types: He Ne – CO2 Laser – Nd:YAG Laser – Semiconductor Laser | | |
| **Unit II LASER OPERATION** | | **8 hours** |
| Optical Resonator- Laser Modes- Axial & Transverse modes- Modiﬁcation in Basic Laser Structure- Basic Principle of Mode Locking- Active & Passive Mode Locking- Q Switching- Pulse Shaping-application of lasers in SMILE surgery. | | |
| **Unit III LASER BEAM CHARACTERISTICS** | | **12 hours** |
| Introduction to Gaussian Beam-width-Divergence-Radius of Curvature-Rayleigh Range-Guoy Phase –formulation of ABCD matrix method –ABCD matrix of some optical system-ABCD Law for Gaussian Beam-The Complex Radius of Curvature. | | |
| **Unit IV FOCUSING OF LASER BEAM** | | **14 hours** |
| Diffraction- limited spot size-tight focusing of light - angular spectrum representation of optical near field-aplanatic lens-Focusing of higher-order laser modes-Radially polarized doughnut mode-Azimuthally polarized doughnut mode- applications-near field optical recording-optical tweezers- STED microscopy | | |
| **Unit V SURFACE PLASMONS** | | **14 hours** |
| Introduction-Optical properties of noble metals- Drude–Sommerfeld theory- Surface Plasmon polaritons at plane interfaces- Properties of surface plasmon polaritons- Excitation of surface plasmon polaritons by Kretschmann Configuration – Otto’s Configuration - Optical Fiber Method - Applications of Surface Plasmon Sensors | | |
| |  |  |  |  | | --- | --- | --- | --- | | **Unit VI** | | **CONTEMPORARY ISSUES** | **2 hours** | | Expert Lectures, Online Seminars – Webinars | | | | | **Total Lecture Hours** | | | **60 hours** | | **Text Book(s)** | | | | | |  |  |  |  | | --- | --- | --- | --- | | **S. No** | **Authors** | **Title of the Book** | **Publishers & Edition** | | 1 | An Introduction to Lasers Theory & Applications | Dr. M.N.  Avadhanulu Dr. P.S. Hemne | S. Chand (2012) 2nd  edition | | 2 | Nano materials: Processing and Characterization with Lasers | Subhash Chandra Singh, Haibo Zeng, Chunlei Guo and  Weiping, Cai, | Wiley-VCH Verlag. (2012) 1st edition | | 3 | Principles of Nano optics | L. Novotny and B. Hecht | Cambridge Univ Press (2016-I Edition) | | | | | | **Reference Books** | | | | | |  |  |  |  |  | | --- | --- | --- | --- | --- | | **S. No** | **Authors** | **Title of the Book** | **Publishers** | **Year of**  **Publication** | | 1 | Principles of lasers | Orazio Svelto | Springer | 2008 | | 2 | Solid state Laser Engineering | Walter Koechner | Springer | 2006 | | 3 | Lasers and Nonlinear Optics | B.B. Laud | New Age International (P) | 2011 | | 4 | Fundamentals of Photonics | Bahaa E. A. Saleh, Malvin Carl Teich | John Wiley & Sons, Inc., | 1995 | | 5 | Encyclopedia of Optical Engineering | R. G. Driggers,  C. Hoffman Marcel Dekker | Springer | 2003 | | 6 | Laser Material Processing | W.M. Steen, J. Mazumder | Springer | 2010 | | | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | 1 | <https://nptel.ac.in/courses/115/101/115101008/> | | | | 2 | https://spie.org/education/courses/coursedetail/SC047?f=InCompany | | | | 3 | <https://ipenche.chania.teicrete.gr/an-introduction-to-laser-physics-and-systems/> | | | | **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |     **Mapping with Programme outcomes**  **(S – Strong; M – Medium; L – Low)**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 43P** | **Practical - VII**  **ADVANCED PHYSICS LAB – II**  **(Examination of 6 Hours Duration at the end of Fourth Semester)** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 0 | 0 | 5 | 4 | | **SEMESTER IV** | | | | | **Syllabus Version**  **2022-2023** | | | | | | |
| **Expected Course Outcomes:** | | |
| On the successful completion of the course, student will be able to: | | |
| 1 | Develop experimental physics skills and analyze the results with theoretical calculations. | **K2** |
| 2 | Utilize Computational Mat Lab & Python Programing skills in problem solving and data representation | **K3** |
| 3 | Become a skillful experimental physicist | **K5** |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | |
| S. No. | **LIST OF EXPERIMENTS** (Any **SIX** experiments) | |
| 1 | Hall Effect - Determination of Hall Coefficient | |
| 2 | Determination of specific charge e/m by Zeeman Method | |
| 3 | B-H Hysteresis Loop - Solenoid | |
| 4 | Determination of particle size by He-Ne Laser Method | |
| 5 | Determination of Conductance of photoconductor, photovoltaic cell (solar cell) and photodiode | |
| 6 | Determination of Thickness of thin mica Sheet - Michelson Interferometer | |
| 7 | Determination of Susceptibility of Given Liquid by Guoy and Quincke’s Method | |
| 8 | Mat Lab Programming-Solution of Ordinary Differential Equations –2nd Order | |
| 9 | Mat Lab Programming-Computer Simulation of Kronig-Penney Model | |
| 10 | Mat Lab Programming-Numerical Integration | |
| 11 | Python Programming: Radioactive Decay | |
| 12 | Python Programming: Wave function of a Harmonic Oscillator | |
| 13 | Python Programming : Simulation of Particle in a Box | |
| 14 | Python Programming : Simulation of a Simple Pendulum | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 43Q** | **Practical - VIII**  **ADVANCED ELECTRONICS LAB – II**  **(Examination of 6 Hours Duration at the end of Fourth Semester)** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 0 | 0 | 5 | 4 | | **SEMESTER IV** | | | | | **Syllabus Version 2022-2023** | | | | | | | |
| **Expected Course Outcomes:** | | | |
| On the successful completion of the course, student will be able to: | | | |
| 1 | Utilize operational amplifiers/Microprocessors/Microcontrollers to build circuits to carry out various tasks and construct multi-purpose electronic devices | | **K4** |
| 2 | Design and develop electronic circuits as well as test/troubleshoot the functioning of these circuits | | **K5** |
| 3 | Become a skilful circuit Designer and thus enhance his employability/entrepreneurial skills | | **K3** |
| **K1** – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create | | | |
| **S. No.** | | **LIST OF EXPERIMENTS (Any Six experiments)** | |
| 1 | | Op-Amp: Instrumentation Amplifier-Light Intensity-Inverse Square Law | |
| 2 | | Op-Amp: Analog Computation-Second Order Differential Equation | |
| 3 | | Op-Amp Comparator-Zero Crossing Detector, Window Detector, Time Marker | |
| 4 | | Op-Amp: Digital to analog converter | |
| 5 | | IC 555 Timer Application-Monostable and Astable Multivibrators | |
| 6 | | IC Counters with Feedback | |
| 7 | | Microprocessor : Traffic Signal Simulation | |
| 8 | | Microprocessor: Hex Keyboard Interfacing | |
| 9 | | Microcontroller: triangle wave generator | |
| 10 | | Python Programming: Simulation of the Electric Field of a Capacitor | |
| 11 | | Python Programming: Half Wave & Full Wave Rectifier | |
| 12 | | Python Programming: Op-Amp Inverting & Non-Inverting Amplifier | |
| 13 | | Python Programming: Simulate and plot the Characteristics of a Zener Diode | |
| 14 | | Python Programming: Simulation of an AC Coupled Amplifier using NPN Bipolar Transistor | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 47R** | **Technical Skills Enhancement Programme**  **(Self-Study Course with Presentation / Viva-Voce Examination Only and No Examination at the End of Fourth Semester)** | L | T | P | C | | **Pre-requisite**  **English Writing, Reading & Speaking Skills With Basic Physics Knowledge** | 0 | 0 | 2 | 4 | | **SEMESTER IV** | | | | | **Syllabus Version**  **2022-2023** | | | | | | | | |
| **Course Objectives:** | | | | |
| The main objectives of this course is to enhance the student’s verbal, written and oral communication skills and thus make them empowered to meet any challenges and situations thereby increase their employability and technical communication/entrepreneurial skills. This course is offered as a stand-alone compulsory self-study course with end of semester Presentation/Viva-voce only and no written examination. | | | | |
| **Expected Course Outcomes:** | | | | |
| On the successful completion of the course, student will be able to: | | | | |
| 1 | Get Familiarized with necessary skills spectrum required in today’s competitive world scenario | | | **K2** |
| 2 | Develop unique technical skills and be able to communicate the same effectively and coherently | | | **K4** |
| 3 | Get themselves ready for exposure to various jobs/careers and attract the attention of employer | | | **K5** |
| **K1** - Remember; **K2 -** Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | |
| **Unit I** | | **INTRODUCTORY ACTIVITIES** | | **8 hours** |
| Listening Skills-Definition - Types - Tips for effective listening - Academic & Technical listening-Listening to talks and presentations - Listening to announcements -Listening to radio and television- Effective listening and English-Activities. Writing Skills: Standard business letter -Report writing-Email drafting and Etiquette -Preparing agenda and writing minutes - Making notes on business conversations-Effective use of SMS-Case studies and documentation-Technical & Scientific Writing | | | | |
| **Unit II** | | **7QC TOOLS** | | **4 hours** |
| Flow diagram - types - Applications - Brain storming -- Key elements - Methods - Uses - Data Collection - Purpose - Types of Data - Check Sheet - Interpretation - Errors in interpretation - Benefits of Data Collection - Graphs - Purpose - Types – Benefits. | | | | |
| **Unit III** | | **DATA REPRESENTATION & INTREPRETATION** | | **6 hours** |
| Stratifications - Steps for stratification - Source and Bases - Pareto Diagram - Principles for selection - Uses of Pareto Analysis - Pit falls - Cause and Effect Diagram - Making of cause and effect Diagram - Types of cause and effect diagram - Scatter Diagram - Making of Scatter Diagram - Pit falls - Need for a good scatter diagram - Histogram - Construction of Histogram Interpretation and Shapes of Histogram- Uses of Histogram - control Chart -Types - Making of control charts – Interpretation. | | | | |
| **Unit IV** | | **QUANTITATIVE & TECHNICAL APTITUDE** | | **4 hours** |
| - Problems on numbers - Ages - Time and Work -Calendar - Odd-man-out and series-Verbal Reasoning: Series completion analogy - Puzzle Test - Logical Sequence of words - Non-verbal reasoning: Figure formation | | | | |
| **Unit V** | | | **COMPUTERS** | **6 hours** |
| Basics of Computers - Email - MS Word - MS Excel Power point presentation - other technical software’s useful for science students. | | | | |
| **Books for Study & Reference :** | | | | |
| **1**. Communication Skills - A Multi-skill Course, Course Team, Bharathiar University, Macmillan Publisher India Limited, Delhi, Reprint 2011(Unit 1).  **2.** Problem Solving Techniques by K. Ganapathy, V. Narayana and B. Subramaniam, Quality circle forum of India, Revised Edition 2003 (Unit 2 & 3).  **3**. Verbal Reasoning by R. S. Aggawal, S. Chand & Co., New Delhi (Unit 4).  **4**. Basic Computers (Unit 5). | | | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 1EA** | **Elective I**  **NON-CONVENTIONAL ENERGY RESOURCES** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 5 | 0 | 0 | 4 | | **SEMESTER I** | | | | | **Syllabus Version 2022-2023** | | | | | | |
| **Course Objectives:** | | |
| The main objectives of this course is to learn about alternative energy resources and their important applications | | |
| **Expected Course Outcomes:** | | |
| On the successful completion of the course, student will be able to: | | |
| 1. Get familiarized with various renewable energy technologies **K2** | | |
| 1. Understand characteristics of solar radiation and solar energy devices **K3** | | |
| 1. Learn about geothermal energy and fuel cells **K3** | | |
| 1. Explore Wind Energy and Bio Mass Energy and its applications **K5** | | |
| **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze, **K5** – Evaluate, **K6** – Create | | |
| **Unit I INTRODUCTION TO NON-CONVENTIONAL ENERGY 10 hours** | | |
| Introduction – Various non-conventional energy resources – Availability – Classification - Relative merits and Demerits Solar Cells - Theory of Solar Cells - Solar Cell Materials - Solar Cell Array - Solar Cell Power Plant - Limitations | | |
| **Unit II SOLAR THERMAL ENERGY 12 hours** | | |
| Solar Thermal Energy - Solar radiation - Flat Plate Collectors and their Materials - Applications and Performance - focusing of Collectors and their Materials - Applications and Performance - Solar Thermal Power Plants - Thermal Energy Storage for Solar Heating and Cooling - Limitations | | |
| **Unit III GEOTHERMAL ENERGY AND FUEL CELLS 12 hours** | | |
| Geothermal Energy - Resources of Geothermal Energy - Thermodynamics of Geo Thermal Energy Conversion - Electrical Conversion – Non electrical Conversion - Environmental Considerations - Magneto Hydrodynamics (MHD) - Principle of Working of MHD Power Plant - Performance and Limitations – Fuel Cells - Principle of Working of Various Types of Fuel Cells and their Working - Performance and Limitations | | |
| **Unit IV WIND ENERGY AND POWER GENERATION 12 hours** | | |
| Wind Power and its Sources - Site Selection – Criterion - Momentum Theory - Classification of Rotors - Concentrations and Augments - Wind Characteristics - Performance and Limitations of Energy Conversion Systems | | |
| **Unit V BIO MASS 12 hours** | | |
| Bio mass - Availability of Bio mass and its Conversion Theory - Ocean Thermal Energy Conversion (OTEC) - Availability - Theory and Working Principle - Performance and Limitations - Wave and Tidal Wave - Principle of Working - performance and Limitations. | | |
| **Unit VI CONTEMPORARY ISSUES 02 hours** | | |
| Expert lectures, online seminars - webinars | | |
| **Total Lecture hours** | | **60 hours** |
| **Text Book(s)** | | |
| 1 | Introduction to Non-Conventional Energy Resources Raja et.al, SciTech Publications | |
| 2 | Non-conventional Energy Resources -D.S. Chauhan, New Age International | |
| **Reference Books** | | |
| 1 | Renewal Energy Resources - John Twideu and Tony Weir, BSP Publications, 2006 | |
| 2 | Energy Resources: Conventional & Non-Conventional - M.V.R. Koteswara Rao, BSP Publications, 2006. | |
| 3. | Renewal Energy Technologies: A Practical Guide for Beginners C.S. Solanki-PHI Learning | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | |
| 1 <https://nptel.ac.in/courses/121/106/121106014/> | | |
| 2 https://onlinecourses.nptel.ac.in/noc20 ge06/preview | | |
| 3. <https://nptel.ac.in/courses/103/107/103107157/> | | |
| |  | | --- | | **Course Designed By:** Dr. Haresh M. Pandya & Team |   **Mapping with Programme outcomes**  S - Strong; M - Medium; L – Low   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 1EB** | **ELECTIVE I**  **NANO-SCIENCE & NANOTECHNOLOGY** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 4 | 0 | 0 | 4 | | **SEMESTER I** | | | | | **Syllabus Version 2022-2023** | | | | | | |
| **Course Objectives:** | | |
| The main objectives of this course is to learn about the basics of Nano-science & Nano-technology & its applications | | |
| **Expected Course Outcomes:** | | |
| On the successful completion of the course, student will be able to:   1. Understand the fundamentals properties of Nano-materials/ quantum dots/Wells/Wires 2. Analyze the morphology and size of the nanoparticles using various analytical techniques 3. Evaluate the potential applications of Nano-materials 4. Understand different methods of synthesis of nanomaterials using various physical, chemical and biological approaches | | |
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| **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze, **K5** – Evaluate, **K6** – Create | | |
| **Unit I** | **OVERVIEW OF NANO-SCIENCE** | **10 hours** |
| Definition of Nano, Nano revolution of the 20th century – emergence and challenges of nano-science and nano-technology- Atomic Structure and atomic size, - large surface to volume ratio, surface effects on the properties. | | |
| **Unit II** | **DIFFERENT CLASSES OF NANO-MATERIALS** | **12 hours** |
| One dimensional, Two dimensional and Three dimensional nanostructured materials. Quantum dots, Wells and Wires - Bucky Balls and Carbon Nanotubes. | | |
| **Unit III** | **SYNTHESIS OF NANO-MATERIALS** | **12 hours** |
| Top down (Nanolithography, CVD, PVD, Ball milling) – bottom up (sol gel processing, chemical deposition, Spin coating, spray pyrolysis) | | |
| **Unit IV** | **CHARACTERIZATION** | **12 hours** |
| Powder X-ray diffraction - Debye-Scherrer technique - Indexing the powder pattern - Calculation of particle size using Scherer method - Lattice constant calculations. Microscopic Analysis: Scanning Electron Microscope (SEM) - EDAX analysis - Principle of Transmission Electron Microscopy (TEM). | | |
| **Unit V** | **APPLICATIONS** | **12 hours** |
| Carbon Nanotubes for energy storage – Nano-materials in waste water treatment- catalytic process - Dye-sensitized solar cells- Biosensors – Gas sensor and its types. | | |
| |  |  |  |  | | --- | --- | --- | --- | | **Unit VI** | | **CONTEMPORARY ISSUES** | **2 hours** | | Expert Lectures, Online Seminars - Webinars | | | | | **Total Lecture Hours** | | | **60 hours** | | **Text Book(s)** | | | | | 1 | Nano-crystals: Synthesis, Properties and Applications - C.N.R. Rao, P.J. Thomas and G.U. Kulkarni, Springer (2007) | | | | 2 | Nanostructured Materials and Nanotechnology - Hari Singh Nalwa, Academic Press, 2002 | | | | **Reference Books** | | | | | 1 | Energy for a sustainable world by L. Freris, D. Infield, Wiley, 2008. | | | | 2 | Nano-materials for Sustainable Energy by Quan (Ed.), Springer, 2016. | | | | 3 | Nano-materials in Energy Devices by Jun Hieng Kait CRC Press, 2017. | | | | 4 | Advanced nano-materials and their applications in renewable energy by J. Louise, L. S. Bashir, 2015. | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | 1 | http://www.ncpre.iitb.ac.in/slotbooking/SOP/62SOP.pdf | | | | 2 | https://en.wikipedia.org/wiki/Nanomaterials | | | | 3 | https://www.nano.gov/you/nanotechnology-benefit | | | | **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |   **Mapping with Programme outcomes**  (**S - Strong; M - Medium; L – Low)**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 1EC** | **ELECTIVE I**  **INDUSTRY (4.0)- ROBOTICS, ARTIFICIAL INTELLIGENCE & INFORMATION THEORY** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 4 | 0 | 0 | 4 | | **SEMESTER I** | | | | | **Syllabus Version 2022-2023** | | | | | | | |
| **Course Objectives:** | | | |
| The main objectives of this course is to become aware of the fundamentals of Robotics, Artificial Intelligence and Programming Electronics through Ardunio IDE. | | | |
| **Expected Course Outcomes:** | | | |
| On successful completion of the course, the students will be able to : | | | |
| 1 | | Understand & acquire basics of robotics/robotic sensors/artificial intelligence | **K2** |
| 3 | | Comprehend & Implement the basics of cyber security and hacking and interfacing between experiments and Ardunio IDE | **K3 K5** |
| 5 | | Familiarize with the basics of classical and quantum computers | **K2** |
| K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create | | | |
| **Unit I** | | **BASICS OF ROBOTICS** | **12 hours** |
| Robot – Definition of Robot – Industrial Robot – Laws of Robotics – Motivating Factors – Advantages and Disadvantages of Robots – Characteristics & Components of an Industrial Robot –– Comparison of the Human and Robot Manipulator – Robot Wrist and End of Arm Tools – Robot Terminology – Robotic Joints – Classification of Robots –Classification on the Basis of Coordinate System, Power Source and Method of Control - Robot Selection – Robot Work cell – Robotics and Machine Vision – Robotic Accidents , Safety, Maintenance and Installation – Robotic Sensors – Types of Sensors in Robots – Exteroceptors – Tactile Sensors – Proximity Sensors – Range Sensors – Machine Vision Sensors – Velocity Sensors – Proprioceptors . | | | |
| **Unit II** | | **ARTIFICIAL INTELLIGENCE** | **10 hours** |
| Introduction to Artificial Intelligence (AI) – Need for AI – Applications domains of AI – tools – Challenges and Future of AI – Fundamentals of Machine Learning and Deep Learning – Machine Learning algorithms to find associations across Biological Data, Cellular Image Classification and Identification of Genetic Variations – AI in Bio Physics Research – AI in drug Design – AI in next generation Sequencing – AI in Protein Structure – AI in Protein Folding Analysis | | | |
| **Unit III** | | **BASICS OF CYBER SECURITY AND ETHICAL HACKING** | **12 hours** |
| Cyber Security - Security Environment – Threats – Cyber Crime – Vulnerabilities in Software – Open Access Data – Open Source Software – Ethical Hacking – Hacker and Cracker – Computer Fraud – Malware Threats – Viruses and Worms – Trojans – Spyware – Malware Counter Measures – Ethical and Legality | | | |
| **Unit IV** | | **PROGRAMMING BASICS WITH C USING ARDUNIO IDE, SENSORS AND ACTUATORS** | **12 hours** |
| Installing and Setting up the Arduino IDE – Basic Syntax – Data Types / Variables / Constant – Operators-Conditional Statements and Loops – Using Arduino C Library Functions for Serial, Delay and Other Invoking Functions – Strings and Mathematics Library Functions – Basics of Analog and Digital Sensors – Interfacing Temperature Sensors, Ultrasound Sensor, Infrared Sensor, LED and Buzzer with Arduino – Introduction to ESP8266 NODEMCU Wifi Module – Basic knowledge of Programming NODEMCU using Arduino IDE | | | |
| **Unit V** | | **INFORMATION THEORY** | **12 hours** |
| Classical Information Theory – Classical Bits - Classical Computers – Classical Turing Machine – von Neumann Computer – Classical Logic Gates and Logic Circuits – Quantum Information Theory – Quantum Bits (Qbits) – Superposition Principle – Collapse of Wave function – EPR Paradox – Bell’s inequality with proof – Quantum Turning Machine – Quantum Gates - Basics of Quantum Teleportation and Cryptography | | | |
| **Unit VI** | | **CONTEMPORARY ISSUES** | **2 hours** |
| Expert Lectures, Online Seminars – Webinars | | | |
| **Total Lecture Hours** | | | **60 hours** |
| **Text Book(s)** | | | |
| 1 | Industrial Automation and Robotics – A. K. Gupta, S. K. Arora and J. R. Westcott, Mercury Learning and Information LLC, 2017 | | |
| 2 | Arduino Cookbook – Michael Margolis, O’ Reilly Media, Inc., 2011 | | |
| 3 | Artificial Intelligence: A modern approach – Stuart Russell and Peter Norvig, Prentice Hall, 3rd  Edition, 2009 | | |
| **Reference Books** | | | |
| 1 | Principles of Information Security – Michael E Whitman and Herbert J Mattord, Vikas Publishing House, 4th Edition, 2011 | | |
| 2 | Ethical Hacking: A Beginners Guide to Learning the World of Ethical Hacking – Lakshay Eshan, Shockwave Publishing, 2018 | | |
| 3 | Quantum Computation and Quantum Information – Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press, 2000 | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | |
| 1 | https://nptel.ac.in/courses/106105166/ | | |
| 2 | http://www.theory.caltech.edu/people/preskill/ph229/ | | |
| **Course Designed By:** **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |

**Mapping with Programme Outcomes** (S - Strong; M - Medium; L – Low)

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** |
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| **CO5** | S | M | S | L | M | M | M |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 2EA** | **ELECTIVE II**  **ATMOSPHERIC PHYSICS** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 4 | 0 | 0 | 4 | | **SEMESTER I** | | | | | **Syllabus Version 2022-2023** | | | | | | |
| **Course Objectives:** | | |
| The main objectives of this course is to study the microphysical processes in the Earth’s Atmosphere with application to meteorology, climatology, remote sensing and the environment. | | |
| **Expected Course Outcomes:** | | |
| On the successful completion of the course, student will be able to: | | |
| 1 | Acquire knowledge about Earth’s composition, structure and Physical phenomena | **K2** |
| 2 | Understand radar meteorology and it’s applications | **K3** |
| 3 | Explore information about clouds, their types, precipitation and Global Energy Balance | **K4** |
| 4 | Become aware of the menace of Atmospheric Pollution and methods to control it. | **K5** |
| 5 | Create a scope to identify new areas of research in the field of atmospheric science | **K6** |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | |
| **Unit I PHYSICAL & DYNAMIC METEOROLOGY 12 hours** | | |
| Physical Meteorology: Structure of Earth’s Atmosphere and Composition - Law of Thermodynamics of the Atmosphere - Adiabatic Process - Potential Temperature - Clausius Clapyeron Equation - Laws of Black Body Radiation - Solar and Terrestrial Radiation – Albedo - Green House Effect - Heat Balance of Earth Atmosphere System | | |
| **Unit II DYNAMIC METEOROLOGY 10 hours** | | |
| Fundamental Forces - Structure of Static Atmosphere - Momentum, Continuity and Energy Equations Thermodynamics of the Dry Atmosphere - Elementary Applications of the Basic Equations - Circulation Theorem – Vorticity - Potential Vorticity and Potential Vorticity Equations | | |
| **Unit III CLIMATE & MONSOON DYNAMICS 12 hours** | | |
| Climate Classification - Polar, Artic, Antarctic, Temperate & Tropical Climates Wind, Temperature & Pressure Distribution over India in the Lower, Middle and Upper Atmosphere during Pre – Post - and Mid - Monsoon Season - Dynamics of Monsoon Depression and Easterly Waves - Intra Seasonal and Inter annual Variability of Monsoon – Quasi Bi Weekly and 30 - 60 Day Oscillations - Walker Circulation, Southern Oscillations & El Nino. | | |
| **Unit IV ATMOSPHERIC POLLUTION 12 hours** | | |
| Role of Meteorology in Atmospheric Pollution - Atmospheric Boundary Layer - Air Stability - Local Wind Structure - Ekman Spiral - Turbulence & Boundary Layer Scaling - Residence Time and Reaction Rates of Pollutants - Sulphur Compounds - Carbon Compounds - Organic compounds –Aerosols - Toxic Gases and Radio Active Particles - Trace Gases | | |
| **Unit V RADAR METEOROLOGY 12 hours** | | |
| Basic Meteorology - Radar Principles and Technology - Radar Signal Processing & Display -Weather Radar - Observation of Precipitating Systems - Estimation of Precipitation - Radar observation of Tropical Storms & Cyclones - Use of Weather Radar in Aviation - Clear Air Radars - Observation of a Clear Air Phenomena.   |  |  |  | | --- | --- | --- | | **Unit VI CONTEMPORARY ISSUES 2 hours** | | | | Expert Lectures, Online Seminars - Webinars | | | | **Total Lecture Hours** | | **60 hours** | | **Text Book(s)** | | | | 1 | The Atmosphere - Frederick K. Lutgens and Edward J. Tarbuk | | | 2 | Dynamic Meteorology - J.R. Holton, Academic Press NY | | | **Reference Books** | | | | 1 | The Physics of Monsoons - R.N. Keshvamurthy & M. Shankar Rao, Allied Publishers | | | 2 | Principles of Air Pollution Meteorology –Tom Lyons & Prillscott, CBS Publishers & Distributors | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | 1 | https://nptel.ac.in/courses/119/106/119106008/ | | | 2 | https://nptel.ac.in/courses/119/102/119102007/ | | | 3 | https://nptel.ac.in/courses/119/108/119108004/ | | | **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | | |
| **Mapping with Programme outcomes**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | |
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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 2EB** | **ELECTIVE II**  **CRYSTAL GROWTH METHODS AND CHARACTERIZATION** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 4 | 0 | 0 | 4 | | **SEMESTER II** | | | | | **Syllabus Version 2022-2023** | | | | | | |
| **Course Objectives:** | | |
| The main objectives of this course is to provide students information about Crystal Structure, various synthesis methods and subsequent characterization for applications purpose. | | |
| **Expected Course Outcomes:** | | |
| On the successful completion of the course, student will be able to: | | |
| 1. Understand the process of crystal nucleation and growth | | **K2** |
| 1. Acquire knowledge about various crystal growing techniques | | **K3** |
| 1. Analyze the methodologies of solution/gel growth/ melt and vapour growth techniques for specific purposes | | **K2, K3** |
| 1. Become aware of different crystal characterization techniques available | | **K4, K5** |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | |
| **Unit I NUCLEATION THEORY** | **10 hours** | |
| Importance of crystal growth –Classification of crystal growth methods –Nucleation Theory - Kinds of nucleation – Homogeneous nucleation - Heterogeneous nucleation - secondary nucleation -Classical theory of nucleation: Gibbs Thomson equations for vapour and solution – Kinetic theory of nucleation –Energy of formation of a spherical nucleus and cylindrical nucleus. | | |
| **Unit II SOLUTION GROWTH TECHNIQUES** | **12 hours** | |
| Growth from low temperature solutions - Selection of solvents and solubility – Meir’s solubility diagram – Saturation and Super saturation – Metastable zone width – Growth by restricted evaporation of solvent, slow cooling of solution and temperature gradient methods - Gel Growth Technique - Principle – Various types – Structure of gel – Importance of gel – Experimental procedure – Chemical reaction method – Single and double diffusion method – Chemical reduction method – Complex and de complexion method – Advantages of gel method - Growth from high temperature solutions - Flux growth – Hydrothermal growth method | | |
| **Unit III MELT GROWTH TECHNIQUES** | **12 hours** | |
| Basics of melt growth - Bridgman method – Growth apparatus - Crucibles, Heater, Measurement and Control of Temperature – growth process – Applications of Bridgman method - Czochralski technique – Growth apparatus – seed preparation – pulling rate – shape of crystal melt interface – Growth process | | |
| **Unit IV VAPOUR GROWTH TECHNIQUES** | **12 hours** | |
| Physical Vapour Transport (PVT) – Processes of sublimation and condensation principle – crystal growth in closed and semi open ampoules – Chemical Vapour Transport – Criteria for the choice of transport reaction – Transported materials and transporting agents – Temperature variation method for crystal growth - Stationary temperature profile - Linearly time varying temperature profile and Oscillatory temperature profile | | |
| **Unit V CHARACTERIZATION TECHNIQUES** | **12 hours** | |
| X Ray Diffraction (XRD) –Powder and single crystal –UV Visible - Fourier Transform Infrared (FT- IR) and Raman spectroscopic analysis –TG DTA/DSC Thermal Analysis - Vickers Micro hardness - Chemical Etching.   |  |  |  |  | | --- | --- | --- | --- | | **Unit VI CONTEMPORARY ISSUES** | | | **2 hours** | | Expert Lectures, Online Seminars - Webinars | | | | | **Total Lecture Hours** | | **60 hours** | | | **Text Book(s)** | | | | | 1 | J. C. Brice, Crystal Growth Processes, John Wiley and Sons, New York, 1986. | | | | 2 | P. Santhana Ragavan and P. Ramasamy, Crystal Growth Processes and Methods, KRU Publications,  Kumbakonam, 2001. | | | | 3 | H.L. Bhat, Introduction to Crystal Growth Principles and Practice CRC Press, Taylor & Francis  Group, Boca Raton, Florida, 2015. | | | | **Reference Books** | | | | | 1 | Govindhan Dhanaraj, Kullaiah Byrappa, Vishwanath Prasad, Michael Dudley (Eds.), Hand book of Crystal Growth Springer Heidelberg Dordrecht London New York, 2010. | | | | 2 | B.R. Pamplin, Crystal Growth, Pergamon Press, Oxford, 1975. | | | | 3 | K. Sangwal, Elementary Crystal Growth (Edited), SAAN Publishers, Lublin, 1994. | | | | 4 | Sam Zhang, Lin Ki, Ashok Kumar, Materials Characterization Techniques, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2009. | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | 1 | https://nptel.ac.in/courses/113/105/113105025/ | | | | 2 | https://nptel.ac.in/courses/104/104/104104011/ | | | | 3 | https://onlinecourses.nptel.ac.in/noc19\_cy35/preview | | | | **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | | | |
| **Mapping with Programme outcomes**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 2EC** | **ELECTIVE II**  **INTRODUCTION TO DATA ANALYTICS** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 4 | 0 | 0 | 4 | | **SEMESTER II** | | | | | **Syllabus Version 2022-2023** | | | | | | | |
| **Course Objectives:** | | | |
| The main objectives of this course is to provide information about data terminologies related to Big Data, AI, ML and related fields | | | |
| **Expected Course Outcomes:** | | | |
| On the successful completion of the course, student will be able to: | | | |
| 1. After completing this course, the student will be able to understand the various data terminologies | | **K1-K5** | |
| 1. Understand the importance of data science | | **K1-K5** | |
| 1. The concepts of Big data and related aspects | | **K1-K5** | |
| 1. The potential of Big data in AI and ML and other fields | | **K1-K5** | |
| 1. To know about various applications of Big Data field | | **K1-K5** | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | |
| **Unit I** | **DATA TERMINOLOGIES** | | **12 hours** |
| Introduction – Data – Information – Data Terminologies – Database – Data Mining – Data Warehouse – Data Evolution Roadmap – Big Data – Definition – Type of Data - Numeric– Categorical – Graphical – High Dimensional Data –– Data Classification – Hot Data –Cold Data – Warm Data – Thick Data – Thin Data - Classification of digital Data: Structured, Semi-Structured and Un-Structured | | | |
| **Unit II** | **DATA SCIENCE** | | **12 hours** |
| Data Science: Data Science-A Discipline – Data Science vs. Statistics, Data Science vs. Mathematics, Data Science vs. Programming Language, Data Science vs. Database, Data Science vs. Machine Learning. Data Analytics - – Relation: Data Science, Analytics, Big Data Analytics. Data Science Components: Data Engineering, Data Analytics-Methods and Algorithm, Data Visualization. | | | |
| **Unit III** | **BIG DATA CONCEPTS** | | **12 hours** |
| Big Data: Digital Data-an Imprint: Evolution of Big Data – What is Big Data – Sources of Big Data. Characteristics of Big Data Vs – Big Data Myths - Data Discovery-Traditional Approach, Big Data Technology: Technology Process – Big Data Exploration -Data Augmentation – Operational Analysis – 360 View of Customers – Security and Intelligence. | | | |
| **Unit IV** | **BIG DATA POTENTIALS** | | **12 hours** |
| Big Data Technology Potentials – AI – Machine Learning – Cloud Computing – Mobile Communication – IoT – Big Data in Industry 4.0- Big Data Platforms – HADOOP –SQL Databases - Types - Big Data Challenges. | | | |
| **Unit V** | **APPLICATIONS OF BIG DATA** | | **10 hours** |
| Big Data Use Cases –- Big Data Roles Data Scientist , Data Architect, Data Analyst – Skills – Case Study : Big Data – Customer Insights – Behavioral Analysis – Big Data Industry Applications - Marketing – Retails – Insurance – Risk and Security – Health care | | | |
| |  |  |  |  | | --- | --- | --- | --- | | **Unit VI** | | **CONTEMPORARY ISSUES** | **2 hours** | | Expert Lectures, Online Seminars - Webinars | | | | | **Total Lecture Hours** | | | **60 hours** | | **Text Book(s)** | | | | | 1 | V. Bhuvaneswari, T. Devi, “Big Data Analytics: Scitech Publisher , 2018 | | | | 2 | Han Hu, Yonggang Wen, Tat-Seng, Chua, XuelongLi,“Toward Scalable Systems for Big Data Analytics: A Technology Tutorial”, IEEE, 2014. | | | | **Reference Books** | | | | | 1 | Big Data Analytics, Radha Shankarmani, M. Vijayalakshmi, Wiley, 2nd Edition (2016) | | | | 2 | Big Data Analytics, Venkat Ankam, Packt Publicatins, (2016) | | | | 3 | Massive Big-Data problems  • https://www.forbes.com/sites/bernardmarr/2017/06/15/3-massive-big-data-problemseveryone-should-know-about/#160a339b6186 | | | | 4 | Big-data analytics: Challenges and Implementation  • https://www.hiddenbrains.com/blog/big-data-analytics-challengesimplementation.html | | | | **Related Online** Contents **[MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | 1 | https://ocw.mit.edu/resources/res-ll-005-mathematics-of-big-data-and-machinelearning-january -iap-2020/ | | | | 2 | https://onlinecourses.nptel.ac.in/noc20\_cs92/preview | | | | 3 | https://onlinecourses.swayam2.ac.in/arp19\_ap60/preview | | | | **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |   **Mapping with Programme outcomes**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 3EA** | **ELECTIVE III**  **EXPERIMENTAL DATA TECHNIQUES AND ANALYSIS** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 4 | 0 | 0 | 4 | | **SEMESTER III** | | | | | **Syllabus Version 2022-2023** | | | | | | | |
| **Course Objectives:** | | | |
| The main objectives of this course is to:   1. Get acquainted with the concept of errors. 2. Explore the constructions and working principle of sensors and transducers. 3. Recognize the measurable parameters in electronic instruments. | | | |
| **Expected Course Outcomes:** | | | |
| On the successful completion of the course, student will be able to: | | | |
| 1. Acquire experiential knowledge for experimental research design | | | **K5** |
| 1. Become aware of experimental limitations | | | **K6** |
| 1. Apply experimental knowledge for interpreting the test results accurately | | | **K3** |
| 1. Propose an appropriate statistical model for a given dataset and interpret the goodness of fit | | | **K5** |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | |
| **Unit I** | **INTRODUCTION** | **12 hours** | |
| Introduction - Measurement of errors: accuracy, precision, resolution, sensitivity - absolute and relative errors - Types of errors - gross error, systematic error and random error- standards of measurements - classification of standards, time and frequency standards, electrical standards. | | | |
| **Unit II** | **ELECTRICAL TRANSDUCER CLASSIFICATION** | **10 hours** | |
| Active and Passive transducers - resistive, inductive, capacitive, thermocouple and Piezoelectric transducers - Digital transducers | | | |
| **Unit III** | **AMPLIFIERS AND SIGNAL CONDITIONING** | **12 hours** | |
| Instrumentation amplifiers - Isolation amplifiers - Chopper amplifiers - Voltage to frequency and voltage to current converters - Frequency multipliers - logarithmic amplifiers - S/H Circuits Active filters - Low pass, High pass, Band pass and Band stop filters | | | |
| **Unit IV** | **ANALYSIS** | **12 hours** | |
| Wave Analyzers - Audio frequency Wave analyzer - Heterodyne wave analyzer - Harmonic distortion analyzers - Resonant harmonic distortion analyzer - Heterodyne harmonic distortion analyzer - Fundamental suppression harmonic distortion analyzer - Spectrum analyzer - Spectra of CW, AM, FM and PM waves | | | |
| **Unit V** | **ELECTRONIC MEASURING INSTRUMENTS** | **12 hours** | |
| Q meter - Vector impedance meter - Digital frequency meter - Digital voltmeter - Phase meter- RF power and voltage measurement - Power factor meter - Vector voltmeter - Display and Recording: X-Y Recorders - Magnetic Tape recorders - Storage Oscilloscope | | | |
| |  |  |  |  | | --- | --- | --- | --- | | **Unit VI** | | **CONTEMPORARY ISSUES** | **2 hours** | | Expert Lectures, Online Seminars - Webinars | | | | | **Total Lecture Hours** | | | **60 hours** | | **Text Book(s)** | | | | | 1 | Electrical & Electronics Measurement &Instrumentation - A. K. Sawhney | | | | 2 | Electronic Instrumentation –H.S. Kalsi TMH | | | | **Reference Books** | | | | | 1 | Modern Electronic Instrumentation - W.D.Cooper | | | | 2 | Instrumentation Devices and Systems - C.S. Rangan, G.R. Sharma and VSV Mani, Tata  McGraw Hill Publications | | | | 3 | Introduction to Instrumentation and Control - A.K. Ghosh - Prentice HallIndia Publications | | | | 4 | Modern Electronic Instrumentation and Measurement Techniques - A.O.  Hefnick and W.D. Cooper., Prentice Hall India Publications. | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | 1 | https://onlinecourse.nptel.ac.in/noc19\_ee38/preview | | | | 2 | https://nptel.ac.in/courses/117/102/117102059/ | | | | 3 | https://www.udem.com/course/electronic-measurements-and-instrumentation/ | | | | **Course Designed By:** Dr. Haresh M. Pandya & Team | | | |   **Mapping with Programme outcomes**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | | |

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Course code : 3EB** | **ELECTIVE III**  **MICROPROCESSORS & MICROCONTROLLERS** | L | T | P | C | | **Pre-requisite**  **B.Sc. Physics /**  **B.Sc. Physics (CA)/**  **B.Sc. Applied Science** | 4 | 0 | 0 | 4 | | **SEMESTER III** | | | | | **Syllabus Version 2022-2023** | | | | | | | |
| **Course Objectives:** | | | |
| The main objectives of this course are to:   1. To study the Architecture of µP8085 & µC8051 2. To study the addressing modes & instruction set of 8085 & 8051. 3. To introduce the need & use of Interrupt structure of 8085 & 8051. 4. To develop skill in simple applications development with programming 8085 & 8051 | | | |
| **Expected Course Outcomes:** | | | |
| On the successful completion of the course, student will be able to: | | | |
| 1. Learn the instruction set of microprocessor | | | **K5** |
| 1. Perform experiments using Intel 8051 microcontrollers and interface seven segment display, stepper motor control and traffic light control | | | **K6** |
| 1. Identify architecture of microprocessor and microcontroller for use in instrumentation applications | | | **K3** |
| 1. Acquire knowledge of the various peripheral devices of Intel 8051 for interfacing them | | | **K5** |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | |
| **Unit I** | **INTRODUCTION & INSTRUCTION SET OF 8085** | **10 hours** | |
| Pin Diagram – Architecture – De multiplexing the Bus – Generation of Control Signals – Fetching, Decoding and Execution of Instruction – Instruction set – Addressing modes – Instruction format – Memory Read Machine Cycle – Simple Programs | | | |
| **Unit II** | **INTERFACING CONCEPTS** | **12 hours** | |
| Peripheral I/O Instructions –Device Selection and Data Transfer – Input Interfacing –Parallel and Serial Interface - Introduction to Programmable Peripheral Interface 8255 –Pin Diagram –Architecture –Modes of Operation: I/O and BSR –Architecture and Operation of 8251 (USART) - 8085 Interrupts | | | |
| **Unit III** | **APPLICATIONS OF µP** | **12 hours** | |
| Time Delay Program –Traffic Light Control System –Water Level Controller –Stepper Motor Control – Interfacing DAC –Interfacing ADC –Temperature Measurement | | | |
| **Unit IV** | **INTRODUCTION & ASSEMBLY PROGRAMMING OF 8051** | **12 hours** | |
| Microcontrollers and Embedded Processors –Microcontrollers for Embedded Systems –Overview of 8051 Family –8051 Instruction Set and Registers - Introduction to 8051 Assembly Programming –the Program Counter and ROM –Data Types and Directives –Flag Bits and PSW Register –Register Bank and Stack –Loop and Jump Instructions –I/O Port Programming Addressing Modes –Simple Programs | | | |
| **Unit V** | **INTERFACING AND REAL TIME APPLICATIONS OF µC** | **12 hours** | |
| Interfacing LCD to the 8051 –Interfacing ADC –Interfacing Sensors to 8051 –Interfacing Stepper Motor – 8051 Interfacing to the Keyboard –Interfacing DAC to the 8051 - Real time applications | | | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Unit VI** | | **CONTEMPORARY ISSUES** | **2 hours** | | | Expert Lectures, Online Seminars - Webinars | | | | | | **Total Lecture Hours** | | | | **60 hours** | | **Text Book(s)** | | | | | | 1 | Microprocessor Architecture, Program And Its Application With 8085 - R.S. Gaonkar, New Age International | | | | | 2 | Microprocessor and Its Application - S. Malarvizhi, Anuradha Agencies Publications | | | | | 3 | The 8051 Microcontroller And Embedded Systems Using Assembly And C - Muhammad Ali  Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, PHI, 2nd Edition, 2006 | | | | | **Reference Books** | | | | | | 1 | The 8085 Microprocessor, Architecture, Programming and Interfacing –K Uday Kumar, S. Uma  Shankar, Pearson | | | | | 2 | Fundamentals of Microprocessors and Microcontrollers - B. Ram, Dhanpat Rai Publications | | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | | | | | 1 | https://nptel.ac.in/courses/108/105/108105102/ | | | | | 2 | https://nptel.ac.in/courses/106/108/106108100/ | | | | | 3 | https://nptel.ac.in/courses/108/103/108103157/ | | | | | **Course Designed By:** Dr. Haresh M. Pandya & Team | | | | |   **Mapping with Programme outcomes**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | | **CO1** | S | S | S | L | M | S | M | | **CO2** | S | S | S | L | S | M | S | | **CO3** | M | M | S | L | M | M | M | | **CO4** | M | S | S | L | S | M | M | | **CO5** | S | S | S | L | M | M | M | | | | |

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| **Course Objectives:** | | |
| The main objectives of this course is to make students to learn primary fundamentals of python programming and use its potential to achieve modern technical computing requirements. | | |
| **Expected Course Outcomes:** | | |
| On successful completion of the course, the students will be able to : | | |
| 1. To learn basics of Python 2. Identify/characterize/define a problem 3. Design a program to solve the problem 4. Create and read executable code | | |
| K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create | | |
| **Unit I** | **INTRODUCTION** | **10 hours** |
| Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using  Numeric data types: int, float etc. | | |
| **Unit II** | **PYTHON PROGRAM FLOW** | **12 hours** |
| Python Program Flow Control Conditional blocks: if, else and else if, Simple for loops in python, For loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks. | | |
| **Unit III** | **PYTHON COMPLEX DATA TYPES** | **12 hours** |
| Python Complex data types: Using string data type and string operations, Defining list and list slicing, Use of Tuple data type. String, List and Dictionary, Manipulations Building blocks of python programs, string manipulation methods,  List manipulation. Dictionary manipulation, Programming using string, list and dictionary in-built functions.  Python Functions, Organizing python codes using functions | | |
| |  |  |  | | --- | --- | --- | | **Unit IV** | **PYTHON FILE OPERATIONS** | **12 hours** | | Python File Operations: Reading files, Writing files in python, Understanding read functions, read(), readline(), readlines(). Understanding write functions, write() and writelines() Manipulating file pointer using seek Programming, using file operations. Database Programming: Connecting to a database, Creating Tables, INSERT, UPDATE, DELETE and READ operations, Transaction Control, Disconnecting from a database, Exception Handling in Databases. | | | | **Unit V** | **PYTHON PACKAGES & PROGRAMS** | **12 hours** | | Python packages: Simple programs using the built-in functions of packages matplotlib, numpy, pandas etc.-  GUI Programming: Tkinter introduction, Tkinter and Python Programming, Tk Widgets, Tkinter examples. Python programming with IDE-Python Program to print Fibonacci Sequence-Program to print prime numbers in an interval-Factorial of a given number-Program to check whether a given number is positive/negative or zero-Program to find LCM & HCF | | | | | |

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| **Unit VI** | **CONTEMPORARY ISSUES** | **2 hours** |
| Expert Lectures, Online Seminars – Webinars | | |
| **Total Lecture Hours** | | **60 hours** |
| **Text Book(s)** | | |
| 1. Jeeva Jose & P. Sean Lal, “Introduction to Computing and Problem Solving with PYTHON”, Khanna Publishers, New Delhi, 2016 2. Mark Lutz, “Learning Python”, 5th edition, Orelly Publication, 2013, ISBN 978- 1449355739 3. Michel Dawson, “Python Programming for Absolute Beginers” , Third Edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1435455009 | | |
| Reference Books | | |
| 1. Wesley J. Chun, “Core Python Applications Programming”, 3rd Edition , Pearson Education, 2016 2. John Zelle, “Python Programming: An Introduction to Computer Science”, Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978- 1590282410 | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]** | | |
| Swayam Course: The Joy of Computing using Python By Prof. Sudarshan Iyengar - IIT Ropar | | |
| **Course Designed By:** Dr. Haresh M. Pandya & Team | | |