1.1.3

List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Name of the Subjects	Yellow	
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	

List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department : ***Department of Pure and Applied Physics***

Programme Name : ***B.Sc. Electronics***

Academic Year : 2022-23

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
01.	PLUATT2	Basic Circuit Theory and Network Analysis
02.	PLUALT2	Basic Circuit Theory and Network Analysis Lab
03.	PLUBTT1	Semiconductor Devices
04.	PLUBLT1	Semiconductor Devices Lab
05.	PLUBTG2	Applied Physics
06.	PLUBLG2	Applied Physics Lab

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Dept. of Pure & Applied Physics
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बिलासपुर (छ.ग.)/Bilaspur (C.G.)

Scheme and Syllabus

Semester - I

Core -2: Basic Circuit Theory and Network Analysis **Credits = 3 (3+0+0)**
Course Code: PLUATT2

Course Objectives:

- The objective of the course is that the student acquires the knowledge of basics of electrical network.
- To gain the knowledge and critical analysis of electrical circuit using network theorem.

Course Outcomes:

- Understand the basic concepts, basic laws and methods of analysis of DC and AC networks and reduce the complexity of network using different network theorems.
- Student will understand the resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.

Unit – I: Circuit Analysis: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion.

Unit – II: DC Transient Analysis: RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits, DC Response of Series RLC Circuits.

Unit – III: AC Circuit Analysis: Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Power in AC Circuits &Power Factor.Sinusoidal Circuit Analysis for RL, RC and RLC Circuits.Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.

Unit – IV: Network Theorems:Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem.

Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters.

Reference Books:

1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004).
2. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill.(2005).
3. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
4. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill(2005).
5. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)

6. Grob's Basic Electronics, 11th ed., Mitchel E. Schultz, McGraw Hill.

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Semester - I

Core - 2: Basic Circuit Theory and Network Analysis Lab

Course Code: PLUALT2 **Credits = 2 (0+0+2)**

Name of Experiments

1. Verification of Kirchhoff's Law.
2. Verification of Norton's theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Superposition Theorem.
5. Verification of the Maximum Power Transfer Theorem.
6. Charging and discharging of Capacitor
7. Designing of a Low Pass RC Filter and study of its Frequency Response.
8. Designing of a High Pass RC Filter and study of its Frequency Response.
9. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.
10. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

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Semester – II

Core 3: Semiconductor Devices **Credit: 3 (3+0+0)**

Course Code: PLUBTT1

Course Objective:

- This module introduces to the students some of the important semiconductor devices along with the underlying semiconductor physics. The module makes the students familiar with the working principles of major semiconductor diode, bipolar transistor, field-effect transistor devices, negative-resistance and power devices and photonic devices.
- Understand the fundamental principles and applications of modern electronic and optoelectronic semiconductor device.
- Understanding the connection between theory and practical as well as to make familiar with Experiments.

Course Outcomes: After completion of this course, students will be able to

- Get an understanding about the working principles and characteristics of different types of semiconductor devices — p-n junction diodes, bi-polar transistors, MOSFETs, MESFETs, tunnel diodes, photo-detectors, LEDs and solar cells

Unit – I: Semiconductor Basics: Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Carrier Transport Phenomena: Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Continuity Equation.

Unit – II: P-N Junction Diode: Formation of Depletion Layer, Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium, Concept of Linearly Graded and an abrupt Junction, Depletion Width and Depletion Capacitance of an Abrupt Junction. Derivation of Diode Equation and I-V characteristics, Zener and Avalanche Junction Breakdown Mechanism. Tunnel diode, varactor diode, solar cell: circuit symbol, characteristics, applications.

Unit – III: Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Current Gain, Energy Band Diagram of Transisto rin Thermal Equilibrium, Quantitative Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. Metal Semiconductor Junctions:

Unit – IV: Field Effect Transistors: JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage OutputCharacteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N-channel and P-Channel) and Enhancement type MOSFET (both N channel and P channel). Power Devices: UJT, Basic construction and working, Equivalent circuit, Characteristics and relaxation oscillator-expression. SCR, Construction, Working and Characteristics, MESFET, Circuit symbols, Basic constructional features, Operation and Applications.

Reference Books:

1) S. M. Sze, Semiconductor Devices: Physics and Technology, 2nd Edition, Wiley India edition (2002).

2) Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)

3) Dennis Le Croissette, Transistors, Pearson Education (1989)

4) Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)

5) Kanaan Kano, Semiconductor Devices, Pearson Education (2004)

6) Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)

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Semester – II

Core 3: Semiconductor Devices Lab **Credit: 2 (0+0+2)**

Course Code: PLUBLT1

List of Experiments:

1. Study of the I-V Characteristics of Diode – Ordinary and Zener Diode.
2. Study of the I-V Characteristics of the CE configuration of BJT and obtain r_i,r_o,β.
3. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain r_i, r_o,α.
4. Study of the I-V CharacteristicsoftheCommonCollectorConfigurationofBJTandobtainvoltagegain, r_i, r_o.
5. Study of the I-V Characteristics of the UJT.
6. Study of the I-V Characteristics of the SCR.
7. Study of the I-V Characteristics of JFET.
8. Study of the I-V Characteristics of MOSFET.
9. Study of Characteristics of Solar Cell

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Semester II

Core 4: Applied Physics **Credit: 3 (3+0+0)**

Course Code: PLUBTT2

Course Objectives:

- Understand the fundamental principles and applications of modern physics.
- This course covers certain conceptual courses of physics by virtue of which the students will be able to understand some concepts of Quantum Mechanics and solid state behavior.
- It also imparts the basic principles of Quantum mechanics, Thermal Properties, Debye's Law and its applications

Learning Outcomes:

Upon successful completion of this course, students will be able to address following points:

- Understand and explain the differences between classical and quantum mechanics.
- Identify behavior of the solid Materials.

Unit – I: Quantum Physics: Inadequacies of Classical physics, Compton's effect, Photo-electric Effect, Wave-particle duality, de-Broglie waves, Basic postulates and formalism of quantum mechanics: probabilistic interpretation of waves, conditions for physical acceptability of wave functions, Schrodinger wave equation for a free particle and in a force-field (1dimension),Boundary and continuity conditions, Operators in Quantum Mechanics, Conservation of probability, Time-dependent form, Linearity and superposition, Operators, Time- independent one dimensional Schrodinger wave equation, Eigen-values and Eigen functions.

Unit – II: Mechanical Properties of Materials: Elastic and Plastic Deformations, Hooke's Law, Elastic Moduli, Brittle and Ductile Materials, Tensile Strength, Theoretical and Critical Shear Stress of Crystals. Strengthening Mechanisms, Hardness, Creep, Fatigue, Fracture.

Unit – III: Thermal Properties, Brief Introduction to Laws of Thermodynamics, Concept of Entropy, Concept of Phonons, Heat Capacity, Debye's Law, Lattice Specific Heat, Electronic Specific Heat, Specific Heat Capacity for Si and GaAs, Thermal Conductivity, Thermoelectricity, Seebeck Effect, Thomson Effect, Peltier Effect.

Unit – IV: Electric and Magnetic Properties: Conductivity of metals, Ohm's Law, relaxation time, collision time and mean free path, electron scattering and resistivity of metals, heat developed in current carrying conductor, Superconductivity, Concepts of Giant Magnetic Resistance (GMR), Magnetic recording.

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Quantum Mechanics: Theory & Applications, A. K. Ghatak & S.Lokanathan, 2004, Macmillan
3. Quantum Mechanics: Concepts and Applications, Wiley Publisher , Nouredine Zettili
4. Introduction to Solid State Physics, Charles Kittel, John Wiley & Sons, Inc

5. Material Science and Engineering ,5th Edition , V. Raghavan,

Semester II

Core 4: Applied Physics Lab **Credit: 2 (0+0+2)**

Course Code: PLUBLT2

Name of the Experiments

1. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
2. To determine the Young's modulus of material of cantilever.
3. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
5. Determination of Planks constant by Photo electric effect.
6. To determine work function of material of filament of directly heated vacuum diode.
7. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.

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List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

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List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department	:	***Department of Pure and Applied Physics***
Programme Name	:	***B.Sc. Physics***

Academic Year : 2022-23

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
01.	PPUATT2	Mechanics
	SECPP01	Analytical Techniques in Physic
03.	SECPP01	Analytical Techniques in Physics Lab
04.	SECPP02	Renewable Energy and Energy Harvesting
05.	PPUBTT2	Waves and Optics

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Scheme and Syllabus

Semester - I

Core - 2: Mechanics
Course Code: PPUATT2 **Credits = 3 (3+0+0)**

Course Objectives

- This course would empower the student to acquire theoretical concept and practical knowledge regarding mechanical motions. This syllabus will cater the basic requirements for their higher studies. This course will provide a theoretical basis for doing experiments in related areas

Learning Outcomes

- Upon successful completion of this course, students will be able to understand basic concept about Newtonian mechanics and Special theory of relativity, which is very fundamental for further higher studies in physics.
-

Unit – I: Fundamentals of Dynamics: Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Momentum of variable-mass system: motion of rocket.Motion of a projectile in uniform gravitational field Dynamics of a system of particles.Centre of Mass. Principle of conservation of momentum.

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces.PotentialEnergy.Energy diagram.Stable and unstable equilibrium.Elastic potential energy. Force as gradient of potential energy. Work & Potential energy.Work done by non-conservative forces.Law of conservation of Energy

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

Unit – II: Rotational Dynamics: Angular momentum of a particle and system of particles. Torque.Principle of conservation of angular momentum.Rotation about a fixed axis.Moment of Inertia.Calculation of moment of inertia for rectangular, cylindrical and spherical bodies.Kinetic energy of rotation.Motion involving both translation and rotation. **Fluid Motion:** Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

Unit – III: Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy.Inertial and gravitational mass.Potential and field due to spherical shell and solid sphere.Motion of a particle under a central force field.Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler'sLaws.Satellite in circular orbit and applications.

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force.Coriolis force and its applications

Unit – IV: Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity.Lorentz Transformations.Simultaneity and order of events.Lorentz contraction.Time dilation.Relativistic transformation of velocity, Variation of mass with velocity. Mass-energy Equivalence (only problems)

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
8. Additional References:
9. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
10. University Physics. F.W Sears, M.WZemansky, H.D Young 13/e, 1986, Addison Wesley
11. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
12. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

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SEC -1: Analytical Techniques in Physics
Course Code: SECPP01 **Credits = 1 (1+0+0)**

Course Objective

- The course focuses on the properties, functions of the internal structure, and arrangement of atoms in a crystalline material. It offers an insight into how x-ray diffraction, can solve crystallographic issues related to single and poly-crystalline material, right from the base. This course will also cover the basic principles and techniques of scanning electron microscopy and Atomic Force microscopies along with demonstrations on the instrument details and imaging experiments. The sample preparation techniques
- for the microstructural analysis and surface Morphology analysis will be discussed. Structural studies by Fourier transform IR (FTIR) and Raman spectroscopies will be discussed.

Course learning outcomes:

- Students will have achieved the ability to: 1. apply appropriate characterization techniques for microstructure examination at different magnification level and use them to understand the microstructure of various materials 3. Determine crystal structure of specimen and estimate its crystallite size by X-ray Diffraction technique 4. Use appropriate spectroscopic technique to measure vibrational / electronic transitions.

Unit – I: Structure and Microstructure analysis by X-ray and electron diffraction: The geometry of crystals and reciprocal lattice, Basics of x-rays and their production and detection, X-ray diffraction, Determination of crystal structure: Qualitative and quantitative analysis, Particle size determination by x-rays, X-rays and stress analysis,

Unit – II: Scanning electron microscopy techniques and Composition analysis by Energy dispersive X-ray (EDX): Introduction to Scanning electron microscopy, Basic principles and components, Different examination modes (Bright field illumination, Oblique illumination, Dark field illumination, Phase contrast,Instrumental details and image formation, Energy-dispersive x-ray spectroscopy (paired with scanning electron microscopy) analysis to gain elemental information about samples.

Unit – III: Structural studies by Fourier transform IR (FTIR) and Raman spectroscopies: Basics of Fourier Transform Infrared (FT-IR) spectrometry,Different regions in infrared radiations, Modes of vibrations in diatomic molecule. characteristic absorption bands, Instrumental details, Qualitative treatment of Rotational Raman effect, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, Instrumental details& data accusation process.

Unit – IV: Ultra-violet and Visible Absorption Spectroscopy: Principle of UV Spectroscopy, Beer's Law and Quantitation, Deviations and limitations to Beer's Law, Instrumentation for UV-VIS spectroscopy i) Components and design ii) Actual commercial instruments, Methods and applications of absorption spectroscopy

Reference Books:

1. Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press, (2008).
2. Cullity, B.D., and Stock, R.S., "Elements of X-Ray Diffraction", Prentice-Hall, (2001).

3. Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Liss, Inc. USA, (2001).

SEC -1: Analytical Techniques in Physics Lab

Course Code: SECPP01 **Credits = 1 (0+0+1)**

1. Study X-ray diffraction for the purpose of (a) identifying (cubic) crystal systems, (b) determining the lattice constant, a,

2. Study scanning electron microscopy (SEM) technique to obtain real space atomic resolution images of conductive surfaces, Energy-dispersive x-ray spectroscopy (paired with scanning electron microscopy) analysis to gain elemental information about samples.

3. Observation and analysis of a given Spectra to understand IR & Raman spectroscopy. .

4. StudyUltra-violet and Visible Absorption Spectroscopy for finding the bandgap of a given sample. (Only Data Analysis)

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SEC : Renewable Energy and Energy Harvesting **Credits = 2 (2+0+0)**

Course Code: SECPP02

Course Outcomes:

- To understand the Energy policies and to know some of the renewable energy sources such as solar energy, off-shore wind energy, tidal energy, biogas energy and hydroelectricity.
- Illustrate Photovoltaic conversion mechanism.
- Appraise wind energy conversion and ocean energy
- Conversion of vibration into voltage using piezoelectric materials,
- Conversion of thermal energy into voltage using thermoelectric modules.
- The students are expected to learn not only the theories of the renewable sources of energy, but also to have hands-on experiences on them wherever possible.

Unit – I: Introduction to Energy Policy:

Overview of world energy scenario; Energy Demand- present and future energy requirements; Review of conventional energy resources, Global warming; Green House Gas emissions, impacts, mitigation; sustainability; Clean Development Mechanism (CDM); Prototype Carbon Fund (PCF). Need and characteristics of photovoltaic (PV) systems, PV modules and sun tracking systems (6)

Unit – II: Renewable Energy Sources & Instruments: Solar, wind, small hydro, biomass, geothermal and ocean energy, energy flow in ecosystem, Solar Energy Resources, Solar radiation: Spectrum of EM radiation, sun structure and characteristics.

Sunshine recorder, Pyranometer, Pyrheliometer, Albedometer, Radiation measurement stations, solar radiation data. (8)

Unit – III: Photovoltaic Materials and Devices:

Bulk and thin film forms of materials, single crystal and polycrystalline, amorphous and nano-crystalline semiconductor materials, Intrinsic, extrinsic and compound semiconductor, Electrical and optical properties of photovoltaic / semiconductor materials, p-n junction: homo and hetero junctions; solar cell design, Dark and illumination characteristics; Principle of photovoltaic conversion of solar energy, various parameters of solar cell. (8)

Unit – IV: Solar Thermal Conversion:

Solar radiation, its measurements and prediction; Solar thermal collectors- flat plate collectors, concentrating collectors; solar heating of buildings; solar still; solar water heaters; solar driers; conversion of heat energy in to mechanical energy, solar thermal power generation systems.

Introduction to Geothermal Energy, Hydro Energy and Piezoelectric Energy harvesting (8)

Reference Books

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi

2. Solar energy - M P Agarwal - S Chand and Co. Ltd.

3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.

4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford

5. University Press, in association with The Open University. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009

6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

7. on- conventional energy resources, B H Khan, Tata McGraw-Hill Publication 2006, ISBN 0-07-060654-42

8. Renewable Energy Resources Paperback John Twidell and Tony Weir ,Routledge, Taylor& Francis, 2015

9. Solar Photovoltaic's: Fundamentals, Technologies And Applications, CHETAN SINGH SOLANKI, PHI Learning Pvt. Ltd., Third Edition 2015

10. Non – Conventional Energy Resources: G. D. Rai, KhannaPublishers,2008.

11. Solar Energy Fundamentals, Technology, and Systems, Klaus JägerOlindoIsabella Arno H.M. SmetsRenéA.C.M.M. van SwaaijMiroZeman Delft University of Technology, 2014

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Semester II

Core - 4: Waves and Optics

Course Code: PPUBTT2 **Credits = 3 (3+0+0)**

Course Objectives:
The course aims to develop an understanding of:

- The type of waves and various phenomenon of optics.
- The superposition of waves, progressive and stationary waves, optical phenomenon based on superposition of waves such as Interference and Diffraction.

Learning Outcomes:

Upon successful completion of this course, students will be able to address following points:

- The physics behind various phenomenon in wave and optics.
- The significance of superposition of waves and optical phenomenon based on principle of superposition of waves.

Unit – I: Superposition of Harmonic oscillations:

Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.

Superposition of two perpendicular Harmonic Oscillations, Graphical and Analytical Methods of Lissajous Figures with equal and unequal frequency and their uses.

Unit – II: Wave Motion and Velocity:

Plane Wave. Longitudinal and Transverse Waves. Plane Progressive (Traveling) Waves. Wave Equation. Particle and Wave Velocities. Group Velocity, Graphical Relation between Wave and Group Velocity, Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.

Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

Unit – III: Interference:

Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

Unit – IV: Fraunhofer and Fresnel Diffraction:

Fraunhofer Diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Reference Books:

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

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Colour Codes		
Name of the Subjects	Yellow	
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	

List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department : ***Department of Pure and Applied Physics***

Programme Name : ***M.Sc. Electronics***

Academic Year : 2022-23

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
01.	PEPATT1	Mathematical Techniques for Electronics
02.	PEPATT2	Semiconductors Materials & Devices
03.	PEPALT2	Semiconductors Materials & Devices Lab
04.	PEPATT3	Analog and Digital Electronics
05.	PEPALT3	Analog and Digital Electronics Lab
06.	OPNPET1	Applications of Nanotechnology in Electronics
07.	OPNPEL1	Applications of Nanotechnology in Electronics Lab
08.	PEPBTT1	Electromagnetic theory and Wave Propagation
09.	PEPBTT2	IC Fabrication and VLSI Technology
10.	PEPBTT3	Microprocessors and Microcontrollers
11	PEPBLT3	Microprocessors and Microcontrollers Lab
12	PEPBTD1	Advanced Communication System-1
13	PEPBLD1	Analog and Digital Communication System Lab

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Scheme and Syllabus

Semester - I

Core -1: Mathematical Techniques for Electronics

Course Code: PEPATT1 **Credits = 5 (4+1+0)**

Course Objectives:

- Create deep interest in learning mathematics techniques.
- To offer a gentle introduction to the concepts of Laplace transforms, Inverse Laplace transforms, solution of ordinary differential equations using Laplace transform, Fourier series and their properties with applications in real life.

Course outcomes:

The student after undergoing this course will be able to:

- Analyze, identify and solve the problem using Laplace Series.
- Analyze, identify and solve the problems using Fourier Series
- Apply -Transforms, Inverse Z-Transforms and solve Difference Equations.
- To apply the application of Mathematics in Electronics.

Unit I: Laplace Transform: Definition and Properties, Laplace Transform derivatives and integrals, Evaluation of differential equations using Inverse Laplace Transform, Applications of Laplace Transform , Fourier Series & Transform: Definition and Properties, Fourier series in the Interval, Uses of Fourier Series,Fourier sine and cosine transform of Derivatives, Finite Fourier Transform,

and Applications of Fourier Transform.

Unit II: Partial differential equations: Homogeneous and non-homogeneous boundary conditions, Solutions by separation of variables and series expansion methods. Laplace, wave and diffusion equations in various coordinate systems. Integral equations: methods and solutions,

Unit III: Mathematical Transforms: Discrete time signal analysis and linear systems , Sampling theorem and applications , Sampling of continuous time signals. z-transform, inverse z-transform, Digital Filters: signal flow graph representation, basic structures for IIR and FIR filters, noise in digital filters, filter design techniques, Transforms: Discrete Fourier Transform (DFT) , properties and Fast Fourier Transforms (FFT)

Unit IV: Mathematical tool for Electrical circuits; Superposition, Thevenin, Norton and Maximum Power Transfer Theorems, Network elements, Network graphs, Nodal and Mesh analysisTime and frequency domain response, Passive filters, Two-port Network Parameters : Z, Y, ABCD and h parameters, Transfer functions, Signal representation, State variable method of circuit analysis, AC circuit analysis, Transient analysis, Zero and Poles, Bode Plots.

Reference Books:

1. Advanced Engineering Mathematics : E Kreyszig (John Wiley & Sons)
2. Higher Engineering Mathematics : Dr. B.S. Grewal, Khanna Publishers, New Delhi.
3. Advanced Engineering Mathematics: H. K. Das, S.Chand&company Ltd.
4. Theory and Application of Digital Signal Processing: L. R. Rabiner and B. Gold, Prentice Hall.
5. Introduction to Digital Signal Processing: J.R. Johnson, Prentice Hall.
6. Industrial Control Electronics – Applications and Design, Michael Jacob Prentice Hall

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Core -2: Semiconductor Materials and Devices
Course Code: PEPATT2 **Credits = 3 (3+0+0)**

Course Objectives

- To provide basic knowledge and concepts of Semiconductor materials and devices.
- It provides a basic background for advanced courses in electronics, optoelectronics and VLSI design.
- To give an appreciation of the role of the physicist in shaping future electronics
- To provide overview of modern low dimensional semiconductor physics.

Course Outcomes

On completion of the course a student will be able to

- Apply basic concepts of semiconducting materials for electronic device applications.
- Understand major properties of semiconducting materials, explain energy band diagrams and connections with the device structures and properties.
- Holistic view of the latest progress in low-dimensional nano materials for electronic devices.

Unit – I: Introduction to Semiconductor, energy bands in solids, concept of effective mass, density of states, Fermi levels. Extrinsic semiconductors: n and p type doping, Densities of carriers in extrinsic semiconductors and their temperature dependence,
Unit – II: Carrier transport, Conductivity, Mobility and Hall Effect, Diffusion and drift of excess carriers, recombination mechanism, Trapping, Continuity Equation, Diffusion Length.

Unit – III: PN Junction, Diode equation and diode equivalent circuit, Breakdown in diodes, Zener diode, Tunnel diode, Metal semiconductor junction – Ohmic and Schottky contacts, Characteristics and equivalent circuits of JFET, MOSFET.

Unit – IV: Low dimensional semiconductor devices – quantum wells, quantum wires, quantum dots. High Electron Mobility Transistor (HEMT), Solar cells – I-V characteristics, fill factor and efficiency, LED, LCD and flexible display devices. Emerging materials for future Devices: Graphene, Carbon Nano tubes (CNT), ZnO, SiC etc.

Reference Books:

1. Physics of semiconductor Devices, S. M. Sze.
2. Semiconductor Devices, ISBN 0-471-36245-X, Jaspreet Singh,
3. Principles of electronic materials and devices, ISBN 0-07-295791-3, S. O. Kasap,
4. The Physics of Low Dimensional Semiconductors (J H Davies, Cambridge)
5. Physics of Semiconductors and their Heterostructures (J Singh, Wiley)
6. Electronic and Optical Properties of Semiconductor Structures (J Singh) Cambridge)
7. Quantum Wells, Wires and Dots, (P Harrison, Wiley)
8. Low Dimensional Semiconductors (M J Kelly Oxford)
9. Solid state Electron Devices-B. G. Streetman.

10. Semiconductor Physics and Device – Neamen, McGraw Hill

Core -2: Semiconductor Materials and Devices Lab
Course Code: PEPALT2 **Credits = 2 (0+0+2)**

Name of the experiments

1. Measurement of resistivity of sample at various temperatures by four probe method.

2. To calculate the energy band gap of given semiconductor sample.

3. To study the Hall Effect: determine the Hall coefficient, type of semiconductor and carrier concentration in the given semiconductor sample

4. I-V characteristics measurement of a p-n diode/Schottky diode calculate its device Parameters.

5. To study the performance of solar cell.

6. To study characteristics of JFET and its application as switch.

7. To study characteristics of MOSFET and its application.

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Core - 3: Analog and Digital Electronics
Course Code: PEPATT3 **Credits = 3 (3+0+0)**

Course Objectives:

- To study rectifiers, ICs based regulated power supply, Transistor Biasing, FETs, operating point and stability, Amplifiers, and Various types of oscillators.
- To study the basic principles, configurations and practical limitations of op-amp. , to understand the various linear, non-linear applications of op-amp and frequency generators.
- To analyze, design and explain the characteristics and applications of active filters, and to analyze different types of Multi vibrators and their design procedures.
- To understand simplification of boolean algebra by Minimization techniques (Karnaugh maps and Quine-McCluskey),
- To analyze logic process and implement logical operation using combinational and sequential logic circuit, mixed logic combinational circuits, multiple output functions
- To understand characteristics of flip-flops, Counters Registers A/D and D/A Convertor, memory and their classifications.

Learning Outcomes:

Upon successful completion of this course, students will be able to address following points:

- This course provides the foundation inrectifiers, ICs based regulated power supply, transistor biasing, amplifiers, and various types of oscillators.
- Able to understanding in operational amplifier and other linear integrated circuits, the op-amp's basic construction, characteristics, parameter limitations, various configurations of opamp,non-linear circuits, active filters and signal generators.
- Able to Analyze and design multivibrators, develop a digital logic and apply it to solve real life problems.
- Able to analyze design and implements combinational and sequential logic circuits.
- Able understanding and implementation of flip-flops, Counters, Registers, A/D and D/A Convertor, memory.

Unit – I: Rectifiers, Voltage regulated ICs and regulated power supply, Biasing of Bipolar junction transistors andFETs, operating point and stability, Amplifiers, Classification of amplifiers, Concept of feedback,Hartley, Colpitt's and Phase Shift oscillators.

Unit – II: Operational amplifiers (OPAMP) - characteristics, computational applications, comparators, Schmitt trigger, Instrumentation amplifiers, wave shaping circuits, Phase locked loops, Active filters, multivibrators, Voltage to frequency convertors (V/F), frequency to voltage convertors (F/V).

Unit – III: Combinational circuits : Logic Families, Logic Gates, Boolean algebra , minimization techniques :Switching equations, canonical logic forms, sum of product & product of sums, Karnaugh maps, two, three and four variableKarnaugh maps, simplification of expressions, Quine-McCluskeyminimization technique, mixed logic combinational circuits, multipleoutputfunctions.Sequential circuits: multiplexers and demultiplexers.

Unit – IV: Flip-flops, clocked and edge triggeredflipflops, Counters – Ring, Ripple, asynchronous and synchronous counters, counter design with state equations, Registers , serial in serial out shift registers, tristateregistor, timing considerations. A/D and D/AConverter, Sequential PLD, FPGA, Analysis and Design of digital circuits using HDL, Programmable Logic Devices (PLD), flip flops memories.

Reference Books:

1. Millman's Integrated Electronics - Analog and Digital Circuit and Systems.
2. A.P. Malvino, Electronic Principles, Tata Mcgraw Hill Publications.
3. Robert L. Boylestad& Louis Nashelsky, Electronic Devices & Circuit Theory.
4. Analysis and Design of Analog Integrated Circuits by Kenneth Martin Chan Carusone, David Johns
5. Digit al Principles &Application: Malvino& Leach.
6. Computer System Architecture: Moris Mano.
7. Digit al Electronic: Schaum Series.
8. Digit al Electronics: R.J.Tossi (PHI).
9. Digit al electronics: R.P. Jain.

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Core - 3: Analog and Digital Electronics Lab

Course Code: PEPALT3 **Credits = 2 (0+0+2)**

Name of the experiments

1. Design some combinational circuits using NAND & NOR Gate.

2. Design circuit Using IC 7400 and 7402 to verify.

3. Study characteristics of FET and MOSFET.

4. Study characteristics of Colpit's oscillator.

5. Experiment based on Operational Amplifier (like adder, subtractor and Others)

6. To Study the characteristics of op- amp as Inverting and non inverting.

7. To Study the characteristics of op- amp as Schmitt trigger & Comprator.

8. Study and designs flip flop.

9. Study and designs of A/D & D/A Convertor.

References:

1. Millman's Integrated Electronics - Analog and Digital Circuit and Systems.
2. Digit al Principles & Application: Malvino& Leach.
3. Digit al electronics: R.P. Jain.

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Open Elective: Applications of Nanotechnology in Electronics
Course Code: OPNPET1 **Credits = 3 (3+0+0)**

Course Objectives

- Foundation knowledge of the nanoscience field
- To bring out the distinct properties such as electronic, optical properties of nanostructures
- To make the students acquire an understanding the nanomaterials and their applications

Learning Outcomes

Upon successful completion of this course, students will be able to address following points:

- Learn about the distinct properties of nanomaterials
- Understand the principles of nanomaterial characterization techniques
- Describe the principle and operation of nanomaterial-based devices

Unit – I: Definition of Nano-science and nano technology, History of nanoscience, Energy band-gap in semiconductors, Fermi level, Donors, acceptors and deep traps, Excitons, Mobility, Conduction electrons, density of states, Zero dimensional (0D), one dimensional (1D) , two dimensional (2D) , three dimensional (3D), Nano-structured materials, Influence of nano over micro/macro.

Unit – II: Properties of Nanomaterials: Size dependence of properties, Optical: Absorption, transmission, Photoluminiscence, Fluoroscence, Phosphorescence, Surface Plasmon Resonance, effect of size of nano particles. Electrical: Conduction mechanisms in 3D (Bulk), 2D (Thin film) and Low dimensional systems.

Unit – III: Type of Nanomaterials: different type of nano materials,Carbon nanotube, Fullerene, Type of CNT: SWNT (Single wall nano tube), Multi wall nano tubes, Graphite and Graphene, metal nano particle silver and gold, ZnO and TiO2 metal oxides, Semiconductors, Nano-composites,Creating nanoparticles by using software.

Unit – IV: Synthesis of nanomaterials: Combustion method, Sol-gel method, Co-precipitation method. Characterization tools for nanomaterials: X-Ray Diffraction, UV-VIS Spectrophotometer, Spectrofluorophotometer, Scanning Electron Microscopy, Transmission Electron Microscopy.

Reference Books:

1. Introduction to Nanotechnology, Charles P. Poole, Jr., Frank J. Owens, Wiley India (P)Limited New Delhi.
2. Nanoscience and Nanotechnology, K.K. Chattopadhyay, A.N. Banerjee, PHI Learning Private Limited, New Delhi.
3. Understanding of Nano Science and Technology, PoorviDutta, Sushmita Gupta, Global Vision Publishing House, New Delhi.
4. Nanotechnology, WM Breck, CBS Publishers & Distributors Pvt Ltd, New Delhi.
5. Optical Imaging and Microscopy (Techniques and Advanced Systems), Peter Török, Fu-Jen Kao, Springer Publication.

Open Elective: Applications of Nanotechnology in Electronics Lab
Course Code: OPNPEL1 **Credits = 2 (0+0+2)**

Name of the experiments

1. To calculate the energy bandgap of nanoparticle from UV-VIS spectra.
2. To measure the average crystallite size using XRD data of a given nanomaterial.
3. Estimation of lattice strain in nanoparticle by XRD pattern.
4. To calculate the grain size of a material fromSEM micrograph.
5. To analyse the absorption and emission spectrum of a given material.
6. Synthesis of nanomaterial by combustion method.

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Semester – II

Core-4: Electromagnetic Theory and Wave Propagation

Course Code: PLPBTT1 **Credit: 5 (4+1+0)**

Course Objectives:

The course aims to develop

- Ability to understand the propagation of electromagnetic waves in different medium
- Understanding of the Gauge transformation and invariance of the fields
- Mathematical analysis of the sinusoidal linear waves
- Ability to understand the physics involved in the waveguides and resonators
- Understanding of the optical fiber communication

Learning Outcomes:

At the end of this course student will demonstrate the ability to:

- Apply the maxwell's equation to explain the propagation of electromagnetic waves in different medium and their related phenomenon such as skin depth etc.
- Understand the concept of Lorentz and Coulomb Gauge.
- Interpret the natural optical phenomenon by using the concept of transverse nature of electromagnetic waves
- Understand the principles involved in the optical fiber communication

Unit – I: Maxwell's equation in terms of scalar and vector potential, Gauge Transformation, Lorentz and Coulomb Gauge, Retarded potential, Electromagnetic waves in free space, wave propagation in linear medium, propagation of sinusoidal voltages, complex analysis of sinusoidal waves and phasor.

Unit – II: Propagation of electromagnetic waves in isotropic dielectric medium. Propagation of em waves in anisotropic dielectric medium, Fresnel law of normal velocities, propagation of em waves in conducting medium, skin depth, Poynting vector in conducting medium, propagation of em waves in ionized gases, plasma frequency.

Unit – III: Interaction of electromagnetic waves with matter, Fresnel Formulae, Snell's law, Brewster's law, total internal reflection, Production of elliptically and circularly lights. Metallic reflection, Rectangular wave guide, TE mode, TM mode. Cavity resonators-TE and TM mode.

Unit – IV: Wave propagation in the wave guide, Power transmission and attenuation, waveguide current and mode excitation, Optical Fiber, Optical fiber transmission modes, Losses in fiber, measurement of fiber characteristics, introduction to fiber optical communication system.

Reference Books:

1. Principles of Electromagnetics by M.N.O. Sadiku and S.V. Kulkarni

2. Engineering electromagnetic by Hayt and Buck
3. Introduction to electrodynamics by David J. Griffiths
4. Optoelectronics an introduction by J. Wilson and J.F.B. Hawkes
5. Electromagnetics by B. B.Laud
6. Introduction to Electromagnetic theory by T. L. Chow
7. Electromagnetics by Schaum Series

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Core -5: IC Fabrication and VLSI Technology
Course Code: PEPBTT2 **Credit: 5 (4+1+0)**

Course Objectives:

The course aims to develop an understanding of:

- Know the physics of semiconductor junctions, metal-semiconductor junctions and metal-insulator-semiconductor junctions.
- Know the physics and application of semiconductor hetero junctions and quantum-confined structures.
- Understand the fundamental principles and applications of modern electronic and optoelectronic semiconductor devices

Learning Outcomes:

Upon successful completion of this course, students will be able to address following points:

- To get understanding of device fabrication methods
- Understands the VLSI technology
- Understanding the IC Technology

Unit – I: Clean room technology - Clean room concept – Growth of single crystal Si , surface contamination, cleaning & etching. (Laboratory Practices : Cleaning of p-type & n-type Si-wafer by solvent method & RCA cleaning) Oxidation – Growth mechanism and kinetic oxidation, oxidation techniques and systems, oxide properties, oxide induced defects, charactrisation of oxide films, Use of thermal oxide and CVD oxide; growth and properties of dry and wet oxide, dopant distribution, oxide quality; (Laboratory Practices : Fabrication of MOS capacitor)

Unit – II: Solid State Diffusion – Fick's equation, atomic diffusion mechanisms, measurement techniques, diffusion in polysilicon and silicon di-oxide diffusion systems. Ion implantation – Range theory, Equipments, annealing, shallow junction, high energy implementation. Lithography – Optical lithography, Some Advanced lithographic techniques. Physical Vapour Deposition – APCVD, Plasma CVD, MOCVD. Metallisation - Different types of metallisation, uses & desired properties. VLSI Process integration.

Unit – III: Materials For Integrated Circuits and Fabrication Technology: Classification of IC's, Electronic grade silicon, Silicon shaping lapping polishing and wafer preparation, Vapour phase epitaxy, Molecular beam epitaxy, Optical lithography, Photomask, Photoresist and process, Limitation of optical Lithography, Idea of electron and X-ray Lithography, Wet chemical etching, reactive plasma etching.

Unit – IV: Microelectronic Fabrication: Fabrication of mono lithic diodes, Fabrication of integrated transistors, idea of burried layer fabrication, Monolithic circuit layout and design rule, Isolation methods, Monolithic FET, MOSFET, Processing idea of HEMT (High Electron Mobility transistor), CCD, MOS integrated circuit, Large and medium scale integrated, Hybrid Integrated circuit.

Reference Books:

1. Integrated Electronics : Milliman and Taub
2. Microelectronics : Milliman and Gros
3. Thin film Phenomenon : K.L. Chopra
4. Hand Books Of Thin Film : Marshe l and Gland
5. Physics of Semiconductor devices : Michel Shur
6. IC Fabrication : J. A. Ellcott
7. Semiconductor Devices Physics and Technology, Author: Sze, S.M.; Notes: Wiley, 1985
8. An Introduction to Semiconductor Microtechnology, Author: Morgan, D.V., and Board, K
9. The National Technology Roadmap for Semiconductors , Notes: Semiconductors Industry Association, SIA, 1994
10. Electrical and Electronic Engineering Series VLSI Technology, Author: Sze, S.M. Notes: McgrawHill International Editions

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Core -6: Microprocessors and Microcontrollers

Course Code: PEPBTT3 **Credit: 3 (3+0+0)**

Course Objectives:

The course aims to develop an understanding of:

- The difference between microprocessor and microcontrollers
- Their architecture including designed, memory organizing, addressing modes, timing
- Data moving and transferring

Learning Outcomes:

After completion of this syllabus, students are able to understand:

- The difference between microprocessor and microcontrollers and their architecture.
- To write the programs and load the data on registers and perform the arithmetic and logical operations.

Unit – I: 8086 Architecture and Programming: 8086 Architecture – Min.Mode, Max.Mode – Software Model – Segmentation – Segmentation of address – Pipe line Processing. Addressing Modes – Instruction Set- Constructing Machine Code – Instruction Templates for MOV Instruction– Data Transfer Instructions– Arithmetic, Logic, Shift, rotate instructions Flag Control instructions-Compare, Jump Instructions– Loop and String instructions -Assembly programs- Block move, Sorting, Averaging, Factorial – Code Conversion : Binary to BCD, BCD to Binary.

Unit – II: 8051 Microcontroller Hardware Introduction – Features of 8051 – 8051 Microcontroller Hardware : Pin-out of 8051, Central Processing Unit (CPU), Internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input / Output pins, Ports and Circuits – External data memory and Program memory : External program memory, External data memory.

Unit – III: 8051 Instruction Set And Assembly Language Programming Addressing modes – Data moving (Data transfer) instructions : Instructions to Access external data memory, external ROM / program memory, PUSH and POP instructions, Data exchange instructions – Logical instructions : byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions : Flags, Incrementing and decrementing, Addition, Subtraction, Multiplication and division, Decimal arithmetic – Jump and CALL instructions : Jump and Call program range, Jump, CALL and subroutines – Programming.

Unit – IV: Interfacing to External World Interfacing keyboard: Simple keyboard interface, Matrix keyboard interface – Interfacing displays: Interfacing seven segment LED displays, Interfacing LCD display – Interfacing DAC to 8051– Interfacing ADC to 8051 – Interfacing sensors – Interfacing stepper motor.

REFERENCE BOOKS:

1. A. P. Godse and D. A. Godse, "Microprocessors & its Applications", Technical Publications, Pune,
2. Kenneth Ayala, "The 8051 Microcontroller", Third Edition, Delmar Cengage Learning, 2005.
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, "The 8051 Microcontroller and Embedded Systems", Second Edition, Pearson Education 2008.

4. W.A. Triebel and Avatar Singh, The 8086 /8088 Microprocessors- Programming, Software, Hardware and application, Prentice Hall of India, New Delhi.
5. Douglas V. Hall : - Microprocessors and Interfacing programming and Hardware (Tata Mc Graw Hill) (Unit 1)
6. B. Brey, 1995, Intel Microprocessors 8086/8088, 80186,80286,80486,80486, Architecture, Programming and Interfacing
7. Yu – Cheng and Glenn A. Gibson, The 8086 / 8088 family Architecture, Programming and Design, Prentice-Hall of India.
8. Muhammed Ali Mazidi and Janice Gillespie Mazidi, 2004, The 8051 Microcontroller and Embedded Systems, Fourth Indian Reprint, Pearson Education.
9. V. Vijayendran, 2002, Fundamentals of Microprocessor –8086- Architecture, Programming (MASM) and interfacing, Viswanathan, Chennai.

Core -6: Microprocessors and Microcontrollers Lab

Course Code: PEPBLT3 **Credit: 2 (0+0+2)**

Name of the experiments

1. Write an assembly language program to multiply two 16-bit hexadecimal numbers.
2. Write an assembly language program to convert a 16-bit hexadecimal numbers to decimal number
3. To write a language program to generate Fibonacci series.
4. To study working of IC 8086 (interfacing experiment)
5. Write an assembly language program to sort hexadecimal numbers in descending order.
6. Generation of Fibonacci series. Micro controller 8051
7. Addition, subtraction, multiplication and division of two 8-bit numbers.
8. Sum of a series of 8-bit numbers, average of N numbers.
9. Factorial of number, Fibonacci series of N terms.
10. Sorting in ascending and descending order – Picking up smallest and largest number

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DSE 1: Advanced Communication System-1

Course Code: PLPBTD1 **Credit: 3 (3+0+0)**

Course Objectives:
The course aims:

- To understands the basics of Information theory, Source coding techniques and calculate Entropy.
- To study Data communication basics such as TCP/IP and the network management concepts.
- To understand various modulation and multiplexing mechanisms.
- To understand the basics of satellite communications and satellite systems.
- To understand the designing of satellite links and the earth station details and their designing.

Learning Outcomes:

Upon successful completion of this course, students will be able to address following points:

- How information is measured in terms of probability and entropy.
- An overview of the concepts and fundamentals of data communication and computer networks.
- Introduction to fundamental technologies of the mobile telecommunications.
- Satellite orbits, link analysis, antenna, interference and propagation effects, modulation techniques, coding, multiple access, and Earth station design.

Unit – I: Introduction to Information and Coding Theories-Information Theory: information measures, Shannon entropy, differential entropy, mutual information, capacity theorem for point-to-point channels with discrete and continuous alphabets.

Unit – II: Introduction to data communication - Introduction to data communication, layered network architecture (OSI and TCP/IP), Public Telephone Network, Cellular Telephone system, data communication codes, error detection and error control, Modems, LAN topologies, Division Multiplexing (WDM) and its network implementation

Unit – III: Mobile Communication elements and system design - Introduction to Cellular Mobile System - Performance criteria - uniqueness of mobile radio environment - operation of cellular systems- Hexagonal shaped cells - Analog and Digital Cellular systems- General description of the problem - concept of frequency channels -Co-channel Interference Reduction Factor -desired C/I from a normal case in a omnidirectional Antenna system - Cell splitting, consideration of the components of Cellular system

Unit – IV: Satellite communication-Introduction: Orbital mechanics and launching, earth station and satellite sub systems, satellite link: design and analysis, multiplexing techniques, multiple accesses for satellite links: FDMA, TDMA CDMA and DAMA, propagation effects, DBS-TV, GPS. VSAT: Network architecture, access control protocol and link analysis.

Reference Books:

1. Communication Systems” by B P Lathi.
2. Communication Systems” by A B Carlson.
3. Communication Systems: Analog and Digital” by R P Singh and S Sapre
4. Introduction to Communication Systems” by Madhow Upamanyu.
5. Communication Systems” by Michael Moher Simon Haykin.
6. Communication Systems: Analog and Digital” by Sanjay Sharma.
7. Modern Digital and Analog Communication Systems” by B P Lathi and Zhi Ding.
8. Digital Communication: Theory, Techniques and Applications” by R N Mutagi.

DSE 1: Advanced Communication System I Lab

Course Code: PEPBLD1 **Credit: 2 (0+0+2)**

Name of the experiments

1. Study the sample signal and sample hold signal and its reconstructions.
2. ASK /FSK/ PSK generation and detection
3. Study of Frequency Modulation using Reactance Modulator.
4. Study of Frequency Modulation using Varactor modulator.
5. Study the operation of Quadrature Detector.
6. Study the operation of Detuned Resonance Detector.
7. Study the operation of Foster - Seeley Detector
8. Study the operation of Ratio Detector
9. Study the FM transmitter and receiver.
10. Study the AM transmitter and receiver.

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1.1.3

List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Name of the Subjects	Yellow	
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	

List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department	: *Department of Pure and Applied Physics*
Programme Name	: *M.Sc. Physics*

Academic Year : 2022-23

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
01.	PPPATT2	Quantum Mechanics
02.	PPPALT2	Quantum Mechanics Lab
03.	PPPATT3	Electronic and Experimental Methods
04.	PPPALT3	Electronic and Experimental Methods Lab
05.	OPNPPT1	Nanomaterials and its Applications
06.	OPNPPL1	Nanomaterials and its Applications Lab
07.	PPPBTD1	Computational Physics and Programming
08.	PPPBLD1	Computational Physics and Programming Lab

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Core –2: Quantum Mechanics
Course Code: PPPATT2 **Credits = 4 (3+1+0)**

Course Objectives:

- To introduce the modern concepts of quantum mechanics in a stimulating, elegant, exhaustive and explanatory manner.
- To explore the nature of the microscopic world into substantial depth in terms of meaning and interpretation so as to acquaint the learners to initiate thinking and analyzing the physically observable phenomena quantum mechanically without exceeding the mathematical level of complexity.
- To lay down the foundation and enhance capabilities of students to pursue various aspects of modern physics and interdisciplinary fields confidently.

Course Outcomes:

After the completion of course, students should be able to understand and grasp.

- The basic concepts of quantum mechanics including the solution of wave equation, interpretation of dynamical variables and applying wave mechanics to various situations in terms of boundary value problems so as to understand the quantum well, barriers and particle motion in different types of force field (potentials).
- Applying special functions as the solutions of differential equation as the wave function/state functions and understanding the physical situations where these can be applied.
- Calculating states of electrons in hydrogen atom and harmonic oscillators and the interpretation of quantum states.
- Applying the stationary perturbation problems to various problems including particle states splitting in electric and magnetic field.

Unit – I: Introduction to Schrodinger equation; probability interpretation, probability current, continuity equation; Ehrenfest theorem; Admissible wave functions; Stationary states, Schrodinger equation in one dimensional problems, wells and barriers; Harmonic oscillators by Schrodinger Equation

Unit – II: Uncertainty relation of x and p, States with minimum uncertainty product; General Formalism of wave mechanics; Commutation Relations; Representation of states and dynamical variables; Completeness of eigen functions; Dirac delta function; Bra and ket Notation; Matrix representation of an operator; Unitary transformation. Solution of Harmonic oscillator by operator method.

Unit – III: Angular momentum in QM, Central force problems: Solution of Schrodinger equation for spherically symmetric potentials; Hydrogen atom problem.

Unit – IV: Time independent perturbation theory; Non-degenerate and degenerate cases; Applications such as Stark effect etc.

Reference Books:

1. Quantum mechanics, by L I Schiff
2. Quantum physics by S Gasiorowicz
3. Quantum mechanics by B Craseman and J D Powell
4. Quantum mechanics by A P Messiah
5. Modern Quantum mechanics by J J Sakurai.
6. Qunatum mechanics by Mathews and Venkatesan

Core –2: Quantum Mechanics Lab

Course Code: PPPALT2 **Credits = 1 (0+0+1)**

1. To determine the Planck Constant and work function

2. Measurement of wavelength of He-Ne LASER (Grating)

3. To determine the wavelengths of Hydrogen spectrum and determine the value of Rydberg's constant.

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Core –3: Electronics and Experimental Methods
Course Code: PPPATT3 **Credits = 3 (3+0+0)**

Course Objectives:

- The course mainly focuses on developing the Electronics, experimental and instrumentation skills of the students.
- To develop the understanding of physics of semiconductor, semiconductor junctions, metal-semiconductor, homo-junction, and hetero-junction and metal-oxide semiconductor contacts.
- Semiconductor photonic devices and hetero-structures for detection and production of optical radiation.
- To understand the concept of Data Interpretation and Analysis of results.

Course Outcomes:

- Students understand the basic of semiconductor and electronics devices.
- Students understand the current voltage characteristics of semiconductor devices, metal-semiconductor, homo-junction, and hetero-junction and metal-oxide semiconductor contacts.
- Student understands the basic mechanism involves in optoelectronics devices.
- Understanding of sensors and transducers for temperature, vacuum, optical and vibration measurements

Unit – I: Energy band in semiconductors, Carrier concentration in intrinsic and extrinsic semiconductors, Fermi levels in intrinsic and doped semiconductors, Concept of degenerate and non-degenerate semiconductors, temperature and doping dependent energy band gap of semiconductors.

Unit – II: Carrier mobility and drift velocity, Resistivity and conductivity, diffusion current, Einstein's relationship, Generation and recombination of carriers, Continuity equation, Carrier Injection and excess carriers, Decay of carriers.

Unit – III: P-N junction; device structure, energy band diagram, depletion region (abrupt junctions), depletion capacitance and C-V characteristics, I-V characteristics, Varactor diode, Tunnel diode principle of operation and I-V characteristics, Semiconductor hetero-junctions, Metal-semiconductor junction, Ohmic contacts. Solar cells, Photo-detectors, LEDs.

Unit – IV: Precision and Accuracy, Error Analysis, Types of errors,Propagation of errors, Curve fitting: Least square fitting, chi-square test. Measurement techniques: Sensors and Transducers (Temperature, vacuum, optical, particle and radiation detectors etc.), Signal and Noise.

References:

1. Semiconductor devices- Physics and Technology by S.M.Sze
2. Electronic Devices and Circuit Theory by Boylestad and Nashelky
3. Integrated Electronics : Milliman and Halkias

4. Measurement, Instrumentation, and Experimental design in Physics and Engineering: Michael Sayer, AbhaiMansingh

5. Transducers and Instrumentation:DVSMurty

Core –3: Electronics and Experimental Methods Lab

Course Code: PPPALT3 **Credits = 2 (0+0+2)**

1. Study the operational Amplifier as inverting and non-inverting amplifier

2. Study the operational Amplifier as a summing amplifier (Voltage adder and voltage subtraction).

3. Study the operational Amplifier as a differentiator and integrator.

4. A study of V-I characteristics of light emitting diode (LED).

5. A study of V-I characteristics of Tunnel diode.

6. Study of Solar Cell characteristics

7. Photoconductivity (Photocurrent as a function of irradiance at constant voltage)

8. Design of regulated Power Supply

9. Verification of De Morgan's Theorem

10. To design a digital to analog converter (DAC) of given specifications

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Open Elective: Nanomaterials and Its Applications
Course Code: OPNPPT1 **Credits = 3 (3+0+0)**

Course Objectives:

The objective of the subject is that the student acquires knowledge

- To foundational knowledge of the Nanomaterials and related fields.
- To understand the influence of dimensionality of the object at nanoscale on their properties
- To make the students acquire an understanding the basic Nanoscience/Nanotechnology and their Applications .
- Students gain knowledge about the principles of various synthesis techniques**.**

Learning Outcomes:

After completing this course students will be able to:

- Learn about the background on Nanoscience
- Understand the various synthesis methods of Nanomaterials and their application and the impact of Nanomaterials on environment
- Apply their learned knowledge to develop new Nanomaterial's.

Unit – I: History of nano- materials, Ancient Indian Culture and Nanotechnology, Role of Feynman in development of Present Nano-sciences, what are Nanoscience and Nanotechnology?Atomic structure and atom size and their effects, Types of 1D, 2D, 3D Nano-structured materials, Influence of nano over micro/macro.

Unit – II: Properties of Nano materials: Physical, Magnetic, Optical, Thermal, Mechanical, Electrical for nano materials and Chemical Properties, Size effects, Surface Effects and Surface to Volume ratio.

Unit – III : Type of Nanomaterials: different type of nano materials,Carbon nanotube, Fullerene, Type of CNT: SWNT (Single wall nano tube), Multi wall nano tubes. 2D nano material, Graphite and Graphene, metal nano particle silver and gold, ZnO and TiO_2 metal oxides, Semiconductors, Nano-composites,Creating nanoparticles by using software.

Unit – IV: Synthesis of nano materials**:** Top- down or bottom up approach, Physical Methods, PLD, Sputtering, Thermal evaporation, Chemical Methods – CVD, Sol-gel, Hydrothermal, Biological Methods – Green Synthesis, mechanical milling, sputtering and microwave plasma, chemical reduction and oxidation, hydrothermal, micelles, sol-gel processes, photolysis, and metal organic chemical vapor deposition

Reference Books:

1. Introduction to Nano Science and Nano Technology – K.K. Chattopadhyay & A. N. Banerjee PHI Pvt. Ltd., 2009.
2. Nano technology: Principles and practices - Sulabha K. Kulkarni, Capital Publisher Co., 2015.

3. Introduction to nano technology: Charles P. Poole, Jr. Frank J. Owen, Wiley, Interscience Pub., May, 2003.
4. Nanostructures & Nanomaterials Synthesis Properties & Applications. Guozhong Cao, Imperials College Press London. 2004
5. Textbook of Nanoscience and Nanotechnology-B.S.Murty, P.Shankar, BaldevRaj, B.B. Rath and James Murday Universities press, IIM, Metallurgy and Materials Science
6. Principles of Nanoscience & amp; Nanotechnology M.A. Shah, Tokeer Ahmad, Narosa Publishing House
7. Nanocrystals: Synthesis, Properties and Applications C.N. Rao, P.J. Thomas, G.U. Kulkarni
8. Nano materials Handbook – Yury Gogotsi
9. Introduction to Nano science and Nano technology – K K Chatopadhayya & Banerjee, PHI
10. Introduction of Nano Technology - Cahrles P. Poole Jr and Franks J. Qwens
11. Nano: The Essentials. T. Pradeep, McGraw Hill Education.20/01/2007
12. Handbook of Nanostructures: Materials and nanotechnology, H.S. Nalwa, Vol 1-5, Academic Press, Bostan. I Ed.,Oct., 1999.

Open Elective: Nanomaterials and Its Applications Lab

Course Code: OPNPPL1 **Credits = 2 (0+2+0)**

1. To determine the crystallite size of given sample and observe the influence of do-pants through given XRD data.
2. To analyze the particle size Scanning Electron Microscopy and Transmission Electron Microscopy images of given samples.
3. To determine the crystallinity and phase composition of the given sample through selective area electron diffraction.
4. To determine the electronic band-gap of given sample through Tauc plots derived from UV-Vis diffused reflectance spectroscopy.
5. To identify Hydrogen bond through FTIR spectroscopy.
6. To analyze the elemental species present in the given sample through X-ray Photoelectron Spectroscopy.

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DSE – 1: Computational Physics and Programming

Course Code: PPPBTD1 **Credit: 3 (3+0+0)**

Course Objectives:

The course aims to develop an understanding of:

- Basic methods, tools and techniques of computational physics with Fortran 90/95.
- Developing practical computational problem solving skills.

Learning Outcomes:

Upon successful completion of this course, students will be able to address following points:

- Identify modern programming methods and describe the extent and limitations of computational methods in physics,
- Independently program computers using leading-edge tools,
- Formulate and computationally solve a selection of problems in physics,

Unit – I: Basic in computer programming, programming preliminaries, Fortran 90 programming: Constants and Variables, Arithmetic expression, I/O statements, Conditional statements

Unit – II: Loops and Logical expressions, Functions and Subroutines, Arrays, Format specifications, Files Processing in Fortran 90

Unit – III: Numerical methods: solution of linear and nonlinear algebraic equations and transcendental equations, bisection method, false position method, Newton Raphson method, Solution of simultaneous linear equations, Matrix inversion, Gaussian elimination, iterative Method.

Unit – IV: Interpolation (with equally spaced and unevenly spaced point), Curve fitting, Numerical integration, Trapezoidal rule, Simpson's method, Numerical solution of ordinary differential equation by Runga-Kutta method.

Reference Books:

1. Sastry: Introductory methods of Numerical Analysis.

2. Rajaraman: Numerical Analysis and Fortran Programming

3. *Numerical Recipes in FORTRAN: The Art of Scientific Computing*, Press, et al. (Cambridge University Press)

4. *Fortran 90 Programming*, Ellis, Philips and Lahey (Addison-Wesley)

5. *Fortran 90/95 Explained*, Metcalf and Reid (Oxford)

6. *Fortran 90/95 for Scientists and Engineers*, Chapman (McGraw-Hill Higher Education)

DSE – 1: Computational Physics and Programming Lab

Course Code: PPPBLD1 **Credit: 2 (0+0+2)**

Name of the experiments

1. Implementation of solving the non algebraic equation using Fortran 90

2. Implementation of Numerical Integration using Fortran 90

3. Implementation of Solving Differential equation using Fortran 90

4. Implementation of Solving linear equations using Fortran 90

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