PHYSICS

PROFESSIONAL ETHICS

First Year | **CORE COURSE I** | **Semester I**

PROPERTIES OF MATTER AND ACOUSTICS

Code: 22SCCPH1 | **(Theory)** | **Credit:5**

COURSE OBJECTIVES:

- To inculcate the knowledge of certain properties of matter namely, elasticity, surface tension and viscosity.
- To enable the students to underst and the basic concepts of sound.
- To describe the experimental techniques for the determination of properties so that the learner can do the experiments with better understanding.

UNIT–I ELASTICITY:

Introduction on the elastic and plastic nature of materials - Hooke's law-Stress-Strain diagram – Factors affecting elasticity – Different moduli of elasticity - Relation between the elastic moduli – Poisson's ratio -Twisting couple on a cylinder – Determination of rigidity modulus by static torsion– Work done in twisting a wire - Torsional oscillations of a body – Torsion pendulum – Determination of rigidity modulus and moment of inertia.

UNIT–II BENDING OF BEAMS:

Bending of beams–Expression for bending moment–Cantilever–Expression for depression of the loaded end of a cantilever – Young's modulus by measuring the tilt in a loaded cantilever–Oscillation of acantilever-Non-uniform bending – Expression for depression – Uniform bending – Expression for elevation – Experimental determination of Young's modulus using pin and microscope method (Non-uniform bending – Uniform bending) –Determination of Young's modulus by Koenig's method.

UNIT–IIISURFACETENSION:

Definition–Molecular forces–Explanation of surface tension on kinetic theory – Surface energy–Workdone on increasing the area of a surface-Angle of contact - Neumann's triangle - Excess pressure inside a liquid drop and soap bubble –Force between two plates separated by a thin layer of a liquid – Experimental determination of surface tension-Drop-weight method– Capillary rise method-Variation of surface tension with temperature.

UNIT–IVVISCOSITY:

Newton's law of viscous flow – streamlined and turbulent motion – Reynold's number-Poiseuille's formula for the flow of a liquid through a horizontal capillary tube – Experimental determination of co-efficient of a liquid by Poiseuille'smethod-Ostwald'sviscometer–TerminalvelocityandStokes' formula – Viscosity of gases - Meyer's formula - Rankine's method -Variation of viscosity with temperature and pressure – Lubrication – Equation of continuity of flow-Bernoulli's theorem–Filter pump and Wings of an airplane.

UNIT–V ACOUSTICS:

Newton's Formula for the velocity of sound–Musical Sound and Noise–Speech–Characteristics of Musical sound–Intensity of sound– Measurement of intensity of sound – Decibel and Phon-Bel – Reverberation–Sabine's Reverberation formula–Factors affecting the Acoustics of Buildings– Sound distribution in an Auditorium – Requisites for good acoustics – Ultrasonics –Production of ultrasonic waves – Piezoelectric method–Detection of ultrasonic waves - Quartz crystal method – Applications of Ultrasonic waves.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Modulus of toughness and modulus of elasticity for different types of concrete - Elasticity and Seismic waves – Bending beam load cell – Composite beams - Surface tension and wetting behaviour of nanofluids – Viscosity of nanofluids – Acoustics sensors.

REFERENCES:

1. R.Murugeshan, *Properties of Matte*r, S.Chand & Co.Pvt.Ltd., Revisededition,2012.
2. D.S.Mathur*, Elements of Propertie of Matter*, S.Chand&Co.Pvt. Ltd.,Revisededition,2010
3. Brijlal & N.Subramanyam,*Properties of Matter*, Vikas Publishing.Pvt. Ltd, 2005.
4. Brijlal & N.Subramanyam, *A Text Book of Sound*, Vikas Publishing.Pvt. Ltd, 2008.
5. Feynman, *Lectures on Physics*, Vol.I & II by Richard P.Feynman, The New Millennium Edition, 2012.
6. David Halliday and Robert Resnick, *Fundamentals of Physics* by Wiley Plus, 2013.
7. B.H.Flowers and E.Mendoza, *Properties of matter*, WileyPlus, 1991.
8. H.R.Gulati*, Fundamentals of General properties of matter*, S.Chand & Co. Pvt. Ltd, 2012.
9. Chatterjee and Sen Gupta, *Atreatise on general properties of matter*, New central Books agency (p) Ltd, Kolkata, 2001.
10. R.L.Saihgal, *A Text Book of Sound*, S.Chand & Co.Pvt.Ltd, New Delhi, 1979.

COURSE OUTCOME:

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

- Differentiate the moduli of elasticity of different materials
- Analyze the moduli of elasticity of materials made in the form of beams.
- Understand the practical applications of surface tension in real life.
- Acquire the knowledge of the flow of liquids based on the irviscous nature and the variation of viscosity with temperature and pressure
- Understand the various characteristics of sound and their practical implications.

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PROFESSIONAL ETHICS

First Year | **CORE PRACTICAL I** | **Semester I**

PROPERTIES OF MATTER

Code: 22SCCPH1P | **(Practical)** | **Credit: 4**

(ANY EIGHT EXPERIMENTS)

COURSE OBJECTIVES:

- To impart the skill of using measuring instruments
- To motivate the learner to study some properties of materials by determining the elastic constants, surface tension and viscosity through experiments.
- To make the learner to realize the vibrations of stretched strings.

EXPERIMENTS:

1. Measurement of length (or diameter) using Vernier calipers, Screw gauge and travelling microscope.
2. Determination of Young's modulus-Non-uniform bending using pin and microscope.
3. Determination of Young's modulus-Uniform bending using pin and microscope.
4. Determination of Young's modulus - Cantilever depression using scale and telescope.
5. Surface tension and interfacial surface tension–Drop weight method.
6. Surface tension by capillary rise method.
7. Coefficient of viscosity of a liquid-Poiseuille's flow method.
8. The viscosity of highly viscous liquid-Stoke's method.
9. Verification of laws of vibration of a stretched string and determination of the frequency of a tuning fork–Sonometer.
10. Determination of frequency of a tuning fork using Melde's string apparatus.
11. Absolute determination of M and H using deflection and vibration magnetometer.
12. Spectrometer-Determination of refractive index of a solid prism.

REFERENCES:

1. Department of Physics, *Practical Physics*,(B.Sc.PhysicsMain),St. Joseph's College, Tiruchirappalli, 2009.
2. Dr. S. Somasundaram, *Practical Physics*, Apsara Publications, Tiruchirappalli, 2012.
3. C.C.Ouseph, U.J.Rao and V.Vijayendran, *Practical Physics and Electronics*, Viswanathan Printers and Publishers, PVT Ltd, 2014.
4. S.Srinivasan, *A Text Book of Practical Physics*, S.Sultan Chand Publications, 2005

5. R.Sasikumar, *Practical Physics*, PHI Learning Pvt. Ltd, New Del, 2011.

COURSE OUTCOMES:

Upon completion of this course, the student would be able to

- Use the measuring instruments for accurate measurement of physical quantities required for the experiment.
- Know the elastic properties of structural materials from the experimental results.
- Realize practically the properties of liquids such as surface tension and viscosity.
- Acquire the experimental skill of verifying laws in Physics.
- Understand experimentally the vibrations of stretched strings.

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PROFESSIONAL ETHICS

First Year **CORE COURSE II** **Semester II**

MECHANICS AND THEORY OF RELATIVITY

Code: 22SCCPH 2 **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To provide a better insight into the change of position of any physical object or event and their consequences.
- To inculcate the Newton's law of gravitation and Kepler's laws of planetary motion and their implications
- To impart the knowledge of theory of relativity and its applications.

UNIT–I PROJECTILE, IMPULSE AND IMPACT:

Projectile – Particle projected in any direction – Path of a projectile is a parabola - Range of a projectile on plane inclined to the horizontal- Maximum range on the inclined plane- Impulse of a force - Laws of impact - Direct impact between two smooth spheres - oblique impact between two smooth spheres -Loss of KE due to direct impact – Oblique impact.

UNIT–II MOTION ON A PLANE CURVE:

Centripetal and centrifugal forces - Hodograph - Expression for normal acceleration - Motion of a cyclist along a curved path – Motion of a railway carriage round a curved track-Motion of a carriage on a banked – up curve – Effect of earth's rotation on the value of the acceleration due to gravity - Variation of 'g' with altitude, latitude and depth.

UNIT–III GRAVITATION:

Newton's law of gravitation - Mass and density of earth - Inertial and Gravitation mass - Determination of G-Boy's experiment -Kepler's Laws of planetary motion -Deduction of Newton's law of gravitation from Kepler's Law - Gravitation - Field - potential -Intensity of Gravitational field - gravitational potential due to a point mass - Equipotential surface - Gravitational potential and field due to a spherical shell and solid sphere.

UNIT–IV DYNAMICS OF RIGID BODY AND CENTRE OF GRAVITY:

Moment of Inertia-Kinetic energy and angular momentum of rotating body-Perpendicular and parallel axes theorems-Acceleration of a body rolling down on inclined plane without slipping-Compound pendulum –Centre of suspension and centre of oscillation-Minimum period of a compound pendulum.-Centre of gravity of a body-C.G. of a solid hemisphere-C.G. of a solid cone – Centre of pressure – Centre of pressure of a triangular lamina immersed in a liquid.

UNIT–V THEORY OF RELATIVITY:

Galilean – Newtonian relativity - Galilean transformations – Michelson Morley experiment and its importance –Basic ideas of general theory of relativity - Lorentz transformations and its interpretation – consequence of Lorentz transformation – Length contraction, time dilation – relativistic addition of velocities – Mass energy equivalence.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Applied mechanics and growing utilization of theoretical mechanics - Structural Engineering– Hydraulics - External fluid dynamics.

REFERENCES:

1. M.Narayanamurthi and N.Nagarathinam, *Dynamics*, The National Publishing Company 2005, Chennai.
2. M.Narayanamurthi and N.Nagarathinam, *Statics, Hydrostatics and Hydrodynamics*- The National Publishing Company 2005, Chennai.
3. R.Murugesan and Kiruthiga Sivaprasath-*Modernphysics*, 18th Revised edition November -2017, S.Chand & Company Ltd., New Delhi.
4. D.S. Mathur,*Mechanics*, S.Chand&CompanyLtd.,NewDelhi, 2007.
5. Venkataraman, MK, *Dynamics*, Trichy: Agasthiar Book Deport, 2011
6. R.Murugesan, *Mechanics and Mathematical Physics*, S.Chand & Company Ltd., New Delhi, 2008.
7. I.H.Shames, *Introduction to Solid Mechanics,* 2009.
8. David Tong, *Dynamics and Relativity*, University of Cambridge, 2012.
9. M. Ray and G. C. Sharma, *A text book of Dynamics*, Chand& Company Ltd.,New Delhi. 13th revised edition, 2005.
10. D.RajanBabu, E.James Je baseel an Samuel,P.Ramesh Babu,V.Ramasubramanian and C.AnuRadha, *Modern Physics*, Anuradha Publisher,2010.
11. P. Duraipandian, LaxmiDurai Pandiyan and Muthamizh Jayapragasam, *Mechanics* Chand& Company Ltd.,N ew Delhi. 2000.
12. Agarwal, JP, *Elements of Mechanics*, India: Pragati Prakashan, 2010.
13. Knight W D, Ruderman M A, Helmholz A C and Moyer BJ**,***Mechanics*, Berkeley Physics Course: Volume 1, 2nd Edition (2011)
14. Kleppner D and Kolenkow R J**,** *An Introduction To Mechanics* (Special Indian Edition) (2007).
15. *University Physics*.F.W.Sears, M.W. Zemansky and H.D.Young, 13/e,1986. Addison-Wesley.
16. https://www.mooc-list.com/tags/gravitation
17. https://archive.org/details/NPTEL-Physics
18. https://www.academia.edu/8233163/Basics_of_Mechanics_notes

COURSE OUTCOMES:

Upon completion of this course, the students would be able to

- Use the principles of projectiles to explain the manner in which gravity affects a projectile motion.
- Gain a deeper knowledge of mechanics and its fundamental concepts.
- Acquire the knowledge of gravitational force between objects and the centre of mass of objects.
- Learn rigid body dynamics interms of moment of inertia and also analyze the center of gravity of different bodies.
- Analyze the special theory of relativity and its applications.

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PROFESSIONAL ETHICS

First Year | **CORE PRACTICAL II GENERAL PHYSICSI** | **Semester II**

Code: 22SCCPH2P | **(Practical)** | **Credit: 4**

(ANY EIGHT EXPERIMENTS)

COURSE OBJECTIVES:

- To enhance the experimental skills of students.
- To develop the knowledge of laws and theorems in Physics through experimental study.
- To make the students realize the optical properties of certain materials by doing experiments.

EXPERIMENTS:

1. Determination of Young's modulus – Uniform bending by Koenig'smethod.
2. Determination of Rigidity modulus - Static Torsion method.
3. Determination of Rigidity modulus and moment of inertia using Torsional pendulum.
4. Sonometer-AC frequency.
5. Determination of 'g' and 'k' using a compound pendulum.
6. The figure of merit of a mirror Galvanometer.
7. Concave lens – Determination of focal length.
8. Determination of focal length, radius of curvature and refractive index of along focus convex lens.
9. Airwedge-Determination of thickness of a thin wire.
10. Spectrometer– Determination of Refractive index of a hollow prism
11. Spectrometer–Determination of Refractive index of a liquid using a prism.
12. Spectrometer–Small-angle prism.

REFERENCES:

1. Department of Physics, *Practical Physics*, (B.Sc. Physics Main), St. Joseph's College, Tiruchirappalli, 2009.
2. Dr.S.Somasundaram, *Practical Physics*, Apsara Publications, Tiruchirappalli, 2012.
3. C.C.Ouseph, U.J.Rao and V.Vijayendran, *Practical Physics and Electronics*, Viswanathan Printers and Publishers, PVT Ltd(www.svprinters.com),Chetpet,Chennai–2014.
4. S.Srinivasan, *A Text Book of Practical Physics*, S.Sultan Chand Publications. 2005.
5. R.Sasikumar, *Practical Physics*, PHI Learning Pvt. Ltd, NewDelhi, 2011.

COURSE OUTCOME:

Upon completion of this course, the students would be able to

- Knowthetechniquesofhandlinglaboratoryinstruments.
- Evaluateaprocessbasedontheresultsobtainedfromtheexperimentsquantitatively and qualitatively.
- Usetheresultsofanexperimenttodescribeaphenomenon.
- Developthe capacity of experimenting collaborativelyand ethically.
- Acquiretheskillofanalyzingthepropertiesofmaterials.

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Second Year | **CORE COURSE III** | **Semester III**

THERMAL PHYSICS

Code: 22SCCPH3 | **(Theory)** | **Credit: 5**

COURSE OBJECTIVES:

- To make the students understand the Quantum theory of specific heat capacities of solids
- To impart the knowledge of changes of entropy in different process
- To make the learners evaluate the thermal conductivities of good and bad conductors
- To make the students to know the different sources of energy
- To provide knowledge so that the students can apply the principle of Refrigerating mechanism

UNIT–I THERMODYNAMICS:

Laws of Thermodynamics: Zeroth law - First law – Second law of Thermodynamics - Heat engines-Isothermal and adiabatic processes-Reversible and irreversible processes- Carnot's theorem - Proof - Internal combustion engine (diesel engine).Entropy: Change of entropy in adiabatic process - Change of entropy in reversible and irreversible process - T-S diagram – Thermodynamic scale of temperature –Thermodynamic potentials - Maxwell's thermo dynamical relations.

UNIT–II CONDUCTION:

Conduction: Coefficient of thermal conductivity –Rectilinear Flow of Heat along a Bar - Thermal conductivity of good conductors: Forbe's method -Thermal conductivity of a bad conductor: Lee's disc method –Heat flow through a Compound Wall – Accretion of Ice on Ponds – Wiedemann- Franz law- Practical Applications of Conduction of Heat.

UNIT–III RADIATION:

Stefan's law – Stefan- Boltzmann law- Deduction of Newton's law of Cooling from Stefan'slaw-Determination of Stefan's constant (laboratory method) –Black Body Radiation – Wien's Displacementlaw-Rayleigh–Jeanslaw-Planck's Law-Solar constant–Surface Temperature of the Sun – Angstrom's Pyrheliometer – Sources of Solar Energy- Photovoltaic cell – Green House Effect.

UNIT–IV LOW TEMPERATUREPHYSICS:

Joule - Kelvin effect - Temperature of inversion - Porous plug experiment - Liquefaction of gases -Principle of regenerative cooling -Linde's process - Liquefaction of Hydrogen -Adiabatic demagnetization - Liquefaction of Helium – Practical Applications of Low Temperature-Refrigerating mechanism–Air Conditioning mechanism-Solid Carbon dioxide (Dry Ice).

UNIT–V SPECIFIC HEAT CAPACITY:

Specific heat capacity of solids–Regnault's method of mixtures-Radiation correction-Dulongand Petit'slaw–Einstein's theory-Specific heat of liquids–Newton's law of cooling

–Specific heat of gases–Mayer's Relation–Quantization of various contributions to energy of diatomic molecules – Specific heat of diatomic gases.

UNIT–VI CURRENT CONTOURS (For Continuous internal assessment only):

Waste thermal Energy – Waste Heat Recovery – Thermal Energy Storage – Thermal Storage materials – Phase change Materials – Thermal Energy Storage Applications: Waste heat to Electricity and Solar Thermal Energy

REFERENCES:

1. Brij Lal, Dr. N. Subrahmaniyam and P.S. Hemine,*Heat, Thermodynamics and Statistical Physics* - S.Chand& Co., New Delhi. 2015.
2. J.B.Rajamand C.L.Arora, *Heat and Thermodynamics*- S.Chand & Co.,NewDelhi, 1983.
3. R.Murugesan, *Thermal Physics*-1stEdition2002.
4. D.S.Mathur, *Heat and Thermodynamics*-S.Chand&Co.,2014.
5. Agarwal, Singhal,Sathyaprakash, *Heat and thermodynamics*.
6. H.C.Saxena and Agarwal, *Thermalphysics*.
7. M. Narayanamoorthy and N. Nagarathinam,*Heat*, National Publishing Co, Chennai, 8thedition, 1987
8. K.Pathak and Poppy Hazarika, *Thermal Physics,*VishalInt.Ltd., 2020.
9. A.B Gupta And H.P.Roy, *Thermal Physics 5th Edition,Books & Allied PLtd*2020
10. Dr. Utpal Jyoti Mahanta, Junmi Gogoi, et al., *Basic Thermal Physics,* Mahaveer Publications, 2020.
11. https://doi.org/10.1016/j.aej.2021.11.003
12. https://web.mit.edu
13. http://www.thermalfluidscentral.org/
14. https://www.grc.nasa.gov
15. https://peer.asee.org

COURSE OUTCOMES:

Upon successful completion of this course, the students would be able to:

- Recall the different specific heat capacities of matters.
- Understand the Maxwell's thermodynamic relations to relate the fundamental and derived quantities.
- Apply the knowledge of conduction of heat in practical applications.
- Use Stefan's constant to evaluate temperature of sun at a particular place.
- Analyze the different principles used in liquefaction of gases

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Second Year | **CORE PRACTICAL III** | **Semester III**

GENERAL PHYSICS II

Code: 22SCCPH3P | **(Practical)** | **Credit: 4**

(ANY EIGHT EXPERIMENTS)

Objective:

To develop the skill of using laboratory instruments to determine some physical quantities required for the understanding of the logics and principles in physics.

Experiment

1. Specific heat capacity of a liquid-Newton's Law of cooling.
2. The emissive power of a surface - Spherical Calorimeter.
3. Joule's calorimeter-Specific heat capacity of a liquid.
4. Thermal conductivity of a bad conductor–Lee's disc method.
5. Spectrometer-i-dcurve.
6. Spectrometer–i-i'curve
7. Spectrometer–Cauchy's constants.
8. Spectrometer–Grating–Normal incidence method.
9. P.Obox–Determination of temperature coefficient of a coil.
10. Potentiometer–Calibration of an Ammeter.
11. Potentiometer–Temperature co-coefficient of a thermistors
12. Characteristics of a Junction diode and a Zener diode.

REFERENCES:

1. Department of Physics, *Practical Physics*, (B.Sc. Physics Main), St. Joseph's College, Tiruchirapalli 2009
2. Dr. S .Somasundaram, *Practical Physics*, Apsara publications, Tiruchirapalli, 2012.
3. C.C. Ouseph, U.J.Rao and V. Vijayendran, *Practical Physics and Electronics*, Viswanathan Printers and Publishers, PVT Ltd(www.svprinters.com), Chetpet,Chennai.- 2014
4. S. Srinivasan, *A Text Book of Practical Physics*, S. Sultan Chand publications. 2005
5. R. Sasikumar, *Practical Physics*, PHI Learning Pvt.Ltd, NewDelhi,2011.

COURSE OUTCOME:

On completion of the course the learner will be able to:

- Realize practically some phenomena of Physics.
- Acquire the skill of handling instruments.
- Develop the observation and circuit drawing skills.
- Enhance the skill of performing process-oriented experiments.
- Verify the laws in Physics through experimental results.

Environment & Sustainability

Second Year | **NON-MAJOR ELECTIVE I** | **Semester III**

Code: | **DIGITAL ELECTRONICS (Theory)** | **Credit: 2**

Course Objectives:

- To understand the basics of Digital Electronics.
- To Study various logical circuits and their implementation.
- To acquire knowledge on various digital circuits like Adder, Subtractor, Multiplexer, Demultiplexer, Decoder and Encoder.

UNIT–1 NUMBER SYSTEM AND BINARY CODES:

Number System:Binary–octal-decimal-hexadecimal number system – conversion-Binary addition and subtraction-Binary Codes: BCD-Excess3–ASCII.

UNIT–II LOGIC GATES:

Basic logic gates–AND-OR–NOT–NAND-NOR-EX-OR gates-Boolean equations- NAND - NOR as Universal Building blocks.

UNIT-III BOOLEAN THEOREMS:

Laws of Boolean algebra-De-Morgan's theorem-Minterm-Maxterm–POS–SOP -K Map-Simplification by Boolean theorems-Don't care condition.

UNIT–IV COMBINATIONAL LOGIC CIRCUITS:

Combinational Circuits and its implementations - Arithmetic Circuits - Adders and Subtractors-BCD Adder - Multiplexer-De multiplexers-Encoders and Decoders.

UNIT-V SEQUENTIAL LOGIC CIRCUITS:

R-S and D Flip-flop -J-K and T Flip-flop - Ripple Counter - UP/Down Counters - Shift Register-Serial in serial out - Parallel in Parallel out.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Memory Devices

Anatomy of Computer-A computer Systems-Computer Memory –RAM and ROM-Expanding Memory Capacity.

REFERENCES:

1. Anil K.Maini,"Digital Electronics: Principles, Devices and Applications" Wiley-India Pvt. Ltd, 1st Edition, 2008
2. David J.Comer "Digital Logic & State Machine Design", 3rd Indian Edition, Oxford University Press.
3. M Morris Mano, *Digital Logic and ComputerDesign*, 4th Edition, 2009,
4. Pearson, LPE, R.P.Jain, *Modern Digital Electronics*, Mc Graw-Hill, 4th ed.2010.
5. Malvino & Leach *Digital Principles and Applications*, 7thEdition, McGraw- Hill Education
6. https://www.classcentral.com/course/youtube-digital-electronics-48205
7. https://www.youtube.com/watch?v=DBTna2ydmC0
8. https://nptel.ac.in/courses/108105132

COURSE OUTCOME:

Upon completion of this course, the student would be able to

- Perform conversion between various number systems.
- Apply knowledge of Boolean algebra and other minimization techniques for digital circuit design.
- Identify, formulate and solve a problem based on combinational circuits
- Select the appropriate hardware and software tools for combinational circuit design.
- Verify the functions of various digital integrated circuits.
- Evaluate the specifications of logic families.
- Create a course project using digital integrated circuits.

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Second Year **CORE COURSE IV** **Semester IV**

ELECTRICITY AND MAGNETISM

Code: 22SCCPH4 **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To study the fundamental ideas on electrostatics and current electricity
- To classify materials based on their magnetic properties
- To understand the concept of resonance circuits

UNIT–I ELECTROSTATICS:

Coulomb's Law – Gauss's Law and its applications (Electric Field due to a uniformly charged sphere, hollow cylinder& solid cylinder)– Electric Potential – Potential at a point due to a uniformly charged conducting sphere – Principle of a capacitor– Capacity of a spherical and cylindrical capacitors – Energy stored in a charged capacitor–Loss of energy on sharing of charges between two capacitors.

UNIT–II CURRENT ELECTRICITY:

Ampere's circuital law and its applications – Field along the axis of a circular coil and Solenoid– Theory of Ballistic Galvanometer – Figure of merit – Damping Correction – Kirchhoff's Laws of Electricity – Wheatstone's bridge – Carey Foster's Bridge–Potentiometer–Calibration of Ammeter– Calibration of Voltmeter (Low range and High range)–Comparison of Resistances.

UNIT–III ELECTROMAGNETIC INDUCTION:

Laws of electromagnetic induction–Self and mutual induction–Self-inductance of a solenoid– Mutual inductance of a pair of solenoids–Coefficient of coupling–Experimental determination of self (Rayleigh's method) and mutual inductance– Growth and decay of current in a circuit containing L and R–Growth and decay of charge in a circuit containing C and R– Measurement of High resistance by leakage.

UNIT–IV AC CIRCUITS:

Alternating EMF applied to series circuits containing LC, LR and CR–Alternating EMF applied to circuits containing L,C and R – Series and Parallel resonance circuits–Sharpness of resonance – Q factor – Comparison between Series and Parallel resonant circuits –Power in AC circuits (R,L-R,L-C-Ronly) – Powerfactor – Wattless current–Choke Coil–Transformer – Uses of Transformers – Skin Effect.

UNIT–V MAGNETIC PROPERTIES OF MATERIALS:

Magnetic field – Magnetic induction – Intensity of Magnetization – Magnetic permeability – Susceptibility – Properties of para, dia, and ferromagnetic materials – Curie point - Curie temperature - Hysteresis – Retentivity – Coercivity – Experiment to draw B-H curve by magnetometer method – Loss of energy per cycle.

UNIT–VI Current contours (For continuous internal assessment only):

Maxwell's Equations, electromagnetic waves, reflection and refraction, wave guides, retarded potential, antennas, relativistic electrodynamics, four vectors, Lorentz, and transformation of fields.

REFERENCES:

1. BrijLal and N.Subrahmanyam, *A Text Book of Electricity and Magnetism*, S.Chand & Company Pvt. Ltd, New Deihi-2020.
2. R. Murugeshan, *Electricity and Magnetism*, S. Chand& Company Pvt. Ltd., New Delhi – 2017.
3. M.Narayanamurthy & N.Nagarathnam, *Electricity & Magnetism*, NPC pub., Revised edition-1992.
4. D.L.Sehgal, K.L.Chopra and N.K.Sehgal, *Electricity and Magnetism*, Sultan Chand& Sons. New Delhi-2020.
5. D.N.Vasudeva, *Electricity and Magnetism*, S.Chand & Co-2011
6. K.K.Tewari, *Electricity and Magnetism*, S.Chand & Co -2002.
7. E.M.Pourcel, *Electricity and Magnetism* – Berkley Physics Course, Vol.2, Mc Graw Hill Education; 2nd edition -2017.
8. D.C.Tayal, *Electricity and Magnetism*, Himalaya Publishing Co., Fourth Edition-2019.
9. D.Halliday, R.Resnick and J.Walker, *Fundamentals of Physics–Electricity and Magnetism*, iley India, Pvt Ltd -2011
10. David Griffith, *Introduction to Electrodynamics*, Pearson Education India Learning Private Limited; 4th edition- 2012.
11. R.B.Singh, *Fundamentals of Electricity and Magnetism,* New Age International (P) Ltd., Publishers-2018
12. Basudev Ghosh, *Foundations of Electricity and Magnetism,* Books & Allied., Publishers - 2021
13. Edward M.Purcell and Edward M.Purcell, *Electricity and Magnetism,* University printing house Cambridge- 2013
14. https://nptel.ac.in/courses/115104088
15. https://www.uou.ac.in/sites/default/files/slm/BSCPH-102.pdf

COURSE OUTCOMES:

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

- Understand fundamental laws of electricity and magnetism
- Analyze the calibration of electrical instruments.
- Verify the laws of electromagnetic induction
- Apply the knowledge of electricity and magnetism towards technological applications
- Differentiate magnetic materials

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Second Year | **CORE PRACTICAL IV ELECTRICITY** | **Semester IV**

Code: 22SCCPH4P | **(Practical)** | **Credit: 4**

(ANY EIGHT EXPERIMENTS)

Course Objectives:

To provide the knowledge on utilization of electrical devices to determine some electrical parameters by executing experiments.

EXPERIMENTS:

1. Meterbridge – Determination of specific resistance of a coil.
2. Determination of specific resistance – Carey Foster's Bridge.
3. Potentiometer – Calibration of low range voltmeter.
4. Potentiometer – Determination of resistance of a coil.
5. Potentiometer – emf of a thermocouple
6. Potentiometer – Calibration of high range voltmeter.
7. Anderson's Bridge – Self - inductance of a coil.
8. Field along the axis of a coil – Determination of moment.
9. B.G – Figure of merit.
10. B.G–Determination of mutual inductance.
11. Series resonance circuit.
12. Parallel resonance circuit.

REFERENCES:

1. Department of Physics, *Practical Physics*, (B.Sc. Physics Main), St. Joseph's College, Tiruchirapalli 2009
2. Dr.S.Somasundaram, *Practical Physics*, Apsara Publications, Tiruchirapalli,2012.
3. C.C.Ouseph, U.J.Rao and V.Vijayendran, *Practical Physics and Electronics*, Viswanathan Printers and Publishers, PVT Ltd (www.svprinters.com), Chetpet, Chennai- 2014
4. S. Srinivasan,*A Text Book of Practical Physics*, S. Sultan Chand publications. 2005
5. R.Sasikumar, *Practical Physics*, PHI Learning Pvt. Ltd, New Delhi, 2011.

COURSE OUTCOME:

On completion of the course the learner will be able to

- Analyze the electrical parameters of some electrical components.
- Carry out electrical experiments with better understanding.
- Develop observation and circuit drawing skills.
- Enhance the skills of trouble shooting electrical circuits.
- Calibrate some electrical instruments

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Environment & Sustainability

Second Year | **NON-MAJOR ELECTIVE II** | **Semester IV**
Code | **MEDICAL PHYSICS (Theory)** | **Credit: 2**

Course Objectives:

- To familiarize students with basic principles of radiation physics and also X-ray Generators, Particle Accelerators used in radiotherapy.
- Understand the basic physics of the electromagnetic and particulate forms of ionizing & non ionizing radiation and understand the interaction of photons.
- Understand the distinctions between the units of radiation quantity, exposure and dose.

UNIT–1 NON-IONIZING RADIATION:

Electromagnetic spectrum - Different sources of Non Ionizing radiation, Radio-frequency, Microwaves, Infrared, Visible and Ultra violet radiation production, physical properties and their interaction with tissues.

UNIT–II IONIZING RADIATION:

Radiation sources- Exposure to ionizing radiation- Health effects of ionizing radiation- Interaction of electromagnetic radiation with matter - Photoelectric and Compton process and energy absorption - Pair production - Attenuation and mass energy absorption coefficients.

UNIT–III RADIATION QUANTITIES AND UNITS:

Particle flux and fluence - energy flux and fluence - Linear and mass attenuation coefficients - Mass energy transfer and mass energy absorption coefficients -Stopping power - LET Absorbed dose - Kerma – Exposure.

UNIT–IV MEDICAL PHYSICS IN DIAGNOSTIC RADIOLOGY:

Discovery - Production - Properties of X-rays -– characteristics of X-ray – different modalities of X- ray – fluoroscopy – mammography –C arm – Digital radiography – Computed tomography (CT) – different generation of CT -Nuclear Medicine.

UNIT–V MEDICAL PHYSICS IN RADIO THERAPY APPLICATIONS:

Construction and working of Tele-cobalt units - The Resonant transformer - Cascade generator - Van De Graff Generator - Pelletron - Cyclotron - Betatron - Synchro-Cyclotron - Design and working of Linear Accelerator

Unit–VI Current Contours (For continuous internal assessment only):

Positron emission to mography(PET)–Single photon emission to mography(SPECT)-Electron Synchrotron-Proton synchrotron.

REFERENCES:

1. K.Thayalan, Basic Radiological Physics ***(2nd Ed)***, Jaypee Brothers Medical Publishers, New Delhi, (2017).
2. Faiz M.Khan & John P.Gibbons, *The Physics of Radiation Therapy* ***(4th Ed)***, Lippincott Williams & Wikins, Philadelphia, (2010).
3. E.B.Podgorsak, *Radiation Oncology Physics: A Hand book for Teachers and Students*, INTERNATIONAL ATOMIC ENERGYAGENCY VIENNA, (2005).
4. W.R.Hendee, *Medical Radiation Physics*, Year Book Medical Publishers Inc., London, (2003).
5. Martin Hollins, *Medical Physics,* Nelson Thornes Ltd,1991
6. Dinesh K Baghel, *Medical Physics, Peepee Publishers, 2017*
7. Stephen Keevil, Renato Padovani, SlavikTabakov, Tony Greener, Cornelius Lewis, *An Introduction to Medical Physics,* CRC Press, 2022
8. B.H Brown, R.H Small wood, D.C.Barber, P.V Law ford, D.RHose, Medical Physics and Biomedical Engineering, CRC Press, 1999.
9. J.R.Cameron, J.G.Skofronick, *Medical Physics,* John Wiley & Sons, 1980.
10. https://www.youtube.com/watch?v=p2rx8Qpw49w
11. https://www.aapm.org/meetings/2010AM/documents/biggs2.pdf
12. http://www-naweb.iaea.org/nahu/DMRP/documents/Chapter5.pdf

COURSE OUTCOMES:

Upon completion of this course, the students would be able to

- Gained knowledge about basic principle of medical physics.
- Understood the basic principles of Ionizing and non-ionizing radiations.
- Learnt the units of radiation.
- Understood the production and working principles of X-ray Generators.
- Learnt the theory of Interactions of photons with matter.

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Third Year **CORE COURSE V** **Semester V**

OPTICS

Code: 22SCCPH5 **(Theory)** **Credit: 5**

COUSE OBJECTIVES:

- To impart knowledge of geometrical optics
- To inculcate the fundamental laws concerning interference, diffraction, polarization and allied phenomena.
- To make the students gain knowledge of basic optical instrumentation

UNIT-I GEOMETRICAL OPTICS:

Spherical aberration - Spherical aberration of a thin and thick lens – Methods of reducing Spherical aberration–Skew rays-Coma–Aplanatic surface–Astigmatism – Curvature of the field – Meniscus lens – Distortion – Chromatic aberration - Chromatic aberration in a lens – Circle of least Chromatic aberration – Achromatic lenses – Computerized lens

UNIT-II INTERFERENCE:

Air wedge – Newton's rings – Haidinger's fringes – Brewster's fringes – Michelson Interferometer and its applications – Fabry-Perot Interferometer–Interference filter – Stationary waves in light – Colour photography (qualitatively) – Holography – Construction and reconstruction of a hologram – Applications.

UNIT-III DIFFRACTION:

Fresnel's diffraction – Diffraction at a (1) circular aperture (2) Straight edge (3) narrow wire – Fraunhofer diffraction at a single slit – Double slit – Missing orders in a Double slit, Diffraction pattern – Grating (theory) – Oblique incidence – Overlapping of spectral lines - Resolving power – Rayleigh's criterion of resolution-Resolving power of a Telescope and Grating – Dispersive power and resolving power of a grating.

UNIT-IV POLARIZATION:

Polarization - Nicol prism – Nicol prism as an analyzer and polarizer – Huygens's explanation of Double refraction in uniaxial crystals – Double Image polarizing prisms– Elliptical and Circularly polarized light – Production and detection– Quarter wave and half wave plates – Babinets compensator – Optical activity – Fresnel's explanation of optical activity – Specific rotation - Laurent's Half shade polarimeter.

UNIT-V OPTICAL INSTRUMENTS AND FIBRE OPTICS:

Microscopes -Simple microscope (magnifying glass) – Eyepieces- Huygens's eyepiece– Ramsden's eyepiece – Telescope.Optical Fibre–Advantages of optical fibre over copper wires-Total internal reflection – propagation of light through an optical fibre-Acceptance angle – Numerical aperture – Types of Optical Fibres based on materials, refractive index and modes of propagation – Fibre optic communication system.

UNIT-VI CURRENT CONTOURS (For continuous internal assessment only):

Fibre optic sensors - Temperature sensors: Intensity modulated sensor, Phase modulated sensor - Displacement sensor – Force sensor –Liquid level detector.

REFERENCES:

1. N. Subrahmanyam Brijlal, M N Avadhanulu, *Optics*, S. Chand Publishing. Pvt. Ltd. NewDelhi, 25th revised edition, 2013.
2. Manna Anandamoy Ghosh Krishnapada,*Text book of Physical Optics*, Mc Millan India Ltd, First edition, 2007.
3. Kiruthiga Sivaprasath, R. Murugeshan, *Optics and Spectroscopy*, S. Chand & Co, 5thedition, 201
4. Singh & Agarwal, *Optics and Atomic Physics*, Pragati Prakashan Meerut, Nineth edition, 2002.
5. A.B.Gupta, *Modern Optics*, Books and Allied (P) Ltd, Kolkata, 5th edition, 2021.
6. Ajoy Ghatak, *Optics*, Mc Graw Hill, NewDelhi, 7thedition, 2020.
7. Arial Lipson, Stephen G.Lipson and Hentry Lipson, *Optical Physics*, Cambridge University Press, 4thedition, 2011.
8. Hect Eugene, Schaum's Outlines, *Optics*, Tata Mc Graw Hill, 2011.
9. R.S.Longhurst, *Geometrical and Physical Optics*, Longman Group Ltd, UK, Third edition,1999

COURSE OUTCOMES:

Upon completion of this course, the students would be able to

- Understand the geometrical optics
- Get the knowledge about interference and holography
- Acquire the theoretical aspects of diffraction and familiarize grating
- Grasp the fundamentals of polarization and its classification
- Understand the working principles of optical instruments like microscopes, telescopes and refract meters, etc.

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Third Year **CORE COURSE VI** **Semester V**

ATOMIC AND MOLECULAR PHYSICS

Code: 22SCCPH6 **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To familiarize the constituents of the atom, atomic models, the impact of magnetic and electric fields on spectra.
- To provide the necessary knowledge of the concepts of photo electric cells.
- To provide the knowledge of molecular spectra and molecular orbital theories

UNIT–I CATHODE AND POSITIVE RAY–ANALYSIS:

Production and Properties of Cathode rays -Electroniccharge-Millikan 'soil-drop method - Production and properties of positive rays - Thomson's parabola method-Aston's, Dempster's and Bain bridge mass spectrographs(e/m)–Mass defect and Packing Fraction.

UNIT–II Atom Model:

Introduction – Vector atom model-Quantum numbers - Pauli's exclusion principle - Magnetic dipole moment due to orbital motion and spin of the electron –The Stern and Gerlach experiment – Zeeman effect – Experimental arrangement for the normal Zeeman effect - Larmor's theorem – Quantum mechanical explanation of the normal Zeeman effect – Anomalous Zeeman effect – Paschen Back Effect –Stark effect.

UNIT–III FREE ELECTRON THEORY OF METALS AND PHOTO ELECTRIC EFFECT:

Free electron theory of metals - Properties of metals -Drude and Lorentz theory – Electrical and thermal conductivities – Wiedemann and Franz law– Photo electric effect- Lenard's experiment-Richardson and Compton experiment – Experimental investigatios on the photoelectric effect - Laws of photoelectric emission-Einstein's photo electric equation – Experimental verification- Millikan'sexperiment–Photo electric cells–Photo emissive cell–Photovoltaic cell – Photoconductive cell-Applications of Photoelectric cells.

UNIT–IV MOLECULAR PHYSICS:

Molecular spectra – Theory of the pure rotational spectrum of a molecule- Theory of the origin of vibration – rotation spectrum of a molecule – Electronic spectra of molecules – Molecular orbital theory of Hydrogen molecule ion – Heitler-London theory of Hydrogen molecule.

UNIT–V MOLECULAR ORBITALS:

Molecular Orbitals – Introduction – Linear Combination of Atomic Orbitals (LCAO) – Proper overlap between atomic orbitals – Molecular Orbital Theory – Introduction –Postulates – Types of molecular orbitals – Formation of molecular orbitals – Characterization of molecular orbitals – Features of molecular orbitals.

UNIT–VI CURRENT CONTOURS (For internal continuous assessment only):

Cold Atoms – Cold Molecules – Quantum Optics – Ultra fast Phenomena – Quantum Simulation– Atomic interferometer and its applications – Molecular aspects of Cold Chemistry.

REFERENCES:

1. R.Murugesan, Kiruthiga Sivaprasath, *Modern Physics*, S.Chand & Co Ltd., New Delhi,14threvised edition, 2016.
2. J.B.Rajam, *Atomic Physics*, S.Chand & Co Ltd., New Delhi, Revised edition, 2009.
3. S.N.Ghoshal, *Atomic Physics*, S.Chand & Co Ltd., New Delhi, Revised Edition, 2010.
4. N. Subrahmanyam, BrijLal, Jivan Seshan, Atomic and Nuclear Physics, S.ChandPublishing, 2008.
5. Puri, Sharma, Pathania, *Principles of Physical Chemistry*, Vishal Publications, 47 Edition, 2021.
6. Sehgal, Chopra and Sehgal, *Modern physics*, Sultan Chand & Sons, New Delhi, 2004.
7. Arthur Beiser, Shobhit Mahajan, S.Rai Choudhury, *Concepts of Modern Physics*, Sixth edition, SIE, 2009.
8. Robert L Brooks, *The Fundamentals of Atomic and Molecular Physics*, Springer, New York, 2014.
9. Dr. P.S Tambade, Dr. S.D. Aghav, Dr. G.R. Pansare, B.M. Laware, V.K.Dhas, Dr. B.G. Wagh, *Atomic and Molecular Physics*, Nirali Prakashan, Pune, India,2018.
10. Christopher J.Foot, *Atomic Physics,* Oxford University Press, New York, 2005.
11. Peter W. Atkins, Ronald S. Friedman, Molecular Quantum Mechanics, Oxford University Press, Oxford, 2011.
12. https://www.pdfdrive.com/atomic-
13. https://content.kopykitab.com
14. https://collegedunia.com
15. http://chem.libretexts.org

COURSE OUTCOMES:

Upon completion of this course, the student would be able to:

- Learn about the elements that made up an atom.
- Acquire the knowledge of underpinning atomic models and the impact of magnetic and electric fields on spectra.
- Communicate the concept of photoelectric cells.
- Enhance the knowledge of molecular spectra
- Provide a detailed study of molecular orbital theories.

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Third Year | **CORE COURSE VII ELECTRONICS** | **Semester V**

Code: 22SCCPH7 | **(Theory)** | **Credit: 5**

COURSE OBJECTIVES:

- To provide the knowledge of intrinsic, extrinsic semiconductors and transistor circuit configuration
- To inculcate the digital electronic concepts required to analyse and design digital electronic circuits and systems.
- To impart knowledge of various number systems, data representation, logical circuits and their implementation, combinational, sequential digital systems and operational amplifiers.

UNIT–I SEMICONDUCTOR DIODES AND BIPOLART RANSISTORS:

Intrinsic and extrinsic semiconductors –PN junction diode – Biasing–V-I Characteristics– Rectifiers – Half wave – full wave and Bridge rectifiers – Break down mechanisms – Zener diode- Characteristics of Zener diode – Zener diode as voltage regulator-Bipolar junction transistor–Basic configurations – Relation between α and β – Characteristics of a transistor – CB and CE configuration.

UNIT–II AMPLIFIERS AND OSCILLATORS:

Single stage CE amplifier – Analysis of hybrid equivalent circuit – Power amplifiers –Efficiency of class A,B& C Power amplifier - General theory of feedback – Properties of negative feedback – Criterion for oscillations – Hartley oscillator – Colpitt's oscillator.

UNIT–III NUMBER SYSTEMS, LOGIC GATES AND BOOLEAN ALGEBRA:

Number Systems: Introduction to decimal, binary, octal, hexadecimal number systems– Inter conversions– 1's and 2's complements. Logic Gates: Symbols and their truth tables – AND, OR, NOT, NAND, NOR, XOR, and XNOR – Universality of NAND and NOR gates. Boolean Algebra: De-Morgan's theorems – Reducing Boolean expressions using Boolean laws – SOP forms of expressions (minterms) – Karnaugh map simplification (Four variables).

UNIT–IV COMBINATIONAL AND SEQUENTIAL DIGITAL SYSTEMS:

Combinational Digital Systems – Half and full adders – Half and full subtractors – Decoder (2:4 line) – Encoder (4:2 line) – Multiplexer (4:1 line) – Demultiplexer (1:4 line) – Sequential Digital Systems Flipflop – RS – clocked RS – T and D flipflops – JK and master slave flip flops – Counters – Four bit asynchronous ripple counter – Mod-10 counter – Shift registers–SISO and SIPO shift registers.

UNIT–V OPERATIONAL AMPLIFIER:

Operational amplifier - Characteristics of an ideal op-amp – Inverting and Non-inverting amplifier – Voltage follower – Adder, Subtractor, Integrator and Differentiator circuits – Log and antilog amplifiers.

UNIT–VI CURRENT CONTOURS (For Continuous internal assessment only):

4 – bit parallel binary adder and subtractor – BCD adder – instrumentation amplifier– Karnaugh map reduction and logic circuit implementation.

REFERENCES:

1. Mehta V.K., *Principles of Electronics*, S.Chand and company Ltd, 2014.
2. A.P.Malvino, D.P.Leach, *Digital Principles and Application*, IV Edition, Tata Mc Graw Hill, New Delhi, 2011.
3. V.Vijayendran, *Digital Fundamentals*, S.Viswanathan (Printers & Publishers) Private Ltd, Chennai, 2014.
4. Theraja.B.L*, Basic electronics – Solid State*, S.Chand and Company Ltd 2002.
5. Sedha R.S., *A text book of applied Electronics*, S.Chand & company Ltd 2002.
6. W.H.Gothmann,*DigitalElectronics*,PrenticeHallofIndia,Pvt.Ltd.,NewDelhi1996.
7. Mehta V.K., Rohit Mehta, *Principles of Electronics*, S. Chand and company Ltd, Revised edition 2010, ISBN 81-219-2450-2.
8. Ben G.Streetman, Sanjay Banerjee, *Solid state electronic device,* Pearson Education (pvt.Ltd.,) NewDelhi, India, fifth edition 2004.
9. Chattopadhyay T., *Advanced Electronics,* CBS publisher, ISBN-978-9390709007, 2021
10. Ganguly, ParthaKumar, *Principles of Electronics,* PHI Learning Pvt. Ltd., 2015.
11. D. H.Horrocks, *Feedback circuits and Op. Amps*, Springer Science & Business Media, 2013.
12. https://www.youtube.com/watch?v=_dQ3OdbyDMk
13. https://nptel.ac.in/courses/108105113
14. https://nptel.ac.in/courses/108101091
15. https://nptel.ac.in/courses/108102145
16. https://www.classcentral.com/course/youtube-digital-electronics-48205
17. https://www.youtube.com/watch?v=DBTna2ydmC0
18. https://nptel.ac.in/courses/108105132
19. https://www.youtube.com/watch?v=kiiA6WTCQn0
20. https://www.youtube.com/watch?v=kbVqTMy8HMg

COURSE OUTCOMES:

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

- Understand the fundamental principles of semiconductors including p-n junctionsand zener diode
- Analyze the characteristics of transistor and transistor biasing circuits
- Performconversionbetweenvariousnumbersystems.
- Apply knowledge of Boolean algebra and other minimization techniques for digital circuit design.
- Identify, formulate and solve problems based on combinational circuits
- Verify the functions of various digital integrated circuits.
- Carryout the project using digital integrated circuit

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Third Year **CORE PRACTICALV** **Semester V**

OPTICS AND DIGITAL ELECTRONICS

Code:22SCCPH5P **(Practical)** **Credit: 4**

(ANY EIGHT EXPERIMENTS)

COURSE OBJECTIVES:

To ignite the minds of the learners with the practical knowledge of Physics by enhancing the hidden talents in troubleshooting experiments.

EXPERIMENTS:

1. B.G. – Absolute capacity of a condenser.
2. Spectrometer–Grating–Minimum deviation position.
3. Spectrometer–Dispersive power of a grating.
4. Construction and study of a Full Wave Rectifier.
5. Transistor characteristics – CE configuration.
6. FET characteristics.
7. Single-stage RC coupled amplifier–Transistor.
8. AND, OR and NOT Gates –Discrete components.
9. AND, OR and NOT Gates–Using ICs
10. Realizing NOR gate as a Universal gate.
11. Realizing NAND gate as a Universal gate.
12. OP-AMP-Adder and Subtractor

REFERENCES:

1. Department of Physics, *Practical Physics*, (B.Sc. Physics Main), St. Joseph's College, Tiruchirapalli 2009
2. Dr.S.Somasundaram, *Practical Physics*, Apsara publications, Tiruchirapalli, 2012.
3. C.C. Ouseph, U.J.Rao and V. Vijayendran, *Practical Physics and Electronics,* Viswanathan Printers and Publishers, PVT Ltd (www.svprinters.com), Chetpet, Chennai-2014
4. S.Srinivasan, *A Text Book of Practical Physics*, S.Sultan Chand Publications. 2005
5. R.Sasikumar, *Practical Physics*, PHI Learning Pvt. Ltd, New Delhi, 2011.

COURSE OUTCOME:

On completion of the course the learner will be able to:

- Understand the characteristics of electronic components.
- Evaluate a process based on the results obtained from the experiments quantitatively and qualitatively.
- Obtain the scope of the investigation as expected.
- Link a process with help of the outcomes of an experiment.
- Develop the skill of collaboratively and ethically.

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Third Year **MAJOR BASED ELECTIVE I** **Semester V**

1) SOLID STATE PHYSICS

Code: 22SMBEPH1A **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To impart the knowledge of crystallography.
- To introduce the basic ideas of bonding and defects in solids
- To make the students understand the properties of metals and semiconductors
- To inculcate the knowledge of dielectric, magnetic and superconducting properties of materials.

UNIT–I CRYSTAL SYSTEMS:

Basic concepts of crystal –Lattice – Basis – Crystal structure - Unit cell – primitive cell-lattice parameters – crystal systems – Bravais lattices – SC, BCC, FCC, HCP crystal structures –number of atoms in unit cell- atomic radius-coordination number - packing fraction- crystal planes – Miller indices- Bragg's law-crystal structure analysis-Laue's photographic method-Powder crystal diffraction method.

UNIT–II BONDING AND DEFECTS IN SOLIDS:

Inter atomic forces – Bonding in solids – Primary bonds – Ionic, Covalent and metallic bonds – Secondary bonds – Dipole, dispersion and hydrogen bonds.
Defects in solids – point defects: vacancy, interstitials, impurity – Line defects: Edge dislocation, screw dislocation –Surface defects: Grain boundary, stacking faults-volume defects.

UNIT–III ELECTRON THEORY OF METALS AND SEMICONDUCTORS:

Classical free electron theory of metals- – Electrical and Thermal conductivity - Wiedemann Franz law – Quantum free electron theory –Fermi energy- density of states – Band theory of solids – Brillouin zones. Semiconductors – carrier concentration of intrinsic-electrical conductivity- carrier concentration of P-type and n-type – Hall Effect – experimental determination of carrier concentration and mobility – application.

UNIT–IV DIELECTRIC AND MAGNETIC PROPERTIES:

Dielectrics: – polarization –– dielectric constant- types of polarization – Lorentz field (derivation) – Clausius - Mossotti relation – Properties of dielectric materials – Dielectric loss and breakdown. Magnetism: dia, para, ferro, antiferro and ferri-magnetism – Ferromagnetic domains- Anti ferromagnetic materials – Ferri magnetic materials.

UNIT–V SUPER CONDUCTIVITY:

Introduction – Historical developments – General properties of superconductivity - Critical field and Crystal temperature – Meissner effect –– Type I and Type II superconductors – London equations - penetration depth - Isotope effect– BCS theory – Applications of superconductors.

UNIT – VI CURRENT CONTOURS (For Continuous internal assessment only):

Smart Materials

Introduction to smart materials – Components of smart materials – Classification of smart materials – Shape memory alloys –Applications of smart materials.

REFERENCES:

1. *Solid State Physics*–N.Singh, Wiley India, ISBN: 978-9390455249, 2021
2. *Solid State Physics* – Gupta & Kumar, K.Nath & Co,Meerut, 2000.
3. *Solid State Physics* – Singhal, Kedarnath Ramnath & Co, Meerut, 2005.
4. *Material Science* – M.Arumugam, Anuratha Agencies, 2002.
5. *Materials Science* – S.L.Kakani and Amit Kakani, 3rdEdition, New Age International, 2016
6. *Introduction to Solid State Physics* – Charles Kittel, John Wiley, 2004.
7. *Elementary Solid State Physics* – Ali Omar, Addison Wesley Publishing Company, 1975.
8. *Elements of Solid State Physics* – J.P.Srivastava, Second Edition, PHI learning Pvt. Ltd., 2006.
9. *Solid State Physics and Electronics* – A.B. Gupta & NurulIslam, Books & Allied Ltd, 2012 ISBN: 978-8187134831
10. *Solid State Physics* - V.K.Dhas Dr.S.D.Aghav, B.M.Laware, Dr.P.S.Tambade, Nirali Prakashan Publishers, 2019.

COURSE OUTCOME:

Upon completion of this course, students would be able to

- To find the crystal structure of materials applying their learnt knowledge.
- To differentiate the bonding in solids and identify the defects prevalent in crystalline solids
- To apply the gained knowledge about theories on conductors and semiconductors for learning related advanced topics
- To analyze the dielectric and magnetic various materials.
- To review the peculiar properties of super conducting materials and their implications.

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Third Year **MAJOR BASED ELECTIVEI** **Semester V**

2) LASER PHYSICS

Code: 22SMBEPH1B **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To provide knowledge of the principle and characteristic features of lasers.
- To impart the concepts of the transient operations
- To make the students acquire knowledge of the working principles of different types of Lasers
- To inculcate the Industrial and Medical applications of lasers
- To transfer the knowledge about the holography and its applications

UNIT–I FUNDAMENTALS OF LASER:

Introduction to LASER – Principle – Characteristics of LASER – Einstein's co-efficient - Derivation - Population Inversion - Pumping action - Optical resonator- different configurations of optical resonators – Stability condition (no derivation required) and stability diagrams for optical resonators

UNIT–II TRANSIENT EFFECT:

Transverse and longitudinal mode selection- Principle of Q- switching and Mode locking – Different types of Q-switching: Electro-optic Q-switching and Pockel's cell.

UNIT–III LASER SYSTEMS:

Ruby LASER–Nd-YAG LASER – He-Ne LASER - CO2 LASER – Dye LASER - Semiconductor LASER:- Homojunction and Heterojunction.

UNIT–IV APPLICATIONS OF LASERS:

Material processing: Welding, Drilling, Cutting and Heat treatment – Medical: Surgery – Ophthalmology – Dermatology –Endoscope - Communication: LIDAR – LASER in Fibre Optics –Optical waveguides and sensors – Laser safety precautions

UNIT–V HOLOGRAPHY:

Introduction – Principle of Holography – Co axial Holography – Off – axis Holography– Holograms – Important Properties of Hologram – Classification of Holograms applications – Medical applications of Holography.

UNIT–VI CURRENT CONTOURS (For Continuous internal assessment only):

Atom laser: Bose-Einstein condensation – Methods of cooling atoms – Laser doppler cooling - Basic atom Laser –Atom laser applications.

REFERENCES:

1. N. Subrahmanyam Brijlal, M N Avadhanulu, *Optics*, S. Chand Publishing. Pvt. Ltd. New Delhi, 25th revised edition, 2013.
2. B.B.Laud, *Lasers and nonlinear optics* – Wiley Eastern Ltd.,(1985)
3. K. Thiyagarajan and A. K. Ghatak, *LASERS: Theory and* Ap*plications* – Macmillan India Ltd.
4. A. Sundaravelusamy, *Applied Physics II,* Priya publications, Revised edition 2015.
5. A.K. Pandey, C. K. Pandey and Manisha Bajpai, Fundamentals of LASER Systems and Applications, Wiley publisher, 1st Edition, 2017, ISBN: 9788126568260, 8126568269.
6. William Silfvast, *Laser Fundamentals*, Cambridge press, 2004
7. O.Svelto, *Principles of lasers*, 5thEdition 2010, SPRINGER
8. A.ESiegman, *Lasers*, University Science Books, California, 1986
9. Peter W.Milonni, Joseph H.Eberly, *Laser Physics,* John Wiley & Sons, 2010.
10. Orazio Svelto,*Principles of Lasers,* Springer Science & Business Media, 2013.
11. KarlF. Renk, Basics of Laser Physics, Springer, 2017
12. Kusam Devgan, Surinder Kaur, *Quantum and Laser Physics,* New rays Publishing House, 2021
13. https://ebook-new.com/gets/book.php?id=dpVDTLPySTQC&item=basics-of-laser-physics&data=bookarchive.net
14. https://ebook-new.com/gets/book.php?id=z13wEOBwn1wC&item=lasers&data=bookarc
15. http://www.youtube.com/c/IIT
16. http://www.youtube.com/c/Nanotechnology

COURSE OUTCOMES:

Upon successful completion of this course, the students would be able to:

- Recall the basic light matter interaction, characteristics of atomic transitions
- Analyze the different types of lasers and their features
- Apply the working principle to produce different types of Lasers
- Describe how the Lasers can be used in various Industries and Medicine
- Adapt appropriate safety measures when handling laser experiments.

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Third Year **SKILL BASED ELECTIVE I** **Semester V**

ELECTRICAL WIRING FUNDAMENTALS

Code: 22SSBEPH1 **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To impart the knowledge about generation of Electricity.
- To provide knowledge of AC, DC, types of electrical circuits, transformers etc.
- To develop skills on electrical wiring.

UNIT–I GENERATION OF ELECTRICITY:

Conventional methods of power generations – Thermal power plant – Atomic power station – Solar energy – wind mill energy.

UNIT–II FUNDAMENTALSOFELECTRICITY:

Electrontheory – Flow of electrons and current – Resistance – Electromotive Force – voltage – potential difference – voltage drop – alternating current – direct current – Ohm's law– Effects of electric current – Types of electrical circuits – work, power and energy.

UNIT–III SINGLE PHASE AND POLY PHASE AC CIRCUITS:

Alternating current – amplitude – time period – frequency – RMS value – polyphase – 2 phase – 3 phase – advantage of polyphase over single phase – star connection – delta connection.

UNIT–IV TRANSFORMER:

Construction – principle of operation – classification of transformers – types of core – Transformer losses – Efficiency – Alternator – Parts of an alternator – AC three phase motors– AC single phase motors.

UNIT–V HOUSE WIRING:

Earthing – Necessity of earthing – Types of earthing – safety fuse – circuit breaker – thermal fuses – Toggle switch – keyboard switches – wires and cables – connectors.

REFERENCES:

1. Electrical power –Dr. S. L. Uppal.
2. Basic Electrical Engineering – M.L.Anwani.

COURSE OUTCOMES:

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

- Distinguish various types of electrical components
- Recall the basic principles of electrical wiring
- Identify and rectify the defects in simple electrical circuits.
- Do electrical wiring.

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Third Year **CORE COURSE VIII** **Semester VI**

NUCLEAR PHYSICS

Code: 22SCCPH8 **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To introduce basic concepts and properties of the atomic nucleus.
- To impart knowledge of radioactivity and related phenomena.
- To inculcate various interactions of nuclear radiation with matter.
- To make the students understand the fission and fusion reactions and their applications.
- To emphasize the understanding of nuclear forces, nuclear models, elementary particles and accelerators.

UNIT–I GENERAL PROPERTIES OF NUCLEI & NUCLEAR FORCES:

Classification of nuclei – General properties of nucleus–determination of nuclear size– electron scattering experiment –Dempster's mass spectrograph – binding energy, mass defect and packing fraction – stability and binding energy curve – Semi-empirical mass formula – Nuclear spin and magnetic moment – Electric quadruple moment – Nuclear forces – basic properties- Meson theory of Nuclear forces.

UNIT–II RADIOACTIVITY:

Laws of Natural radioactivity – Law of radioactive disintegration – Half life period – Mean life period – Law of successive disintegration – Radioactive Equilibrium – Types of radioactive radiations – Properties – Alpha emission – Geiger and Nuttal law –Alpha particle spectra – Theory of alpha decay – Gamow's theory – Beta ray spectra– line and continuous spectrum – Neutrino theory – Gamma rays spectra – origin of Gamma rays– Nuclear isomerism – Internal conversion.

UNIT–III NUCLEAR REACTIONS:

General ideas of nuclear reactions – types of Nuclear reactions – energy balance in nuclear reaction – threshold energy – nuclear transmutations – types of transmutations with examples – discovery of neutron – properties -Nuclear models: liquid drop model – shell model - fission – fusion.

UNIT–IV DETECTORSANDACCELERATORS:

Solid state detectors – Geiger - Muller counter – Wilson-cloud chamber – Bubble chamber –Scintillation counters – Cerenkov counter – Linear accelerator – Cyclotron– Synchrocyclotron – Betatron – Electron synchrotron – Proton synchrotron.

UNIT–V COMIC RAYS AND ELEMENTARY PARTICLES:

Discovery of Cosmic rays – Latitude effect – Azimuth effect – Altitude effect – Primary and Secondary cosmic rays – cosmic ray showers – Van Allenbelts – Origin of cosmic rays – Elementary particles: classification – Particles and antiparticles – fundamental interactions – elementary particle quantum numbers – conservation laws and symmetry.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Radiation monitoring – Dosimeters – Biological effects of radiation – Penetration and ionizing power of nuclear radiation in human body – Nuclear power plants in India

REFERENCES:

1. R.Murugesan, S.Kiruthiga, *Modern Physics,* S.Chand Company Ltd.Revised edition(2006).
2. M.L. Pandya, R.P.S. Yadav, Amiya Dash, *Elements of Nuclear Physics*, Kedaar Nath & Ram Nath (2000).
3. Satya Prakash*, Nuclear Physics*, A Pragati Prakasan Publication (2011).
4. Vimal Kumar Jain, *Nuclear and Particle Physics,* Ane Books (2016)
5. N. Subrahmanyam BrijLal, Jivan Seshan,*Atomic and Nuclear Physics*, S. Chand; Reprint Edn. (2006) edition.
6. Gupta & Roy., *Physics of the Nucleus*, Books and Allied (P) Ltd. Kolkatta (2011).
7. S.N.Ghoshal, *Nuclear Physics (Revised Edition)*, S.Chand & Company PVT, LTD, New Delhi (2016).
8. S.B.Patel, *Nuclear Physics: An Introduction,* New AGE (2020)
9. W.J.Price, *Nuclear Radiation Detectors*, Mc Graw - Hill
10. D.C.Tayal, *Nuclear Physics,* Himalaya PublishingHouse, (2009).
11. https://onlinebooks.library.upenn.edu/webbin/book/lookupid?key=olbp75446)

COURSE OUTCOMES:

Upon completion of this course, students would be able to

- Gather advanced knowledge in nuclear physics.
- Explain the general properties of the nucleus, shell model and collective model
- Gain knowledge to explain the radio active decays and apply various aspects of nuclear reactions in view of compound nuclear dynamics.
- Describe the working principles of nuclear detectors and accelerators
- To explain the nuclear fusion, nuclear fission reaction and elementary particles.

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Third Year **CORE COURSE IX** **Semester VI**

THEORETICAL PHYSICS

Code: 22SCCPH9 **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To give an exposure to advanced topics in Physics and to learn the basisof fundamental principles and the Lagrangian formulation.
- To enhance students understanding about relativity.
- To build a strong base on the foundation of Quantum Mechanics.
- To get acquainted with problem solving skills in the basic aspects of Lagrangian Mechanics, relativity and foundation of Quantum mechanics.
- To provide a basic knowledge in the topic Universe.

UNIT–1 FUNDAMENTAL PRINCIPLES AND LAGRANGIAN FORMULATION:

Mechanics of a particle and system of particles – Conservation laws - Constraints – Generalized coordinates – Principle of virtual work – D' Alembert's principle and Lagrange's equation – Hamilton's principle – Lagrange's equation of motion – Simple pendulum – Atwood's machine – Conservation theorem and symmetry properties.

UNIT–II RELATIVISTIC DYNAMICS:

Lorentz Scalars and Lorentz Vectors – Relativistic Linear Momentum and Energy – Energy and Linear momentum of subatomic Particles – Conservation Laws and Transformation Rules for Energy and Linear Momentum – Photons and Doppler Shift-Relativity and Subatomic Particles; Relativistic Collisions and Decay – Mass to Energy Conversion.

UNIT–III DUAL NATURE OF MATTER:

De Broglie concept of matter waves – De Broglie wavelength – Wave velocity and group velocity for the De Broglie waves – Experimental study of matter waves – Davison and Germer experiment – Heisenberg's uncertainty principle.

UNIT–IV BASICS OF QUANTUM MECHANICS:

Basic postulates of wave mechanics – Development of Schrödinger wave equation – Time independent and dependent forms of equation – Properties of wave function – Orthogonal and normalized wave function and eigen values – Expectation values and Ehrenfest's theorem – Particle in a box.

UNIT–V THE UNIVERSE:

Introduction –Galaxy - Milky way galaxy - Structure of the Sun – Temperature of the Sun–The Earth-Moon system–Composition of Earth's internal shells and Earth's

Magnetic field – Neutron stars – Pulsars – Black Holes –The origin of the Universe (Big Bang Theory)–Stellarevolution–Proton-protoncycle.

UNIT–VI CURRENTCONTOURS(ForContinuousinternalassessmentonly):

Quantum sensors–Quantum sensing for gravity cartography–Quantum based search for dark matter – Relativistic astrophysics.

REFERENCES:

1. S.I.Gupta,V.Kumar and Hv. Sharma, *Classical Mechanics* (Pragati Prakashan, Meerut, 2019).
2. J.C.Upadhyaya, *Classical Mechanics* (Himalaya Publishing House, Bangaluru, 2019).
3. G.Aruldas, *Quantum Mechanics* (PHI Learning Pvt.Ltd., NewDelhi, 2008).
4. A.K.Saxena, *Principle of modernphysics* (Narosa, NewDelhi, 2014).
5. R.Murugesan, Kiruthiga Sivaprasath, *Modern Physics* (S.Chand,2006).
6. H.Goldstein, C.P.Poole and J.Safko, *Classical Mechanics* (Pearson,London, UK, 2019).
7. N.C.Rana and P.S.Joag, *Classical Mechanics* (Tata Mc Graw-Hill, NewDelhi, 2017).
8. N.Zettili, *Quantum Mechanics*(Wiley Pvt. Ltd., India, 2016).
9. L.D.Landau and E. M.Lifshitz, *Mechanics* (Elsevier,India,2010).
10. GeorgJoos, IraM.Freeman,*Theoretical Physics,* (Dover Publications;3rd Revised ed. edition 2013).
11. https://Theoretical-Physics-1-Classical-Mechanics-ebook/dp/B01HPHM7HE
12. https://Theoretical-Physics-Dover-Books-ebook/dp/B00C8UR0B2

COURSE OUTCOMES:

Upon completion of this course, Students would be able to

- Grown familiarity with the foundation of Classical Mechanics.
- Develop problem solving skills in Mechanics.
- Understand the basic formalism of Quantum Mechanics.
- Understand mathematical implication in Physics.
- Acquire basic knowledge about our Universe.

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Third Year **CORE PRACTICAL VI** **Semester VI**

ELECTRONICS, MICROPROCESSOR AND PROGRAMMING

Code: 22SCCPH6P **(Practical)** **Credit: 4**

COURSE OBJECTIVE:

- To improvise the knowledge on utilization of electronic devices in electrical appliances by performing some experiments and executing programmes in order to realize the applications of microprocessors and computers.

EXPERIMENTS:

SECTION A
(ANY FOUR EXPERIMENTS)

1. Construction of a regulated power supply using Zener diode – Percentage of regulation.
2. Hartley oscillator using Transistor.
3. OP-AMP –Integrator and Differentiator.
4. Half adder and full adder using basic and EX-OR gates.
5. Half subtractor and full subtractor using basic and EX-OR gates.
6. Verification of Boolean laws (Anyfour).

SECTION B – MICRO PROCESSOR8085
(ANY TWO EXPERIMENTS)

1. 8–bit addition and 8–bit subtraction.
2. 8–bit multiplication and 8–bit division.
3. Finding the larger and the smaller number in a data array.
4. Block data transfer.

SECTION C – COMPUTER PROGRAMMING IN C
(ANY TWO EXPERIMENTS)

1. Conversion from Centigrade to Fahrenheit.
2. Calculation of volume of Sphere, Cone, Cube and Cuboid.
3. Sum of series of numbers of a given array.
4. Finding the average of these to numbers in an array.

REFERENCES:

1. Department of Physics, *Practical Physics*, (B.Sc.PhysicsMain),St.Joseph'sCollege, Tiruchirapalli 2009
2. Dr. S. Somasundaram, *Practical Physics*, Apsara Publications, Tiruchirapalli, 2012.

3. C.C. Ouseph, U.J.Rao and V. Vijayendran, *Practical Physics and Electronics*, Viswanathan Printers and Publishers, PVT Ltd(www.svprinters.com), Chetpet,Chennai - 2014
4. S. Srinivasan, *A Text Book of Practical Physics*, S. Sultan Chand publications. 2005
5. R.Sasikumar, *Practical Physics*, PHI Learning Pvt.Ltd, New Delhi, 2011.

COURSE OUTCOMES:

On completion of the course, the learner will be able to:

- Perform few technical operation swith electronic equipments.
- Understand the use of electronic components in Digital computers.
- Acquire the skill of verifying laws in Physics through experiments.
- Realize the applications of electronic devices.
- Acquire the skill of applying the developed software for some scientific and industrial applications.

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Third Year **MAJOR BASED ELECTIVE II** **Semester VI**

1) MICROPROCESSOR AND C PROGRAMMING

Code: 22SMBEPH2A **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

The purpose of this course is to introduce students about the key features and implementation of C language and 8085 Microprocessor ALP.

- To introduce algorithms and flow charts for language independent programming logic development.
- To provide fundamental knowledge on the Architecture and Instruction Set of 8085.
- To impart the various features and components of C program writing.

UNIT – I BASICS OF DIGITAL COMPUTER, INTEL 8085 MICROPROCESSOR ARCHITECTURE AND INSTRUCTIONS

Basic components of digital computer – Semiconductor memories – Hardware and Software – History of microprocessors - INTEL 8085 - Pin Diagram - Architecture - Various registers – Status Flags – 8085 Instructions: Machine Language, Assembly Language, Instruction Set and Format – Data Transfer, Arithmetic, Logical, Branching and Machine Control Operations- Addressing Modes: Register, Implied, Immediate, Direct and indirect addressing.

UNIT–II ASSEMBLY LANGUAGE PROGRAMMING:

Addition - subtraction - multiplication - division of two 8- bit numbers - Finding the large stand smallest number in a data array – Arranging a list of numbers in ascending or descending order - complement – shift – mask-look up table – multibyte addition and subtraction –decimal addition - subtraction.

UNIT–III ESSENTIALS OF C LANGUAGE:

Basic Structure of C Programs – Character set – C tokens - Keywords and identifiers – constants – variables – Data types – declaration of variables – Assigning values to variables – Symbolic constants – Operators and Expressions -Arithmetic operators - Relational, Logical and Assignment operators, Increment and Decrement operators – Conditional operator, Bitwise and Special operators– Arithmetic Expressions – Mathematical functions.

UNIT–IV I/O FUNCTIONS AND CONTROL STATEMENTS:

Data input and output: getchar, putchar, scanf, printf functions - Decision making and branching: simple if - if…else - else if ladder – switch – break - continue -goto – Looping: while - do… while - for - nested loops.

UNIT–V ARRAYS AND C LANGUAGE PROGRAMMING:

Introduction to Arrays – Declaration - Initialization — One dimensional array —Two dimensional arrays – Library functions.

C Language Programming:

1. Conversion of Centigrade into Fahrenheit.
2. Calculation of volume of sphere/cone/cube/rectangularcuboid.
3. Solving quadratic equation.
4. Sum of digits of a series
5. Finding the largest and smallest number in a data array
6. Arranging numbers in ascending order/descending order.
7. Matrix arithmetic operation(Addition/Subtraction/Multiplication)

UNIT–VI CURRENT CONTOURS:(For continuous internal assessment only):

Introduction to functions-Function Declaration - Function definition - Function call – Recursion -Structures – Unions.

REFERENCES:

1. B. Ram – *Fundamentals of Microprocessors and Microcontrollers*–DhanpatRai Publications (P) Ltd., New Delhi, 2013.
2. E.Balagurusamy–*Programming in ANSIC*–Tata Mc Graw Hill Education Private Limited, New Delhi,2018.
3. Yashavant Kanetkar, *LetusC,* BPB Publications, Fifteenth edition 2017.
4. Carl Hamacher, ZvonkoVranesic, SafwatZaky *Computer Organization*, McGraw-Hill, FifthEdition, Reprint 2017
5. R. S.Gaonkar- *Microprocessor Architecture, Programming, and Applications with the 8085*, Penram International Publishing (India) Private Limited, Mumbai,2007.
6. DrDAGodse and APGodse,*Microprocessors & Introduction to Microcontroller: 8085, 8086, 8051 - Architecture, Interfacing and Programming,* Technical Publications, 2020
7. K. R. Venugopal and S. R. Prasad – *Programming with C* – Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002.
8. *Advance Microprocessor*, DenielTabak,TMH.
9. IBMPC *Assembly Language & Programming*, Peter Abel, PHI.
10. S.Palaniswamy, *Physics through C-Programming*, A Pragati Edition, 2004.
11. https://www.youtube.com/watch?v=4pTiujyY4IM
12. https://www.youtube.com/watch?v=zAXAb_ttazY
13. https://nptel.ac.in/courses/106106210
14. https://nptel.ac.in/courses/108105102
15. https://archive.nptel.ac.in/courses/106/104/106104128/

COURSE OUTCOMES:

Upon completion of this course, the students would be able to:

- Study of the basic structure and operation of a digital computer system.
- Describe architecture of 8085 processors.
- Write, compile and debug programs in assembly language
- Develop algorithms for arithmetic and logical problems and write programs in Assembly and C language.
- Design programs involving decision structures, loops, and arrays.
- Create and perform different Programs.

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Third Year **MAJOR BASED ELECTIVE II** **Semester VI**

2) NANO TECHNOLOGY

Code: 22SMBEPH2B **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To introduce basics of nanoscience, nanomaterials and nanotechnology.
- To impart the knowledge of nanomaterials preparation methods
- To make the students learn the characterization techniques for analyzing the properties of nanomaterials and applications of nanomaterials.

UNIT–I INTRODUCTION TO NANOTECHNOLOGY:

Nanoscience – Nanotechnology – Definitions - History of nanotechnology – Nanomaterials: classification – Zero, one and two dimensional nanomaterials – Properties of nanomaterials– Surface area to volume ratio (S.A/V) – Effect of S.A/V on the properties of materials –Quantum dots– Production of quantum dots – Applications of quantum dots– Quantum wires –properties and applications of quantum wires-Challenges in nanotechnology.

UNIT–II PREPARATION METHODS:

Top – down and Bottom – up approaches – Top – down methods: Ball milling, Chemical etching photolithography and Electron beam lithography – Advantages– Limitations. Bottom-upmethods: Vacuum evaporation, Sputter deposition process, Laser ablation, Hydrothermal method – Advantages– Limitations.

UNIT–III FULLERENES:

Fullerenes – Types of fullerenes – Bucky ball/Buckminster fullerene-Carbon nanotubes (CNTs) - Single walled CNTs – Multi walled CNTs – Differences – Properties of CNTs: mechanical, electrical and superconducting properties – Preparation of CNTs– Plasma discharge method – Chemical vapour deposition method – Applications.

UNIT–IV CHARACTERIZATION TECHNIQUES:

Construction, working principle, merits and demerits of X-ray diffractometer - Scanning Electron Microscope (SEM) – Atomic Force Microscope (AFM) – UV-Vis–NIR double beam spectrophotometer– Energy dispersive X-ray analysis (EDAX)- SQUID – Raman spectroscopy.

UNIT–V APPLICATIONS:

Nanoelectronics – Molecular electronics – Nanophotonics – Nanorobotics – Nanomechanics – Carbon nanotubes FETs – Nano MOSFETs – Molecular diodes and transistors – Biomedical applications: Targeted drug delivery –targeted

chemotherapy.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Bandgap engineered quantum devices – Quantum computers–Nanomaterials in environmental applications – Nanomaterials in energy

REFERENCES:

1. K.Ravichandran,K.Swaminathan,P.K.Praseetha,P.Kavitha, *Introductionto Nanotechnology*, JAZYM publications, 2019ISBN 978-93-87360-40-2
2. M.Ratneret.al.,*Nanotechnology*;A Gentle intro Practices–hall,2002,ISBN0-13-101400-5, 2003.
3. Nanotechnology; *Basic Science and Emerging Technologies*,CRCPress,2002, ISBN 9781584883395
4. CharlesP. PooleJr and Frank J.Owens. "*Introduction to Nanotechnology*" Wiley, 2003, DOI: 10.1002/anie.200385124
5. R.B.Bhise,A.B.Bhise,V.D.Kulkarani,A.PZambare,*Physics of Nanomaterials*, 2019 ISBN 978-93-89406-80-1
6. A.S.EdelstienandR.C.Cornmarata,*Nanomaterials; synthesis, Properties and Applications*, 2ed, Iop (U.K), 1996.
7. Shubra Singh M.S.Ramachandra Rao, Nanoscience and Nanotechnology: Fundamentals of Frontiers, Wileypublications, 2013.
8. Thomas Varghese& K.M. Balakrishna, *Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials,* Atlantic; Reprint 2016 edition (1 January 2021)
9. William Illsey Atkinson, *Nanotechnology,* Jaico Publishing House; First edition (9 July 2006)
10. Risal Singh ShipraMital Gupta, *Introduction to nanotechnology,* Oxford University Press (2018)
11. https://en.wikibooks.org/wiki/Nanotechnology
12. https://bookboon.com/en/nano-technology-ebook

COURSE OUTCOMES:

Upon completion of this course, the students would be able to:

- Classify the synthesizing techniques based on the states of matter
- Make use of the available instruments to study the properties of nanomaterials
- Assess the effect of grain sizes on various physical properties of nanomaterials
- Interpret the results of physical and chemical properties measurements
- Develop new materials for green energy and environmental applications

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Third Year **PROJECT** **Semester-VI**

Code: 22SPHPW **Credit: 3**

The candidate shall be required to take up a Project Work by group or individual and submit the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the students in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT/EVALUATION/VIVA VOCE:

1. PROJECT REPORT EVALUATION (Both Internal & External)

   I. Plan of the Project -20marks

   II. Execution of the Plan/collection of marks Data / Organisation of Materials / Hypothesis, Testing etc and presentation of the report. - 45

   III. Individualinitiative -15marks

2. Viva-Voce/Internal & External -20marks

TOTAL **- 100marks**

PASSING MINIMUM:

	Vivo-Voce 20 Marks	**Dissertation 80 Marks**
Project	40% out of 20Marks (i.e.8 Marks)	40% out of 80 marks (i.e.32 marks)

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month.A maximum of 2 chances will be given to the candidate.

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Environment & Sustainability

Third Year **SKILL BASED ELECTIVEII** **Semester VI**

DOMESTIC ELECTRICAL APPLIANCES AND MEASURING INSTRUMENTS

Code: 22SSBEPH2 **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To inculcate the knowledge of resistors, capacitors and electrical appliances
- To provide training on measuring instruments
- To provide knowledge of the working principles and constructions of house appliances

UNIT–I RESISTORS:

Resistance – unit – Law of resistance – effect of temperature on resistance (carbon, metal film, thin film, wire wound) – variable resistors – colour code.

UNIT–II INDUCTORS:

Inductance – General information – types of inductors(ferrite and choking inductors).

UNIT–III CAPACITORS:

Capacitors - Principle – types of capacitors (Air, Paper, electrolyte and mica) – fixed and variable capacitors – specifications - applications.

UNIT–IV LIGHT SOURCES:

Definition and units of light – luminous flux - Luminous intensity – illumination –units of luminous intensity – types of light sources – Sodium vapour lamp – Mercury vapour lamp – Fluorescent lamp.

UNIT–V MEASURING INSTRUMENTS:

Galvanometer – Ammeter – Voltmeter – Ohmmeter – Multimeter – CRO.

UNIT–VI ELECTRICAL APPLIANCES (For continuous internal assessment only):

Electric iron – Soldering iron – water heaters– Electric Oven– Geysers– Electric mixer-Bell and Buzzer – Electric fan – Emergency lamp – Refrigerator – Water cooler.

REFERENCES:

1. Home appliances GT Publications, Jaipur.

2. Electrical power – Dr.S.L.Uppal.
3. Basic Electrical Engineering – M.L.Anwani, Dhanapat Rai and Co.New Delhi.

COURSE OUTCOMES:

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

- Recall the concepts of resistors, inductors and capacitors
- Apply their skills on connecting various components like resistors, capacitors etc.
- Identify the defects in electrical appliances
- Rectify the defects in the parts of electrical appliances.
- Able to design prototypes of simple electrical appliances.

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ALLIED COURSEI

PHYSICS I

Code: 22SCACPH1 **(Theory)** **Credit:4**

COURSE OBJECTIVES:

- To know the elastic nature of materials, analyze the expression for Young's modulus and comprehend about viscosity and surface tension of fluids.
- To acquire knowledge of the centre of gravity, states of equilibrium of rigid bodies and stability of floating bodies.
- To understand the laws of thermodynamics, thermal conductivity and black body radiation.
- To familiarize the concepts of interference and diffraction.
- To know the formation, characteristics and applications of diodes and transistors.

UNIT-I PROPERTIES OF MATTER:

Elasticity: Stress–Strain–Hooke's law–Young's modulus- Behaviour of wire under progressive tension – Bending of beams – Expression for the bending moment–Measurement of Young's modulus by bending of beams – Non-uniform bending and Uniform bending.

Viscosity: Streamline flow and Turbulent flow – critical velocity - Poiseuille's formula–Determination of coefficient of viscosity of a liquid (Variable pressure head).

Surface Tension: Drop weight method of determining the surface tension of a Liquid–Experiment to determine the interfacial tension.

UNIT-II MECHANICS:

Centre of Gravity–Centre of Gravity of a solid hemisphere–Hollow hemi sphere – Solid cone.States of Equilibrium:Equilibrium of a rigid body– Stable,unstableand neutral equilibrium – Example.Stability of Floating bodies – Meta centre – Determination of meta centric height of a ship.

UNIT-III THERMAL PHYSICS:

Thermodynamics: Laws of thermodynamics – Reversible and irreversible process – Heat engine – Carnot's theorem.

Radiation: Black body–Stefan's law–Newton's law of cooling– Newton's law of cooling from Stefan's law–Experimental determination of Stefan's constant–Wien's displacement law–Rayleigh-Jean's law–Planck's law.

Heat Conduction: Coefficient of Thermal Conductivity –Determination of Thermal Conductivity of a bad Conductor by Lee's disc method.

UNIT-IV OPTICS:

Interference: Superposition of waves –Principle of interference – Air wedge – Newton's rings.

Diffraction: Introduction –Plane diffraction Grating – Theory of plane transmission Grating.

Fiber Optic communication: Introduction – Optic Fiber – Numerical Aperture – Coherent bundle – Fiber optic communication System and its advantages.

UNIT–V ELECTRONICS:

Intrinsic and extrinsic semiconductor–PN Junction diode–Biasing of PN junction–V-I characteristics of junction diode–Rectifiers– Half wave – Full wave and Bridge rectifiers – Zener diode –Characteristics of Zener diode – Voltage regulator – Transistor – Characteristics of transistor – CB and CE mode –Transistor as an amplifier.

UNIT–VI CURRENT CONTOURS (For internal continuous assessment only):

Reinforced concrete–Advanced Nanophotonics–Surface tension of thermal fluids–Nano fluids–Low Viscous silicon liquid immersed transformers–Bio diesel –fueled diesel engines–Electronic transformers.

REFERENCES:

1. R.Murugeshan, *Properties of matter,* S.Chand & Co. Pvt. Ltd., Revised Edition, 2017.
2. Narayanamoorthy and N.Nagarathinam, *Mechanics Part II*, The National Publishing Company, Chennai, 2005.
3. Dr.N.Subramaniyam, Brijlal and Dr.M.N.Avathanulu, *Optics*, S.Chand & Co. Pvt. Ltd. - 5 Edition, New Delhi, 2015.
4. BrijLal,N.Subrahmanyam, P.S.Hemne, *Heat and Thermodynamics and Statistical Physics,* S.Chand & Co. Pvt. Ltd., Revised edition, 2021.
5. V.Vijayendran, S.Viswanathan, *Digital Fundamentals,* Printers & Publishers Private Ltd, Chennai, 2004.
6. Brijlal and Subramaniy an, *Properties of Matter*, S.Chand & Co. Pvt. Ltd, 2005.

7. D SMathur, *Mechanics*, S.Chand & Co.Reprint Edition,2006
8. Brijlal and Subramaniyan, *Thermal Physics*, S.Chand & Co., 2001.
9. R.Murugeshan and Kiruthiga Sivaprasath,*A Text Book of Optics*, S.Chand& Co. Pvt. Ltd.- 9 the revised edition Ram nagar, New Delhi, 2014.
10. V.K.Mehta and Rohit Mehta, *Principles of Electronics*, S.Chandand company Ltd., 2015.
11. https://byjus.com
12. https://digitalcommons.unl.edu/cgi/viewcontent.
13. https://sciencing.com

COURSE OUTCOME:

Upon completion of this course, the students would be able to

- Apply the concepts of elasticity, viscosity and surface tension to solve problems encountered in everyday life.
- Understand the centre of gravity, states of equilibrium of rigid body and also stability of floating bodies.
- Understand the law soft thermodynamics, thermal conductivity and black body radiation.
- Understand the theories and experiments on interference and diffraction using air wedge, Newton's ring and grating.
- Know the formation, characteristics and applications of diodes and transistor.

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ALLIED PRACTICAL
PHYSICS PRACTICAL I

Code: 22SCACPH1P **(Practical)** **Credit: 2**

COURSE OBJECTIVES:

- To educate and motivate the students in the field of Physics.
- To acquire the skill of handling instrument.
- To develop the observation and circuit drawing skills.
- To enhance the process-oriented performances kills.
- To inculcate the skill of experimental verification of laws in Physics.

(ANY 12 EXPERIMENTS)

EXPERIMENTS:

1. Determination of Young's modulus by Non-Uniform bending using Pin and Microscope.
2. Determination of Young's modulus by Uniform bending using Scale and Telescope.
3. Surface tension and Interfacial Surface tension by Drop weight Method.
4. Coefficient of viscosity of a liquid–Variable Pressure head Method.
5. Specific heat capacity of a liquid by Newton's law of cooling Method.
6. Thermal conductivity of a bad conductor by Lee's disc Method.
7. Spectrometer–Refractive index of a solid prism.
8. Spectrometer–Finding the wavelength of spectral lines using Grating–Normal incidence method.
9. Newton's Rings–Determination of radius of curvature of along focus lens.
10. Air wedge–Thickness of the given thin wire.
11. Meter bridge–Determination specific resistance of a coil.
12. Carry Foster's Bridge–Determination of specific resistance of a coil.
13. Potentiometer–Calibration of a Low range voltmeter.
14. Characteristics of a Junction diode–Forward resistance and knee voltage.
15. Characteristics of a Zener diode–Break down voltage.
16. Basic logic gates – AND, OR and NOT gates using discrete components.
17. Basic logic gates–AND,OR and NOT gates using ICs.
18. Realizing NAND as a Universal gate.
19. Realizing NOR as a Universal gate.
20. Verification of De-Morgan's theorem.

REFERENCES:

1. Department of Physics, *Practical Physics*,(B.Sc. Physics Main), St.Joseph's College, Tiruchirapalli-2009.
2. Dr.S.Somasundaram, *Practical Physics,* Apsara publications, Tiruchirapalli, 2012.

3. M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, *A text Book of Practical Physics,*S.Sultanch and publications,New Delhi, 2013.
4. Dr.R.K. Shukla, Dr.Anchal Srinivastava, *Practical Physics*, New Age International (P) Ltd, India, 2022.
5. P.R.Sasikumar,*Practical Physics*,PHI Learning Pvt.Ltd,New Delhi, 2011.
6. C.L.Arora,*A Text Book of Practical Physics*,S.Sultanch and publications, New Delhi, 2019.
7. Indu Prakash,Ram Krishna,A.K.Jha,*A text book of Practical Physics*, Kitab MahalPublications, Delhi, 2011.
8. N.N.Ghosh, *B.Sc Practical Physics*, Bharath Bhawan Publications, India, 2nd Edition 2017.
9. https://www.kanchiuni.ac.in/maths
10. https://nptel.ac.in/courses

Course Outcome:

Upon completion of this course, the student would be able to:

- Understand the Laboratory techniques.
- Evaluate a process based on the results obtained from the experiments quantitatively and qualitatively.
- Extend the scope of investigation as expected.
- Communicate a process with help of the outcomes of an experiment.
- Develop the skill of conducting an experiment collaboratively and ethically.

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ALLIED COURSE II
PHYSICS II

Code: 22SCACPH2 **(Theory)** **Credit:4**

COURSE OBJECTIVES:

- To understand the Coulomb's law and Gauss theorem and to gain a brief knowledge of capacitors.
- To acquire the knowledge on properties, types of magnetic materials and hysteresis of Ferro magnetic material.
- To know atom models and understand the properties, types of x-rays and Crystal structure.
- To study the basics of nucleus and their properties, nuclear reaction, nuclear models and elementary particles.
- To learn the binary number system, binary arithmetic operations, logic gates and De-Morgan's theorem.

UNIT-I ELECTROSTATICS:

Coulomb's inverse square law–Gauss theorem and its applications- Intensity at a point due to a charged sphere and cylinder – Principle of a capacitor–Capacity of a spherical and cylindrical capacitors–Energy stored in a capacitor–Loss of energy due to sharing of charges – Capacitors in series and parallel–Types of capacitors.

UNIT –II MAGNETISM:

Intensity of magnetization – Susceptibility – Types of magnetic materials – Properties of para, dia and ferromagnetic materials–Cycle of magnetization – Hysteresis – B-H curve –Applications of B-H curve–Magnetic energy per unit volume–Ferro magnets and their applications.

UNIT-III ATOMIC PHYSICS:

Atom Models: Summerfield's and Vector atom Models – Pauli's exclusion principle –Various quantum number sand quantization of orbits.

X- Rays: Continuous and Characteristic X-rays–Mosley's Law and its importance–Bragg's law–Miller indices–Determination of Crystal Structure by Laue's Powder photograph method.

UNIT-IV NUCLEAR PHYSICS:

Introduction–Nucleus–Classification of Nuclei–Nuclear Size–Charge–Mass and Spin–Liquid drop model–Nuclear Radiations and their properties-Particle accelerators–Betatron–Proton Synchrotron–Four types of reactions–Elementary particles and their classifications.

UNIT-V DIGITAL ELECTRONICS:

Decimal–Binary Octal and Hexa Decimal number systems and their Mutual Conversions – 1's and 2's complement of a Binary number and Binary arithmetic (Addition, Subtraction, Multiplication and Division) – Binary Subtraction by 1's and 2's complement method – Basic logic gates –AND, OR, NOT–NAND,NOR and EX-OR gates–NAND and NOR as universal gates– De-

Morgan's Theorems.

UNIT – VI CURRENT CONTOURS (For internal continuous assessment only):

Magnetic and electromagnetic components- Atom interferometer- Nuclear reactor simulations – Cold fusion – Artificial intelligence – Electronic Schoolbooks.

REFERENCES:

1. R.Murugeshan,Er.Kiruthiga Siva prasath,*Modern Physics*,S.Chand & Co, New Delhi, First edition, 2004
2. R.Murugeshan, *Electricity and Magnetism*, S.Chand & Co, New Delhi,Third Revised Edition, 2008.
3. Brijlal & Subramanian,*Electricity and Magnetism*,Ratan Prakash an Mandir,1995.
4. R.S.Sedha,*A text book of Digital Electronics*, S.Chand & Co,New Delhi,First Edition, 2008.
5. R.Murugesan,*Allied Physics Paper I and II*,S.Chand & Co,NewDelhi, Revised Edition, 2010.
6. Arthur Beiser, Mahajan, Choudhury, *Concepts of Modern Physics*, Pustakkosh Pubications, India, 2015
7. Gurbinder Kaur,Gary RPickrell,*Modern Physics*,Tata Mcgraw Hill Educational (P) Ltd, India, 2014.
8. Narayanamurthi, *Electricity and Magnetism*, The National Publishing Co, First Edition, 1988.
9. J.B.Rajam,*Atomic Physics*,S.Chand & Company Limited, NewDelhi, First Edition, 1990.
10. B.N.Srivastava,*Basic Nuclear Physics*, Pragati Prakashan,Meerut,005.
11. Donald P.Leach, Albert Paul Malvino, Goutam Saha ,*Digital principle and Applications,* Mc Graw-Hill Publishing Company, 6thEditions, New York, 2008.
12. https://wepdf.com/al/allied-physics
13. https://archive.nptel.ac.in/courses
14. https://nptel.ac.in/courses

COURSE OUTCOME:

Upon completion of this course, the student would be able to

- Understand Coulomb's law, Gauss theorem and gain a brief knowledge of capacitors.
- Understand the properties, types of magnetic materials and hysteresis of ferromagnetic material.
- Acquire the knowledge of atom models and Xrays.
- Know the basics of nucleus and their properties, nuclear reaction, nuclear models and elementary particles.
- Learn the binary number system, binary arithmetic operations, logic gates and De-Morgan's Theorem.

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ALLIED COURSE I

APPLIED PHYSICS I

Code: 22SCACAP1 **(Theory)** **Credit:4**

COURSE OBJECTIVES:

- To bring out the subjects related with the computer field which help students to keep pace with these topics.
- To make the students understand the basic concepts of current electricity alternating current and the related laws.
- To enable the learners to acquire knowledge about four different number systems, conversion, Boolean algebra, Logic gates and semiconductor memories.

UNIT–I CURRENT ELECTRICITY:

Ohm's Law-Verification of Ohm's Law-Kirchhoff's law-Applications of Kirchhoff's law Whetstone's bridge-Metre bridge-Carey Foster's bridge-Potentiometer Measurement of Current and Resistance-Calibration of low range Voltmeter.

UNIT– II ALTERNATING CURRENT:

AC circuits with double components – measurement of current and voltage – power in an AC Circuit-Power Factor (derivation)- Wattless current – Choke - series and parallel resonant circuits - Impedance-Q factor- Sharpness of resonance.

UNIT -III NUMBER SYSTEMS CODES AND LOGIC GATES:

Number Systems - Conversions - Binary: Addition, Subtraction, Multiplication, Division-8421 Code - BCD Code - Excess 3 code - Gray code - Binary to Gray and Gray to Binary Conversion-ASCIIcode–BasicandDerivativeGates:AND,OR,NOT,NAND,NOR,EX-OR - NAND & NOR as Universal Gates.

UNIT – IV BOOLEAN ALGEBRA, ARITHMETIC AND COMBINATIONAL LOGIC CIRCUITS:

Basic laws of Boolean algebra - De Morgan's theorem - Verification of Boolean expression using Boolean laws-Half-adder-Full adder-Half-Subtractor-Full subtractor (using basicgates)–Encoder-Decimal to BCD encoder-Decoder-BCD to decimal decoder.

UNIT–V SEMICONDUCTOR MEMORIES:

Introduction–ROM using diodes and transistors–ROM in terms of digital circuits– Building memory of larger capacity – PROM – EPROM – EEPROM – ROM as a unit in microcomputers–RAM–Static RAM–Dynamic RAM–Memory Parameters.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Solar electricity-Hydro electricity-Digital camera-Digital television-CRO-Digital computer

REFERENCES:

1. BrijLal and N.Subrahmanyam,*A Text Book of Electricity and Magnetism*,S.Chand & Company Pvt. Ltd, New Deihi-2020.
2. Puri V.K.,*Digital Electronics circuits and systems*,TATA Mcgrawhill publications, New Delhi, 2011.
3. Vijayendran.V & Subramanian.V,*Introduction to Integrated Electronics*,S. Viswanath PVT Ltd., Chennai 2012.
4. Murugeshan.R,*Electricity and Magnetism,*S.Chand&CompanyLtd.,Tenthedition, 2017.
5. Sundaravelusamy,A,*Applied Physics Paper-I B.Sc Computer Science,*Karur:Priya Publications, 2011.
6. NarayanamurthiandNagarathinam,*ElectricityandMagnetism,*TheNationalPublishing Company, Madras, 1994.
7. Murugeshan.R, *Electricity and Magnetism,*S. Chand & Company Ltd., 2015.
8. GothamanW.H.,*Digital Electronics,*PrenticeHallofIndiaPVT.,NewDelhi,1996.
9. Sanjay D Jain,*Applied Physics*, Universities Press,Hyderabad,Telengana. 2013
10. TewariK K,*Electricity and Magnetism,*S.Chand & CompanyLtd.,3rdedition,2007.
11. Sathya Prakash,*Electricity and Magnetism,*Pragatiprakashan,2016.
12. Arthur Beiser,*Concepts of ModernPhysics*2009,McGraw-Hill
13. J.R.Taylor,C.D.Zafiratos,M.A.Dubson,*Modern Physics*,2009,PHILearning.
14. Albert Paul,Malvino,*Digital Principles and Applications*,Delhi:TataMcgrawhill Publishing, 2012.
15. TewariKK,*Electricity and Magnetism,*S.Chand & CompanyLtd.,3rdedition,2007.
16. 1.https://archive.nptel.ac.in/courses/115/106/115106122/
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COURSE OUTCOMES:

Upon completion of this course, the students would be able to

- Recall the basic concepts of current electricity and its various laws.
- Solve basic electronics problems with ac circuits that involve capacitance, inductance, impedance, reactance and power calculations.
- Differentiate all the four number systems studied.
- Review Boolean algebra and draw arithmetic circuits.
- Analyse the calibration of electrical instruments.

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ALLIED PRACTICAL
APPLIEDPHYSICS
(Practical)

Code: 22SCACAP1P

Credit:2

COURSE OBJECTIVES:

- To familiarize students with basic laboratory equipment to study the physics concepts encountered in the lecture course.
- To give knowledge of some basic electronic components and circuits.
- To promote the exhaustive requirements and expectations of the students to acquire practical knowledge for the theory given in their syllabus.

ANY 12 EXPERIMENTS:

1. Semi-Conductor diode- Characteristics.
2. Zener diode–Characteristics.
3. FET-Characteristics.
4. Transistor Characteristics-CE configuration.
5. Transistor Characteristics-CB Configuration.
6. Field along the axis of a coil–Determination of M and H
7. Metre Bridge-Determination of Specific Resistance.
8. Potentiometer-Measurement of Current.
9. Potentiometer-Calibration of low range voltmeter.
10. Carey Foster's Bridge-Determination of Specific Resistance.
11. LCR-Series resonance circuit
12. LCR-Parallel resonance circuit
13. Mathematical Operator-Addition, Subtraction using OP-Amp.
14. Logic Gates (AND,OR,NOT,NAND,NOR)Using IC's.-Verification of truth tables.
15. NAND and NOR as Universal Gates.
16. Verification of De-Morgan's Theorems.
17. Half Adder and Half Subtractor using logic gates.
18. Full Adder and Full Subtractor using logic gates.
19. Single Stage Amplifier.
20. Logic Gates (AND,OR,NOT)Using Discrete's.Components–Verification of truth tables.

REFERENCES:

1. Srinivasan M.N.Balasubramanian S. & Renganathan R.,A Text book of Practical Physics, Sulthan Chand & Sons, New Delhi, 2000.
2. SomasundramS.,Practical Physics,Apsara Publications,Tiruchirappalli.2012.
3. Arora CL.,B.Sc.Practical physics,Chand and company,2010.
4. Department of Physics,Practical Physics,(B.Sc.Physics Main),St.Joseph's College, Tiruchirapalli 2009. .
5. Kushwaha P S., Applied physics practical & viva-voce, Bharat Bharati Prakashan & Co, 2015.
6. John Henderson,Practical Electricity and Magnetism,Forgotton books publisher, 2018.
7. Tooley M.,Practical Digital Electronics Hand book Bpb Publications,2008

8. https://onlinecourses.nptel.ac.in/noc20_ph16/preview

COURSE OUTCOMES:

Upon completion of this course, the students would be able to

- Gain the practical knowledge about electricity, magnetism and measurements such as resistance, voltage, current.
- Distinguish electronic components
- Construct the learnt electronic circuits on their own
- Analyze the logic gates and their usage in digital circuits.
- Develop the skill of conducting an experiment collaboratively.

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ALLIED COURSE II
APPLIED PHYSICS II

Code: 22SCACAP2 **(Theory)** **Credit:4**

COURSE OBJECTIVES:

- To impart knowledge of certain important fields of physics by simplifying the learning process to a greater extent
- To make the students understand how Laser and Maser is powerful than normal light, their types and its advantages.
- To inculcate the knowledge of transistor and different configurations, H parameters and applications of FET amplifier.

UNIT–I SEMICONDUCTOR PHYSICS

Theory of energy bands in crystals-Distinction between conductors, Insulators and Semiconductors – Intrinsic and Extrinsic semiconductors – Hall effect in semiconductor– Zener diode –Tunnel diode - Backward diode - Breakdown voltage avalanche Breakdown.

UNIT–II TRANSISTORS:

Transistors - PNP and NPN transistors - DC Characteristics of CE and CB configuration-Hybrid parameters-Functions of Transistor as an amplifier and oscillator – FET-N-channel FET - performance Characteristics - FET amplifier.

UNIT– III LASERS:

Laser and Maser - Basic concepts of stimulated emission –Population inversion and Meta stable state-He-Ne laser-Ruby laser - Ammonia Maser - production – Advantages.

UNIT– IV OPTO-ELECTRONIC DEVICES:

LED Radiation transition - Emission spectra –Luminescent efficiency-Method of Excitation-Visible LED-Materials for LED - LED configuration -Photo conduction – Photodiode-Phototransistor-electronic watches-seven segment display-LCD.

UNIT-V OPERATIONAL AMPLIFIER:

The basic operational amplifier–Inverting and Non inverting operational Amplifier – Differential operational amplifier- CMRR-Basic uses of operational amplifier as sign and scale changer and phase shifter - Adder – Subtractor – comparator - Differentiator - ADC Successive approximation.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Electric car technology-IOT sensors and devices-Robot control-Laser cladding-Barcode reader-Laser surgery-Laser pointer-ADC-DAC.

REFERENCES:

1. Jacob Millman,Micro electronics,Mc Graw Hill publications,NewDelhi,1985.
2. Mithal G.K. and Vanvasi,Pulse and Digital electronics,Khanna publication,New Delhi, 2006.
3. Sundaravelusamy, A, Applied Physics Paper-II B.Sc Computer Science, Karur: Priya Publications, 2011.
4. Theraja,BL,Electronics Devices &Circuits,Delhi:S.Chand&Co, 2011
5. Mehta V.K. & Mehta Rohit, Principles of Electronics (Multi colour Edition) ,10th Rev.edition,2006
6. Ramanan,Function Electronics,TMH,NewDelhi,1994.
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9. SanjayDJain,Engineering Physics,Universities Press,Hyderabad,Telengana 2012.
10. Ali,SN,Basic Electronics,Delhi:Vayu Education of India,2011
11. Amar K Gangully,Opto Electronic Devices and Circuits Theory and Applications, Delhi: Narosa Publishing House, 2011.
12. Mehta V.K,Principles of Electronics,S.Chand&Co,2005.electronics.
13. William T. Silfvast,*Laser fundamentals* Second edition ,University of Central Florid, Cambridge University Press, June 2012.
14. K. ThyagarajanAjoy Ghatak,*Lasers- Fundamentals And Applications* ,Edition:2,Laxmi Publications Pvt Ltd,2019
15. Thomas F. Schubert, Jr. And Ernest M. Kim.*Fundamentals Of electronics. Book 1, Electronicdevices and circuit applications,* SanRafael,California(1537FourthStreet, San Rafael, CA 94901 USA): Morgan & Claypool, 2014.
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17. **https://www.classcentral.com/course/swayam-laser-fundamentals-and-applications-12914**.
18. **https://www.tutorialspoint.com/linear_integrated_circuits_applications/linear_integrated_circuits_applications_op_amp_applications.htm**

COURSE OUTCOME:

Upon completion of this course, the students would be able to

- Understand the rapid growth of electronic technology.
- Know the semiconductors classification and their applications in various domains.
- Analyse the characteristics of transistor, transistor biasing circuits and oscillator circuits.
- Evaluate the advantages of Opto-Electronic Devices.
- Demonstrate analog electrical devices, particularly operational amplifiers and their applications applying the learnt concepts.

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ALLIED COURSE I

DIGITAL COMPUTER FUNDAMENTALS

Code: 22SCACAP1 **(Theory)** **Credit:4**

COURSE OBJECTIVES:

- To provide knowledge on various number systems
- To inculcate the concepts of Boolean algebra
- To make the students learn combinational circuits and flip-flops

UNIT–I NUMBER SYSTEMS AND CODES:

Binary Number System – Binary to Decimal Conversion – Decimal to Binary Conversion – Binary Addition and Subtraction – Binary subtraction by 1s and 2s complement - Binary Multiplication and Division – Octal Numbers – Hexadecimal Numbers – Binary Codes – 8421 code - Error Detecting and Correcting Codes.

UNIT–II BOOLEAN ALGEBRA AND LOGIC GATES:

Boolean Algebra – Laws and Theorems – Minterms and Maxterms –– DeMorgan's Theorems. Logic Gates: AND,OR,NOT,NAND,NOR and Exclusive OR Gates – Exclusive NOR Gate – Positive and Negative Logic – Logic Characteristics –Bipolar Logic Families – Universal Building Blocks (UBB) – NAND Gate as UBB – NOR Gate as UBB.

UNIT–III K MAP TECHNIQUES:

Simplification of Boolean expression using Karnaugh Map with 2,3and4 variables-Sum of Products-AND-OR Network and Product of Sum-NAND and NOR Implementation – AND-OR-INVERT Implementation – OR-AND-INVERT Implementation–Don't Care Conditions–Overlapping Groups–Rolling the Map–Eliminating Redundant Group

UNIT–IV COMBINATIONAL LOGIC CIRCUITS:

Half and Full Adders – BCD Adder - Half and Full Subtractors – Multiplexers (4:1line) – 1to4 line Demultiplexers – Decoders: BCD to decimal, BCD to Seven Segment. Encoders: 4:2line.

UNIT–V SEQUENTIAL LOGIC CIRCUITS:

Flip Flops–RS Flip Flop–Clocked RS Flip Flop–D Flip Flop–JK Flip Flop–T Flip Flop – Triggering of Flip Flops – Master Slave Flip Flop – Conversion of D Flip Flop and T Flip Flop–Clock–Counters and Shift Registers: Counters– Asynchronous or Ripple Counter–Ring Counter.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Twisted Ring Counter–State Diagrams and StateTables–Magnitude Comparator –

Programmable Arrays of Logic Cells – Shift Registers-SISO – SIPO– PIPO – PISO

REFERENCE:

1. Principles of Digital Electronics, Dr.K.Meena,PHI Learning Private Limited, New Delhi, 2009.
2. Integrated Electronics (Analog and digital circuits and systems), Jacob Millman and Christos C. Hal Kias, Tata McGraw Hill edition, New Dehli.
3. Micro Electronics, Digital and Analog circuit and system–Jacob Millman
4. *Digital Logic Design*,M.Morris Mano,Pearson Education,2010
5. *Digital Technology*,Virendrakumar, New Ageinternational (P) Ltd., publisher, New Delhi, 2001.
6. Malvino and Leach–Digital Principle andApplication,2014
7. W.H.Gothmann–Digital Electronics ,Prentice-Hall of IndiaPvt.Ltd
8. https://archive.org/details/digitalcomputerf00bart
9. https://www.pdfdrive.com/digital-computer-fundamentals-computer-architecture-e5719965.html

COURSE OUTCOMES:

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

- Convert numbers from any system to another system
- Design logical circuits based on the learnt concepts of Boolean algebra
- Construct combinational circuits

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ALLIED PRACTICAL

DIGITAL COMPUTER FUNDAMENTALS LAB

Code: 22SACPH1P **(Practical)** **Credit: 2**

(ANY 12 EXPERIMENTS)

1. Verification of Logic gates
2. Construction of Half and Full adder
3. Construction of Half and Full subtractor
4. K-Map
5. Arithmetic Logic Unit
6. Study of Multiplexer and De-multiplexer
7. Encoder and Decoder using diodes
8. Flip-flops using NAND and NOR gate
9. Shift Register
10. Up Down Counters
11. Ring Counter
12. Johnson counter/Twisted ring counter
13. NAND as UBB
14. NOR as UBB
15. Study of RAM

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M.Sc

PROFESSIONAL ETHICS

First Year **CORE COURSE I**

CLASSICAL MECHANICS **Code: P22PYCC11**

Credit: 5

COURSE OBJECTIVES:

- To provide in-depth knowledge on the foundations of Classical Mechanics.
- To familiarize the laws of motion and learn about their applications in other branches of Physics.
- To build a strong base on dynamical systems.

UNIT - I: LAGRANGE'S FORMULATION:

Mechanics of a system of particles – Constraints – Generalized coordinates – DAlembert's principle and Lagrange's equations – Simple application of theLagrangian formulation – Hamilton's (variational) principle and derivation ofLagrange's equations – Generalized momenta and energy – Cyclic coordinates –Conservation Laws.

UNIT – II CENTRAL FORCE MOTION AND RIGID BODY DYNAMICS:

Central Force Motion: General features – The Kepler Problem: inverse square lawforce – Scattering in a central force field. Rigid Body Dynamics: Moment of inertiatensor – Euler angles – Euler's equations of motion – Symmetrical top – Problems.

UNIT – III HAMILTON'S FORMULATION:

Legendre transformation – Hamiltonian and Hamilton's equation of motion –Properties – Derivation of Hamilton's equations from variational principle –Canonical transformation – Applications – Poisson brackets – Hamilton Jacobiequation for Hamilton's principle function – Hamilton's characteristic function –Application (Harmonic Oscillator) – Action-angle variables - Problems.

Unit – IV Small Oscillations and Vibrations:

Small Oscillations: Theory of small oscillations – Eigenvalue problem – Normalmodes and Normal frequencies - Frequencies of free vibrations – Normalcoordinates – Examples – Two coupled Pendula - Linear triatomic molecule –Forced vibrations.

Unit – 5 Theory of Relativity:

Inertial and non-inertial reference frames – Addition of velocities, mass, energy –Mass-Energy equivalence – Pseudo forces – Galilean and Lorentz transformations– Invariance of Maxwell's equations under Lorentz transformation – Lagrangianand Hamiltonian of relativistic particles.

UNIT – 6 CURRENT CONTOURS (For continuous internal assessment only):

Nonlinear Dynamical Systems - Linear Stability Analysis – Classification of Fixedpoints. Hamilton's principle and Lagrange's equations to electrical systems –Dynamics of gyroscopes – Multibody dynamics and robotics.

REFERENCES:

1. H. Goldstein, C. P. Poole and J. Safko, Classical Mechanics (Pearson, NewDelhi, 2011).

2. G. Aruldhas, Classical Mechanics (Prentice Hall of India, New Delhi, 2015).

3. J. C. Upadhyaya, Classical Mechanics (Himalaya, Bangalore, 2019).

4. B. D. Gupta and Satya Prakash, Classical Mechanics (Kedar Nath Ram Nath,Meerut, 2020).

5. S. Dutta, Mechanics (Pearson, New Delhi, 2012).

6. M. Lakshmanan and S. Rajasekar, Nonlinear Dynamics: Integrability, Chaos,and Patterns (Springer, Chennai, 2003).

7. T. L. Chow, Classical Mechanics (CRC, New York, 2013).

8. N. Rana and P. Joag, Classical Mechanics (McGraw Hill, New Delhi, 2017).

9. S. T. Thornton and J. B. Marion, Classical Dynamics of Particles andSystems (Cengage Learning, New Delhi, 2012).

10. H. V. Sharma, S. L. Gupta and V. Kumar, Classical Mechanics (PragatiPrakashan, New Delhi, 2019).

11. R. G. Takwale and P. S. Puranik, Introduction to Classical Mechanics(McGraw Hill, New Delhi, 2017).

12. K. Prathapan, Analytical Problems in Classical Mechanics: Complete Solutions(Dreamtech, New Delhi, 2019).

13. J. Awrejcewicz and Z. Koruba, Classical Mechanics: Applied Mechanics andMechatronics (Springer, Heidelberg, 2012).

14. F. C. Moon, Applied Dynamics (Wiley-VCH, New Delhi, 2008).

15. 1.https://ocw.mit.edu/courses/8-09-classical-mechanics-iii-fall-2014/pages/lecture-notes/

16. https://nptel.ac.in/courses/115105098

First Year PROFESSIONAL ETHICS

CORE COURSE II **Semester I**

MATHEMATICAL PHYSICS

Code: P22PYCC12 **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To give a solid mathematical foundation in vector calculus, matrices and differential equations.
- To help learn and appreciate the importance of Special functions and their applications in Physics.
- To develop mathematical skills and solve problems in various branches of Physics.

UNIT – I VECTOR CALCULUS:

Vector integration – Line integral – Path independence – Surface integral – Flux – Volume integral – Green's theorem – Stokes' theorem – Divergence theorem – Orthogonal curvilinear coordinates – Unit vectors in curvilinear coordinate system – Gradient,divergence, curl and Laplacian in cylindrical and spherical polar coordinates.

UNIT – II MATRICES:

Matrix algebra – Solution of a system of linear equations – Properties of (i) symmetric, (ii) anti-symmetric, (iii) orthogonal, (iv) Hermitian, (v) skew-Hermitian and (vi) unitary matrix – Eigenvalues and eigenvectors of a square matrix – Diagonalization – Matrix Analysis of Single nth order differential equation and system of second order linear differential equations and their solutions.

UNIT – III ORDINARY DIFFERENTIAL EQUATIONS:

Methods of finding solutions of first and second order ordinary differential equations (ODEs) with constant coefficients – Initial value and boundary value problem – Methods of finding solutions – Superposition principle – Wronskian – Definition of ordinary and singular points of second order ODEs – Power series solution – Examples – Solutions about ordinary point and singular point in power series.

UNIT – IV SPECIAL FUNCTIONS:

Strum-Liouville problem – Basic properties – Need for studying Strum-Liouville problems in physics – Specific examples for Strum-Liouville equation: (i) Legendre, (ii) Hermite and (iii) Laguerre differential equations – Power series solutions – Polynomials – Generating function – Rodrigue's formula – Recursion relations – Orthogonality relations.

UNIT – V PROBABILITY:

Definition – Addition rule of probability – Multiplication law of probability – Probability distribution – Binomial distribution – The first four moments of Binomial distribution – Poisson distribution – Normal distribution – The first four moments of Poisson and Normal distribution – Applications of Binomial, Poisson and Normal distributions – Central limit theorem.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Beta, Gamma and Delta functions – Concepts of regression, dimensionality reduction, density estimation and classification – Linear filters and wavelets.

REFERENCES:

1. H. K. Dass and R. Verma, Mathematical Physics (S. Chand, New Delhi, 2022).
2. B. S. Rajput, Mathematical Physics (Pragati Prakashan, Meerut, 2019).
3. N. Saran, S. D. Sharma and T. N. Trivedi, Special Functions (Pragati Prakashan, Meerut, 2021).
4. B. D. Gupta, Mathematical Physics (S. Chand, New Delhi, 2009).
5. Sathya Prakash, Mathematical Physics with Classical Mechanics (S. Chand, NewDelhi, 2021).
6. D. G. Zill and M. R. Cullen, Advanced Engineering Mathematics (Narosa, New Delhi,2020).
7. E. Kreysig, H. Kreysig and E. J. Norminton, Advanced Engineering Mathematics (John Wiley, New Delhi, 2011).
8. G. B. Arfken, H. J. Weber and R. E. Harris, Mathematical Method for Physicists (Academic, Cambridge, 2011).
9. T. L. Chow, Mathematical Methods for Physicists: A Concise Introduction (Cambridge University Press, Cambridge, 2014).
10. M. P. Boas, Mathematical Methods in the Physical Sciences (Wiley, New York, 2018).
11. Charlie Harper, Introduction to Mathematical Physics (Prentice Hall of India, NewDelhi, 1998).
12. M. P. Deisenroth, A. A. Faisal and C. S. Ong, Mathematics for Machine Learnin (Cambridge University Press, Cambridge, 2020).

13. C. Hurley and J. Mclean, Wavelet Analysis and Methods (Ed-Tech Press, London,2018).
14. K. F. Reily, M. P. Hobson and S. J. Bence, Mathematical Methods for Physics and Engineering (Cambridge University Press, Cambridge, 2006).

PROFESSIONAL ETHICS

First Year **CORE CHOICE COURSE I** **Semester I**

1) ANALOG AND DIGITAL ELECTRONICS

Code: P22PYCC1A **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To introduce students to the circuit designs and provide an in-depth knowledge on Digital Electronics.
- To understand the working of advanced semiconductor devices and digital circuits and the utility of OP-AMP.
- To learn the basics of integrated circuit fabrication, applications of timer IC- 555 and the building block of digital systems.

UNIT – I SEMICONDUCTOR DEVICES:

SCR - DIAC - TRIAC – Construction, operation and V-I characteristics –Tunnel diode – Gunn diode – V-I characteristics. Basic monolithic ICs – Epitaxial growth– Masking – Etching - Impurity diffusion – Fabricating monolithic resistors, diodes, transistors, inductors and capacitors – Circuit layout – Contacts and inter connections.

UNIT – II OPERATIONAL AMPLIFIER:

Wien bridge and phase-shift oscillators – Triangular, saw-tooth and square-wave generators – Schmitt trigger – Voltage controlled oscillator – Phase-locked loops -Weighted resistor and binary R-2R ladder D/A converters - Counter type and successive approximation A/D converters – Solving simultaneous and differential equations.

UNIT – III 555 TIMER AND PHASE LOCKED LOOP:

Introduction – Description and functional diagram of 555 timer – Monostable operation – Frequency divider Astable operation – Frequency Shift Keying (FSK) generator. PLL Basic principle – Analog phase detector – Digital phase detector –PLL applications – Frequency multiplication/division.

Unit – IV Digital Circuits-I:

Digital comparator – Parity generator/checker – Data selector - BCD to decimal decoder – Seven segment decoder – Encoders – RS, JK, D, T and JK master-slave flip-flops.

UNIT – V DIGITAL CIRCUITS-II:

Serial-in serial-out, Serial-in parallel-out and Parallel-in serial-out shift registers – Synchronous, asynchronous, ring and up/down (using mod 10) counters -Multiplexers – De-

multiplexers.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Nanoelectronic circuits – New Ohm's law – Energy harvesting – High speed electronic memories –Transmission lines.

REFERENCES:

1. D. P. Leach and A. P. Malvino, Digital Principles and Applications (McGraw Hill, New Delhi, 2006).
2. R. A. Gayakwad, Op-Amps and Linear Integrated Circuits (Pearson, New Delhi, 2021).
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PROFESSIONAL ETHICS

First Year **CORE PRACTICAL I** **Semester I**

GENERAL PHYSICS AND ELECTRONICS I

Code: P22PYCC1P **(Practical)** **Credit: 3**

COURSE OBJECTIVES:

Experimental determination of certain physical constants and properties and verification of characteristics and applications of electronic components and devices.

A. GENERAL PHYSICS EXPERIMENTS:

1. Determination of q, n, by elliptical fringes method.
2. Determination of Stefan's constant.
3. Determination of bulk modulus of a liquid by ultrasonic wave propagation.
4. Determination of Rydberg's constant.
5. Study of Hall effect in a semiconductor.
6. Determination of dielectric constant at high frequency by Lecher wire.
7. Michelson interferometer - Determination of wavelength of monochromatic source.
8. Determination of wavelength of monochromatic source using biprism.
9. Charge of an electron by spectrometer.
10. Polarization of light - Verification of Malus law and Brewster angle of glass.
11. BH loop – Energy loss of a magnetic material – Anchor ring using B.G./CRO.
12. Determination of e/m of an electron by magnetron method.

B. ELECTRONICS EXPERIMENTS:

1. Construction of dual regulated power supply.
2. Astable and monostable multivibrators using IC555.
3. Characteristics of UJT.
4. Characteristics of SCR.
5. Design and study of Wein bridge oscillator using op-amp.
6. Design and study of square and triangular waves generators using op-amp.
7. V-I characteristics of a solar cell.
8. Operation of shift register using serial-in serial-out, serial-in parallel-out and parallel-in serial-out.
9. Digital to analog converter - R-2R and weighted method.

10. BCD to 7 segment display.

11. Study of A/D converter - Counter ramp type method.

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2. G. Kennedy, Electronic Communication Systems (McGraw Hill, New Delhi 1994).13

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PROFESSIONAL ETHICS

First Year **ELECTIVE COURSE I** **Semester I**

1) COMPUTATIONAL PHYSICS WITH C++

Code: P22PYE1A **(Theory)** **Credit: 4**

Objectives:

- To impart knowledge of curve fitting, interpolation, and linear and nonlinear equations.
- To familiarize numerical integration and differentiation.
- To provide the knowledge of C ++ language constructs.

UNIT – I THEORY OF EQUATIONS, THEIR ROOTS AND CURVE FITTING:

Descartes' rules and signs - Cardon method of solving cubic and biquadraticequation - Roots of algebraic and transcendental equations: Graphical method –Bisection method – Method of false position – Newton-Raphson method. CurveFitting: Method of least squares – Normal equations, straight line fit, exponentialand parabola fits.

UNIT – II SOLUTION TO SIMULTANEOUS LINEAR ALGEBRAIC EQUATIONS:

Solution using inverse of a matrix – Crammer rule – Gauss elimination method –Jordan method – Crout reduction method – Factorization method – Jacobiiterative method – Gauss-Seidel iterative method – Solution of tridiagonal system.

UNIT – III INTERPOLATION AND NUMERICAL INTEGRATION

Interpolation: Divided differences - Lagrange interpolation formula. Integration ofa function: Trapezoidal rule for single integral and Simpson's rule for singleIntegral - 1/3 and 3/8 rules. Integration of ODE: Euler formula – modified Euler formula – Fourth order Runge-Kutta method.

UNIT – IV FUNDAMENTALS OF C++ LANGUAGE

Object Oriented Programming paradigm – Benefits of OOP - Applications of C++ -Structure of C++ program – Tokens: Keywords, Identifiers and Constants – Basic data types – User-defined data types – Scope resolution operator. Control structures: Decision making with simple if - if-else - nesting of if-else - switch – go to statement - Looping with while - do-while - for statements - break and continue statements-arrays -Library functions - User-defined functions.

UNIT – V SPECIAL FEATURES OF C++

Encapsulation – Polymorphism - Classes and objects – Specifying a class – Creating objects

– Accessing class members – Defining member functions – Inline functions - Arrays of objects – Objects as function arguments– Returning objects - Friendly functions - Constructors – Destructors – Function overloading –Operator overloading – Overloading unary operators - Overloading binary operators – Rules for overloading operators - Derived classes – Inheritance - Files.

Unit – VI Current Contours (For continuous internal assessment only):

Advanced interpolation methods and certain advanced features of C++: Newton divided difference interpolation formula for unequal intervals - Derivation of Newton forward interpolation formula from Newton divided difference formula.

REFERENCES:

1. H. S. Nita, Numerical Methods with C++ programming (Prentice Hall of India, New Delhi, 2009).
2. D. Ravichandran, Programming with C++ (McGraw Hill, New Delhi, 2014).
3. E. Balagurusamy, Numerical Methods (McGraw Hill, Chennai, 2017).
4. E. Balagurusamy, Object Oriented Programming with C++ (McGraw Hill, New Delhi, 2020).
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10. R. Rajaram, Object Oriented Programming and C++ (New Age International, New Delhi, 1999).
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PROFESSIONAL ETHICS

First Year **VALUE ADDED COURSE I** **Semester I**

RESEARCH PUBLICATION AND ETHICS

Code: P22PYVAC1 **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To provide the fundamental knowledge on basics of research ethics, research integrity and publication ethics.
- To expose research misconduct and predatory publications.
- To explore citation databases, open access publications, research metrics (citations, h-index, Impact Factor, etc.)

UNIT – I PHILOSOPHY AND ETHICS:

Introduction to philosophy: definition - Nature and scope - Concept - Branches – Ethics: Definition - Moral philosophy - Nature of moral judgements and reactions.

UNIT – II SCIENTIFIC CONDUCT:

Ethics with respect to science and research – Intellectual honesty and research integrity – Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) – Redundant Publications: duplicate and overlapping publications, salami slicing – Selective reporting and misrepresentation of data.

UNIT – III PUBLICATION ETHICS:

Publication ethics: definition, introduction and importance – Conflicts of interest – Publication misconduct: definition, concept, problems that lead to unethical behavior and vice – versa, types – Violation of publication ethics, authorship and contributorship – Identification of publication misconduct, complaints and appeals – Predatory publisher and journals.

UNIT – IV OPEN ACCESS PUBLISHING AND PLAGIARISM TOOLS:

Open access publications and initiatives – SHERPA/RoMEO online resource to check publisher copyright & self – archiving policies – Software tool to identify predatory publications developed by SPPU – Journal finger / journal suggestion tolls viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc. Use of plagiarism software like Turnitin, Urkund and other open source software tools.

UNIT – V DATA BASES AND RESEARCH METRICS:

Databases: Indexing databases, Citation databases: Web of Science, Scopus, etc. Research Metrics: Impact Factor of journal as per journal Citations Report, SNIP, SJR, IPP, Citation score – Metrics: h-index, g index, i10 Index, altmetrics.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Group Discussions: Subject specific ethical issues and authorship - Conflicts of interest - Complaints and appeals: examples.

REFERENCES:

1. K. Ravichandran, A. T. Ravichandran, M. Ayyanar and P. Kavitha, Research Methodology and Publication Ethics (Jazym Publications, Tiruchirappalli, 2022).
2. N. H. Steneck, Introduction to the Responsible Conduct of Research (Office of Research Integrity, Maryland, 2007).
3. P. Oliver, Student's Guide to Research Ethics (Open University Press, United Kingdom, 2003).
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5. A. B.H. Dursaton and M. Poole, Thesis and Assignment Writing (Wiley Eastern, New York, 1997).
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PROFESSIONAL ETHICS

First Year **CORE COURSE III** **Semester II**

QUANTUM MECHANICS

Code: P22PYCC21 **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To enhance the knowledge of the foundations of Quantum Mechanics.
- To get acquainted with solving problems using the Schrödinger equation.
- To provide a basic understanding of state vectors in abstract representation.

UNIT – I FOUNDATIONS OF QUANTUM MECHANICS:

Equations of motion of matter waves: Postulates of Quantum mechanics – Time independent Schrödinger equation, Time dependent Schrödinger equations- Physical interpretation of wave function-Normalized and orthogonal wave functions – Solution of Schrödinger equation - Stationary state solutions – Expectation value of dynamical quantities – Probability current density – Ehrenfest's theorem – Wave packets.

UNIT – II EXACTLY SOLVABLE SYSTEMS:

The free particle – One and three dimensional Harmonic oscillator - Particle in a box– Rigid rotator with free axis, with fixed plane – Hydrogen atom — Rectangular potential barrier – Square well potential.

UNIT – III LINEAR VECTOR SPACE AND FORMULATION OF QUANTUM MECHANICS:

Linear vector space – The Hilbert space, Dimensions and basis – Operator and properties – Representation of vectors and operators, Commutator, Function of operator, Eigenvalue and Eigenvector – Matrix representation of bras, kets, and operator – Coordinate and momentum representation and their connection – Projection operator.

UNIT – IV ANGULAR MOMENTUM:

Angular momentum operators – The rotation operator and angular momentum – Spin angular momentum – Total angular momentum operator – Commutation relation – Eigenvalue of angular momentum operator – Matrix Representation – Addition of angular momentum – Clebsch-Gordan coefficients.

UNIT – V PARTICLES AND SPIN:

Physical meaning of identity – Symmetric and anti-symmetric wave functions – Exchange

degeneracy – Particle exchange operator – Distinguishability of identical particle – The Pauli exclusion principle – Spin angular momentum – Electron spin hypothesis - (Pauli) spin matrix for electron – Commutation relations – Two component wave function – Pauli operator – Pauli Eigenvalues and Eigenfunction – Electron-spin formulation – Spin matrix and Eigenmatrix –
Spin matrices and Eigenfunctions.

UNIT – IV CURRENT CONTOURS (For continuous internal assessment only):

Time dependence of density matrix – Symmetry and anti-symmetric wave functions of hydrogen molecule. Concepts of Quantum circuits, computation and information.

REFERENCES:

1. P. M. Mathews and K. Venkatesan, Quantum Mechanics (McGraw Hill, New Delhi, 2010).
2. Satya Prakash, Advanced Quantum Mechanics (Kedar Nath Ram Nath, New Delhi, 2014).
3. S. Rajasekar and R. Velusamy, Quantum Mechanics I: The Fundamentals (CRC Press, Boca Raton, 2022).
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12. A. D. Vos, S. De Baerdemacker and Y. V. Rentergem, Synthesis of Quantum Circuits vs. Synthesis of Classical Reversible Circuits (Morgan and Claypool, California, 2018).
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PROFESSIONAL ETHICS

First year **CORE COURSE IV** **Semester II**

ELECTROMAGNETIC THEORY

Code: P22PYCC22 **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To impart an understanding of the fundamental aspects of electromagnetictheory.
- To build a strong base in Maxwell's equations.
- To bestow knowledge about dispersion and scattering of electromagneticwaves.

UNIT – I ELECTROSTATICS, MAGNETOSTATICS AND ELECTROMOTIVE FORCE:

Coulomb's law - Gauss's law in differential form - Poisson's equation - Laplace's equation – Work and energy in electrostatics – Energy of a point charge distribution – Dielectrics – Induced dipoles – Gauss's Law in the presence of dielectrics. Lorentz force– Biot-Savart Law – Divergence and curl of B – Ampere's Law – Comparison of magnetostatics and electrostatics – Magnetic vector potential. Ohm's Law – Electromotive force - Faraday's Law – induced electric field – Energy in magnetic field.

UNIT – II MAXWELL'S EQUATION AND ELECTROMAGNETIC WAVES:

Maxwell's equations – Poynting theorem - Wave equation in terms of scalar and vector potential – Transverse nature of electromagnetic wave- Conservation of energy and momentum Continuity equation - Propagation of plane electromagnetic waves in (a) free space, (b) Isotropic and Anisotropic nonconducting medium and (c) conducting medium - Skin depth - Polarization of electromagnetic waves.

UNIT – III APPLICATIONS OF ELECTROMAGNETIC WAVES:

Boundary conditions at the surface of discontinuity - Reflection and refraction of electromagnetic waves at the interface of non-conducting media –Fresnel's equations – Reflection and transmission coefficients at the interface between two dielectric media - Brewster's law and degree of polarization -Total internal reflection.

UNIT – IV MICROWAVE GENERATION AND WAVEGUIDES:

Klystron, Magnetron -Travelling wave tube - Rectangular and cylindricalwaveguides - TM

mode – TE mode – TEM mode - Resonant cavities.

UNIT – V DISPERSION AND SCATTERING OF ELECTROMAGNETIC WAVES:

Normal and Anomalous dispersion – Dispersion in Gases – Experimental demonstration of Anomalous dispersion in gases- Solids and Liquids – Clasusius Mossotti relation – Lorentz formula – Scattering and scattering parameters - Theory of scattering of electromagnetic waves – Polarization of scattered light – Coherence and incoherence of scattered light.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Introduction - Conditions for plasma existence – Occurrence of plasma – Magneto hydrodynamics – Magnetic confinement -Pinch Effect-Instabilities- Plasma waves. Waves in guiding structures – Emission of electromagnetic waves – Cellular phone applications – Electromagnetic tunnelling - Photonic crystals.

REFERENCES:

1. Satya Prakash, Electromagnetic Theory and Electrodynamics (Kedar Nath Ram Nath, New Delhi, 2016).
2. D. J. Griffith, Introduction to Electrodynamics (Pearson, New York, 2013)
3. K. K. Chopra and G. C. Agarwal, Introduction to Electromagnetic Theory (Kedar Nath Ram Nath, Meerut, 2010).
4. Narayana Rao, Basic Electromagnetics with Application (Prentice Hall of India, New Delhi, 1997).
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6. A. K. Saxena, Electromagnetic Theory and Applications (Narosa, New Delhi, 2013).
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9. W. Miah, Fundamentals of Electromagnetics (McGraw Hill, New York, 1980).
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11. J. D. Joannopoulo, S. G. Johnson, J. N. Winn and R. D. Meade, Photonic Crystals: Molding the Flow of Light (Princeton University Press, Princeton, 2008).
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PROFESSIONAL ETHICS

First Year **CORE CHOICE COURSE II** **Semester II**

1) ADVANCED MATHEMATICAL PHYSICS

Code: P22PYCC2A **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To give a strong mathematical foundation in linear vector space, tensors andcomplex analysis.
- To provide a basic understanding of hypergeometric functions.
- To impart knowledge on applying group theory to physical problems.

UNIT – I LINEAR VECTOR SPACE:

Definition of linear vector space – Examples – Linear independence – Basis and dimensions of a vector space – Scalar product – Schwartz Inequality – Orthogonality of vectors – Linear transformations – Linear operator – Matrix representation of a linear operator.

UNIT – II TENSORS:

Tensors – Rank of the Tensors – Covariant and Contravariant Tensors – Mixed Tensors – Symmetric and Anti-symmetric Tensors – Invariant Tensors –Kronecker Delta – Levi Civita Symbol – Contraction – Tensor product – Exterior Product – Metric Tensor – Application – Stress and Strain Tensors – Polarizability Tensor - Dynamics of rigid bodies.

UNIT – III COMPLEX ANALYSIS:

Complex variables and functions – Analytic functions – Cauchy-Riemann conditions with proof– Complex integration – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series – Residues and Singularities – Poles – Cauchy's residue theorem – Computations of Residue – Evaluation of the definite integrals – Principal value integrals.

UNIT – IV HYPERGEOMETRIC FUNCTION:

Hypergeometric series – Elementary Properties of Hypergeometric function – Integral representation of Hypergeometric function – Solution of Hypergeometric differential equation – Confluent Hypergeometric function - Properties of confluent Hypergeometric function – Representation of various functions in terms of Hypergeometric and confluent Hypergeometric functions.

UNIT – V GROUP THEORY:

Definition of Group theory – Group table – Sub Group – Classes – Isomorphism and Homomorphism – Schur's Lemma – Orthogonality theorem – The character of representation – Reducible and Irreducible – Formation of character table – Point Groups – Elementary ideas of rotation Groups.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Solving three dimensional inhomogeneous differential equations using Green's functions technique - Fourier spectrum analysis for real time data of nonlinear phenomena like Tsunami waves and unusual seasonal data - Evaluation ofintegrals using residues for natural phenomena.

REFERENCES:

1. H. K. Dass and R. Verma, Mathematical Physics (S. Chand, New Delhi,2022).
2. G. B. Arfken, H. J. Weber and R. E. Harris, Mathematical Method for Physicists (Academic Press, Cambridge, 2011).
3. T. L. Chow, Mathematical Methods for Physicists: A Concise Introduction (Cambridge University Press, Cambridge, 2000).
4. M. P. Boas, Mathematical Methods in the Physical Sciences (Wiley, New York,2005).
5. D. G. Zill and M. R. Cullen, Advanced Engineering Mathematics (Narosa, New Delhi, 2020).
6. V. K. Sharma, Matrix methods and Vector Spaces in Physics (Prentice Hall of India, New Delhi, 2009).
7. S. Rajput, Mathematical Physics (Pragati Prakashan, Meerut, 2020).
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PROFESSIONAL ETHICS

First Year **CORE PRACTICAL II** **Semester II**

GENERAL PHYSICS AND ELECTRONICS II

Code: P22PYCC2P **(Practical)** **Credit: 3**

COURSE OBJECTIVES:

Experimental determination of certain physical constants and properties and verification of characteristics and applications of electronic components and devices.

A. GENERAL PHYSICS EXPERIMENTS

1. Determination of q, n, by hyperbolic fringes method.
2. Determination of thermal conductivity of a good conductor – Forbe's method.
3. Determination of bulk modulus of a liquid using ultrasonic interferometer.
4. Planck's constant - Photoelectric cell.
5. Band gap energy of a semiconductor - Four-probe method.
6. Determination of L of a coil by Anderson's method.
7. Determination of e/m of an electron by Thomson's method.
8. Determinations of wavelength of a laser source using plane diffraction grating and thickness of a wire.
9. Polarizability of liquids by finding the refractive indices at different wavelengths.
10. Magnetic susceptibility of a paramagnetic solution using Quincke's tube method.
11. Determination of specific rotatory power of a liquid using polarimeter.
12. Determination of magnetic susceptibility of liquid by Guoy method.

B. ELECTRONICS EXPERIMENTS:

1. Characteristics of LED and photo diodes.
2. Characteristics of laser diode and tunnel diode.
3. Study of phase-shift oscillator using op-amp.
4. Design and study of Schmitt trigger using op-amp.
5. Flip-flops - RS, JK and D.
6. Decoder and encoder.
7. Pulse-width and pulse-position modulations.
8. Digital comparator using XOR and NAND gates.
9. Characteristics of LDR.

10. Pulse code modulation and demodulation.

11. Voltage controlled oscillator using IC 555.

12. Design of AC/DC voltage regulator using SCR.

REFERENCES:

1. J. Millman and C. C. Halkias, Electronic Devices and Circuits (McGraw Hill, New Delhi, 1985).

2. G. Kennedy, Electronic Communication Systems (McGraw Hill, New Delhi, 1994).

3. D. R. Choudhury and S. Jain, Linear Integrated Circuits (New Age International, New Delhi, 2001).

4. K. A. Navas, Electronics Lab Manual, Volume I&II (Rajat Publications, New Delhi, 2015).

5. M. N. Avadhanulu, A. A. Dani and P. M. Pokley, Experiments in Engineering Physics (S. Chand, New Delhi, 1999).

PROFESSIONAL ETHICS

First Year **ELECTIVE COURSE II** **Semester II**

1) MICROPROCESSOR AND MICROCONTROLLER

Code: P22PYE2A **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the architecture and programming and applications of Intel 8085.
- To know the various peripheral devices and interfacing applications.
- To understand the architecture and programming, and applications of Intel8051.

UNIT - I MICROPROCESSOR ARCHITECTURE AND INTERFACING:

Intel 8085 microprocessor architecture – Pin configuration – Instruction cycle – Timing diagram – Instruction and data formats – Addressing modes – Memory mapping and I/O mapping I/O scheme - Memory mapping I/O interfacing – Data transfer schemes - Synchronous and asynchronous data transfer – Interrupt driven data transfer - Interrupts of Intel 8085.

UNIT - II ASSEMBLY LANGUAGE PROGRAMS (8085 ONLY):

BCD arithmetic - Addition and subtraction two 8-bit and 16-bit numbers - Largest and smallest numbers in a data set – Ascending order and descending order – Sum of a series of a 8-bit numbers – Sum of a series of multibyte decimal numbers – Square root of a number – Block movement of data – Time delay – Square-wave generator.

UNIT - III PERIPHERAL DEVICES AND MICROPROCESSOR APPLICATIONS:

Generation of control signals for memory and I/O devices - I/O ports - Programmable peripheral interface - Architecture of 8255A - Control word - Programmable interrupt controller (8259) - Programmable counter - Intel 8253 - Architecture, control word and operation – Block diagram and interfacing of analog to digital converter (ADC 0800) – Digital to analog converter (DAC 0800) –Stepper motor – Traffic control.

UNIT - IV MICROCONTROLLER 8051:

Features of 8051 – Architecture – Pin configuration – Memory organization --External data and program memory - Counters and timers – Serial datainput/output - Interrupt structure – External interrupts – Addressing modes -Comparison between microprocessor and microcontroller.

UNIT - V 8051 INSTRUCTION SET AND PROGRAMMING:

Instruction set – Data transfer, arithmetic and logical instructions – Booleanvariable

manipulation instructions – Program and machine control instructions –Simple programs – Addition and subtraction of two 8-bit and 16-bit numbers –Division – Multiplication - Largest number in a set – Sum of a set of numbers.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Discussion and demonstration of water level indicator – Security alarm – EVM - Microprocessor system design – FPGAs – Embedded systems - Raspberry Pi.

REFERENCES:

1. B. Ram, Fundamentals of Microprocessor and Microcomputers (Dhanpat RaiPublication, New Delhi, 2006).
2. M. A. Mazidi, J. G. Mazidi and R. Mckinlay, The 8051 Microcontroller and Embbeded Systems using Assembly and C (Pearson, New Delhi, 2007).
3. A. P. Godse and D. A. Godse, Microprocessors and Microcontrollers(Technical Publications, Pune, 2021).
4. R. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085 (Penram International Publishing, Mumbai, 2013).
5. K. Kant, Microprocessors and Microcontroller (Prentice Hall of India, New Delhi, 2013).
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8. V. Vijayendran, Fundamentals of Microprocessor 808 Architecture, Programming and Interfacing (Viswanathan Publication, Chennai, 2002).
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Environment & Sustainability

First Year | **NON MAJOR ELECTIVE COURSE I** | **Semester II**

PHYSICS FOR EVERYONE

Code: P22PYNME1 | **(Theory)** | **Credit: 2**

COURSE OBJECTIVES:

- To understand the fundamental principles and basics of physics.
- To know the light sources in our environment with concepts of physics.
- To impart knowledge on energy sources in diverse fields.

UNIT–I MATTER:

Structure of the atom – Bohr atom Model – Somerfield's Relativistic Atom Model–The Vector Atom Model–Coupling Schemes–Pauli Exclusion Principle–Bonding in Crystals– Ionic, Covalent, Metallic, Molecular, and Hydrogen Bond– Few simple crystal structure.

UNIT–II LIGHT:

Light as an electromagnetic wave – Light velocity in various media – Polarization – Wavelength, Amplitude, Phase, Period, Frequency - Sources of Light –Huygen's principle – Interference, Reflection, Refraction, Diffraction, Scattering – Lenses – Concave, Convex–LED– Laser.

UNIT–III SOUND:

Intensity - Loudness of Sound - Decibel - Free, damped and forced vibrations – Resonance – Reverberation – Absorption coefficient – Damping and Damping Materials – Piezo electric effect – Ultrasonic waves – Transducer, Production and Detection of ultrasonic waves.

UNIT–IV HEAT:

Modes of heat transfer – Conduction, Convection, Radiation – Effect of temperature on thermal conductivity of different solids, liquid and gases-General laws of heat transfer – Black and White body – Emissive power and emissivity, laws of radiation–Planck's Constant.

UNIT–V ENERGY:

Energy Resources – Conventional and Renewable Energy – Energy Conversion –Solar Energy – Solar thermal applications – heating, cooling, desalination, drying, cooking,etc.–Photovoltaic conversion of solar energy, Types of solar cells– Bio mass resources and their classification – Pyrolysis and liquefaction – Biodiesel production – Urban waste to energy conversion.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Ohms law – battery - fuel cells - Methods of generating electrical power: diesel engine - steam engine - Hydro-electric - Nuclear and gas turbine. Layout and main components of electricity distribution - transformers, feeders.

REFERENCES:

1. R.Murugesan,*Modern Physics*(S.Chand,NewDelhi,2018).
2. B.LalandN.Subrahmanyam,*Heat,Thermodynamics and Statistical Physics* (S. Chand, New Delhi, 2008).
3. R.Murugesan,*PropertiesofMatter*(S.Chand,NewDelhi,2017).
4. G. N. Tiwari,*Solar Energy: Fundamentals, Design, Modelling and Applications* (Narosa, New Delhi, 2016).
5. M. S. Longhair,*Theoretical Concepts in Physics*(Cambridge University Press, Cambridge, 2020).
6. D.Franceschetti,*Principles of Physics* (SalemPress,NewYork,2016).
7. A.H.Cook, *Physics of the Earth and Planets* (Macmillan, London, 1973).
8. B.Gutenberg, *Physics of the Earth's Interior* (Academic Press, Cambridge, 1986).
9. https://ocw.aprende.org/courses/physics/

COURSE OUTCOME:

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

- Apply Physics concepts in day-to-day life activities.
- Appreciate the knowledge of light and sound.
- Use the concept of heat in various modes.
- Comprehend energy storage and how to use it as electricity.
- Acquire the knowledge on fundamental Physics ideas for diverse applications.

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PROFESSIONAL ETHICS

Second Year **CORE COURSE V** **Semester III**

THERMODYNAMICS AND STATISTICAL MECHANICS

Code: P22PYCC31 **(Theory)** **Credit:5**

COURSE OBJECTIVES:

- To understand what is temperature and how to calculate it.
- To give an exposure to various statistical ensembles and their applications in physics.
- To get familiar with the foundations and applications of quantum statistics.

UNIT–1 EQUILIBRIUM THERMODYNAMICS:

Review of Laws of thermodynamics and thermodynamic potentials –Microstates and Macro states of classical and quantum systems–Phase space–μ-space and Γ-space – Density of states – Expression for density of states in energy space and momentum space–Introduction to Ensembles–Ensemble average–Principle of a priori probability – Thermodynamic probability – Boltzmann entropy relation-Liouville's theorem – Equilibrium solutions.

UNIT–II MICRO CANONICAL ENSEMBLE:

Introduction–Micro canonical distribution–Micro canonical Average–Entropy(S) – Derivation of S=klogW–Entropy of a Perfect Gas in a Micro canonical Ensemble–Gibbs Paradox–Thermodynamic Quantities in Micro canonical Ensemble.

UNIT–III CANONICAL ENSEMBLE:

Introduction – Canonical Distribution – Canonical Average – Canonical Ensemble Partition Function – Importance of the Canonical Ensemble Partition Function – Maxwell Velocity Distribution – Maxwell Energy Distribution – Most Probable Velocity–Mean Kinetic Energy–Thermodynamic Function–Classical System in a Canonical Ensembles–IdealGas–Micro canonical versus Canonical Ensembles.

UNIT–4 GRAND CANONICAL ENSEMBLE:

Introduction – Grand Canonical Distribution – Grand Canonical Average –Grand Canonical Partition Function–Quantum Statistics–Thermodynamic Functions in Grand canonical Ensemble – Classical System – Ideal Gas in Grand Canonical Ensemble–Density and Energy Fluctuations–Comparison of Various Ensembles.

UNIT–V QUANTUM STATISTICS:

Need for Quantum Statistics–Difference between classical and quantum statistics – Identical Particles – Bosons and Fermions – Symmetric and anti-symmetric wave functions – Difference between Bose-Einstein and Fermi-Dirac statistics–Calculating the partition function for Bosons and Fermions–

Derivation of Bose-Einstein and Fermi-Dirac distributions – Definition ofthermal wavelength – Bose-Einstein Condensation -Applications – Black body radiation(Bose system)–Fermi gas at low temperature–Fermi momentum.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

The Boltzmann Distribution: Convergence of the stochastic dynamics–Monte-Carlo Simulation – Simulated annealing – Boltzmann machines – Sampling – Interactions–Optimization–Inference–Learning–Restricted Boltzmann machines. Bayesian networks– q-bit systems–Quantum annealing.

REFERENCES:

1. K.AgarwalandM. Eisner,StatisticalMechanics(NewAge International,New Delhi, 2020).
2. R.K. Pathria and P.D. Beale, Statistical Mechanics (Academic Press, Cambridge, 2021).
3. S.L.Kakaniand C.Hemrajani,Statistical Mechanics(VivaBooksPrivate Limited,NewDelhi,2017).
4. K.Saxena,An Introduction to Thermodynamics and Statistical Mechanics (Alpha Science International, New Delhi, 2010).
5. Satya Prakash,Statistical Mechanics(KedarNathRamNath,Meerut,2008).
6. S.ChandraandM.K.Sharma,ATextbook on StatisticalMechanics (CBS Publisher, New Delhi, 2016).
7. S.C.Garg,R.M.Bansal and C.K.Ghosh,Thermal Physics:KineticTheory, Thermodynamics and Statistical Mechanics (McGraw Hill, New Delhi, 2013).
8. D.A.McQuarrie,Statistical Mechanics(VivaBooksIndia,NewDelhi,2018).
9. F.Reif,Fundamentals of Statistical and ThermalPhysics (SaratBooks,Kolkata, 2010).
10. Engel and C.V.D.Broeck,Statistical Mechanics of Learning (Cambridge UniversityPress,Cambridge,2001).
11. W.Greiner,L.NeiseandH.Stocker, Thermodynamics andStatistical Mechanics(Springer,NewYork,2001).
12. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf
13. https://nptel.ac.in/courses/104103112

COURSE OUTCOMES:

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

- Calculate the thermodynamical quantities,theoretically,using different methods.
- Construct partition function for a system in thermal equilibrium and calculate the corresponding thermodynamical quantities.
- Applyensembleapproachtosolveclassicalandquantumthermodynamicsystems.
- Explain Bose-Einstein condensation and its applications.
- Demonstrate the ensemble approach to different physical problems like Black body radiation, white dwarfs, etc.

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PROFESSIONAL ETHICS

Second Year | **CORE COURSE VI** | **Semester III**

SOLID STATE PHYSICS

Code: P22PYCC32 | **(Theory)** | **Credit:5**

COURSE OBJECTIVES:

- To give exposure to structural properties of crystals and the X-ray diffraction principle.
- To enhance understanding of the properties of conductors and semiconductors.
- To build a strong foundation for the materials 'lattice dynamics and thermal, dielectric and electrical properties of materials.

UNIT–I CRYSTAL STRUCTURE:

Crystal symmetry–symmetry elements-symmetry operations-Bravais lattices– Miller indices – X-ray diffraction – Bragg's law – Experimental methods of X-ray diffraction: Rotating crystal method and Debye – Scherrer powder method. Scattered wave amplitude: Fourier analysis-reciprocal lattice vector–Diffractioncondition– Laue equations-Brillouin zones–reciprocal lattices to SC and BCC lattices– structure factor of BCC lattice–Atomic form factor.

UNIT–II CONDUCTORS AND SEMICONDUCTORS:

Conductors: Free electron theory – Classical and Quantum theory – Band theory of solids – Density of states – K-space – Bloch theorem – Kronig-Penny model – Electrical conductivity and Ohm's law: Experimental electrical resistivity of metals – Umklappscattering.Semiconductors:IntrinsicandExtrinsicsemiconductors– Band gap – Effective mass – Carrier concentration – Electrical conductivity – Wiedmann-Franz law – Hall effect – Determination of type of conductivity – Carrier concentration – Mobility – Resistivity.

UNIT–III MAGNETIC AND DIELECTRIC PROPERTIES:

Langevin's classical theory of diamagnetism and paramagnetism–Quantumtheory of paramagnetism–Weiss theory of ferromagnetism–Origin of domains–Hysteresis –Domain theory–Curie temperature and Neel temperature.Dielectrics– Macroscopic electric field – Local electric field – Clausius-Mosotti relation - Dielectric constantandpolarizability– Typesofpolarization–Determinationofdielectric constant – Parallel plate method.

UNIT–IV SUPERCONDUCTIVITY:

Zeroresistance–Behaviourinmagneticfield–Meissnereffect–Heatcapacity– Energy gap – Microwave and infrared properties – Isotopic effect –Type I and Type II superconductors – Entropy –Thermal conductivity – Thermodynamics of superconducting transmission - London equations – Coherence length– BCS theory – Penetrationdepth–JosephsonEffect– ACandDC–Quantumtunneling–HighTc super conductors.

UNIT–V OPTICAL PROPERTIES AND NEW MATERIALS:

Photoconductivity – Simple model of photoconductor – Traps – Influence of traps – Luminescence and its types–Photo luminescence–Cathodo luminescence–

Chemi luminescence and Thermo-luminescence and glow curve.Shapememoryalloys – Types – Structure – Temperature induced transformation – Stress induced transformation – Functional properties – Shape memory effect – Super elasticity.

UNITVI CURRENT CONTOURS(For continuous internal assessment only):

Applications of superconductors – SQUID - Maglev. Electron transport in semiconductors and nanostructures – Semiconductor quantum wells – Molecular materials – Nonlinear optics.

REFERENCES:

1. N.Singh,Solid State Physics(WileyIndia,NewDelhi,2021).
2. S.L.GuptaandV.Kumar,Solid State Physics (KedarNathRamNath,Meerut, 2000).
3. R.L.Singhal,Solid State Physics(KedarNathRamNath,Meerut,2005).
4. M.Arumugam,Material Science(AnurathaAgencies,Chennai,2002).
5. J. P. Srivastava, Elements of Solid State Physics (Prentice Hall of India, New Delhi, 2014).
6. M. A. Wahab, Solid State Physics: Structure of Properties of Materials (Narosa, New Delhi, 2001).
7. S. L. Kakani and A. Kakani, Materials Science (New Age International, New Delhi, 2016).
8. Kittel,Introduction to SolidState Physics (Wiley,NewDelhi,2019).
9. Omar,Elementary Solid State Physics(Pearson,NewDelhi,1999).

a. Gupta and N. Islam, Solid State Physics and Electronics (Books & Allied, Kolkatta, 2012).

10. M.A.Wahab,Numerical Problems in Solid State Physics(Narosa,NewDelhi, 2019).
11. Kumar,Introductionto Solid State Physics(PrenticeHallofIndia,NewDelhi, 2010).
12. V.V.Mitin,V.A.KochelapandM.A.Stroscio,IntroductiontoNanoelectronics (Cambridge University Press, Cambridge, 2012).
13. K. S. Thorne and R. D. Blandford, Modern Classical Physics (Princeton University Press, Princeton, 2018).
14. http://physics.bu.edu/~okctsui/PY543/3_notes_Crystals_2013.pdf
15. http://www.phys.nthu.edu.tw/~spin/course/106F-2/Chapter%203.pdf
16. https://nptel.ac.in/courses/115105099

COURSE OUTCOMES:

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

- Apply the knowledge of crystal structure to various types of crystalline solids, electrical and magnetic materials.
- Differentiate various solid materials basedontheir properties and the learnt theories.
- Analyse the magnetic dielectric and optical properties of materials.
- Understand the peculiar properties of superconducting materials.
- Know new materials and their practical applications.

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PROFESSIONAL ETHICS

Second Year **Semester III**

CORE CHOICE COURSE III
1.ADVANCED QUANTUM MECHANICS

Code: P22PYCC3A **(Theory)** **Credit:5**

COURSE OBJECTIVES:

- To get acquainted with approximation methods for time-independent and time-dependent Hamiltonians.
- To provide a sound knowledge of atomic and molecular structure through quantum formalism.
- To give a basic understanding of the theory of relativistic quantum mechanics.

UNIT–I TIME INDEPENDENT PERTURBATION THEORY:

Stationary theory – Non-degenerate case: First and Second order corrections-Normal Helium atom –– Degenerate case: Energy correction - Stark effect in Hydrogen atom and Hydrogen molecule––Zeeman effect without electron spin.

UNIT–II TIME DEPENDENT PERTURBATION THEORY:

Constant perturbation – Transition probability - Fermi Golden Rule –Harmonic perturbation – Adiabatic and sudden approximation. Semi classical theory of Radiation: Application of the Time dependent perturbation theory to semi classical theory of radiation.

UNIT–III VARIATION METHOD:

Variation principle–Upper bound states–Ground state of Helium atom– Hydrogen Molecule – WKB approximation – Schrödinger equation – Asymptotic solution – Validity of WKB approximation – Solution near a turning point – Connection formula for perturbation barrier.

UNIT–IV RELATIVISTIC QUANTUM MECHANICS:

Klein-Gordon equation - Charge and current densities – Interaction with electro magnetic field – Hydrogen like atom – non relativistic limit – Dirac relativistic equation: Dirac relativistic Hamiltonian – Probability density – Dirac matrices – Plane wave solution – Eigen spectrum – Spin of Dirac particle – Significance of negative eigen state – electron in a magnetic field – Spin magnetic moment.

UNIT–V MANY ELECTRON SYSTEMS:

The Hartree – Fock self-consistent field method–Electron correlation–The atomic Hamiltonian – The Cordon State rules – The Born – Oppenheimer– Approximation– The Hydrogen molecule ion–Approximate treatment of H^{2+} ground state–Molecular orbitals theory–The Hydrogen moleculeion–H_2^+.s

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Lagrangian and Hamiltonian formulation of classical fields–Quantization of fields – Quantization of the Schrödinger equation – Klein Gordan and Dirac field – Quantization of electromagnetic fields.

REFERENCES:

1. SatyaPrakash,Advanced Quantum Mechanics(KedarNathRamNath,Meerut, 2014).
2. P.M.MathewsandK.Venkatesan,Quantum Mechanics(McGrawHill,New Delhi, 2010).
3. N.Levine,Quantum Chemistry(Pearson,NewDelhi,2016).
4. K. D. Krori, Principles of Non-Relativistic and Relativistic Quantum Mechanics (Prentice Hall of India, New Delhi, 2012).
5. AjitKumar,Fundamental of Quantum Mechanics(CambridgeUniversity Press, Cambridge, 2018).
6. S.Rajasekarand R.Velusamy,Quantum MechanicsI:The Fundamentals (CRC Press, Boca Raton, 2022).
7. V.K.Thankappan,Quantum Mechanics(NewAgeInternational,NewDelhi, 2003).
8. K.GhatakandS. Lokanathan,Quantum Mechanics,(Trinity,NewDelhi, 2019).
9. D.J.Griffiths, Introduction to Quantum Mechanics (Cambridge University Press, Cambridge, 2020).
10. N.Zettili,Quantum Mechanics:Concepts and Application(Wiley,NewDelhi, 2022).
11. L.I.Schiff,J.Bandhyopadhyay,Quantum Mechanics(McGrawHill,New York, 2017).
12. https://nptel.ac.in/courses/115103104
13. https://theory.physics.manchester.ac.uk/~judith/AQMI/PHYS30201.pdf

COURSE OUTCOMES:

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

- Understand three approximation methods.
- Compute the correction in energy using the approximation technique.
- Apply the approximation method to the stationary state problem.
- Appreciate the relativistic effecting quantum mechanics.
- Acquire basicknowledge of atomic and molecular structures.

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Second Year **CORE PRACTICAL III** **Semester III**

MICROPROCESSOR AND PROGRAMMING IN C++

Code: P22PYCC3P **(Practical)** **Credit:3**

COURSE OBJECTIVES:

- To develop programming skills in microprocessor and C++ programming to solve some mathematical problems and learn their applications.

A. Microprocessor (8085)

1. Finding the largest and smallest numbers in a data array.
2. Arranging a set of numbers in ascending and descending orders.
3. Study of multi byted decimal addition and subtraction.
4. Study of seven segment display.
5. Study of DAC inter facing (DAC 0900).
6. Study of ADC inter facing (ADC 0809).
7. Study of programmable interrupt controller (IC8259).
8. Traffic control system.
9. Digital clock.
10. Generation of square and sine waves using DAC0800.
11. Digital thermometer (temperature controller).
12. Control of stepper motor using microprocessor.

B. C++Programming

1. Least-squares curve fitting–Straight-line fit.
2. Least-squares curve fitting–Exponential fit.
3. Real roots of one-dimensional nonlinear equations-Newton Raphson method.
4. Complex roots of one-dimensional non linear equations-Newton-Raphson method.
5. Interpolation–Lagrange method.
6. Numerical integration–Composite trapezoidal rule.
7. Numerical integration–Composite Simpson's 1/3rule.
8. Solution of a second-order ODE–Eulermethod.
9. Solution of a first-order ODE–Fourth-order Runge-Kutta method.
10. Gaussian random number generation–BoxandMullermethod.
11. Calculation of mean and standard deviation of a set of uniform random numbers.
12. Computation of eigen values of linear harmonic oscillator by numerically solving Schrödinger equation.

REFERENCES:

1. Nagoorkani, *8085 Microprocessor and its Applications* (McGraw Hill, New Delhi, 2017).
2. Stroustrup, *Programming: Principles and Practice Using C++*(Addison Wesley, Massachusetts, 2014).

COURSE OUTCOMES:

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

- Acquire hands – on knowledge of Microprocessor programming
- Understand DAC and ADC interfacing.
- Gain Knowledge of Traffic control systems.
- Acquire hands – on knowledge of C++ Programming.
- Determine the eigen values of the harmonic oscillator numerically.

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Second Year **ELECTIVE COURSEIII** **Semester III**

1. PHYSICS OF NANOMATERIALS

Code: P22PYE3A **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To provide an introduction to nanomaterials and their peculiar properties.
- To describe various techniques for the preparation of nano materials.
- To introduce various applications and characterization techniques.

UNIT–I INTRODUCTION TO NANOTECHNOLOGY:

Emergence of nanotechnology – Nanomaterials – Classification of nanomaterials based on composition, number of dimensions in nanoscale and morphology – Characteristics of nanomaterials – Surface area to volume ratio – Its effect on properties of nanomaterials – Nanoparticles – Nanoclusters – Nanocomposites – Nanohybrids.

UNIT–II QUANTUM DOTS AND CARBON NANOTUBES:

Quantum dots (QDs) – Excitons confinement in quantum dots – Production and applications of QDs – Quantum wires – Quantum wells – Carbon allotropes – Discovery of C60 – Fullerenes –Types of fullerenes – Bucky balls – Carbon nanotubes (CNTs) – Single walled CNTs – Multi-walled CNTs – Properties of CNTs – Synthesis of CNTs – Plasma-arc discharge method –Laser ablation technique – Chemical vapour deposition method–CNT emitters - Potential applications of CNTs.

UNIT–III PREPARATION OF NANOMATERIALS:

Nanomaterials preparation: Top-down method – Working principles, merits and demerits of Ball milling – Photolithography–Electron beam lithography – Molecular beam epitaxy – Bottom-up technique – Soft-chemical method – Sol-gel synthesis –Electro chemical deposition – Atomic layer deposition – Langmuir - Blodgett film (2D nanostructure) preparation–Green synthesis.

UNIT – IV ANALYTICAL TECHNIQUES FOR NANOMATERIALS CHARACTERIZATION

Structural characterization: Principle of X-ray powder diffraction – Determination of structural parameters – Optical studies: UV-Vis-NIR spectrometry – Band gap determination by Tauc's plot method – Surface morphological analysis: Scanning electron microscopy (SEM) – Scanning tunnelling microscope (STM) –Transmission Electron Microscope (TEM) –X-ray photoelectron spectroscopy (XPS).

UNIT–V APPLICATIONS OF NANOMATERIALS:

Nanoelectronics – Molecular diodes and transistors – Quantum electronic devices – Nano photonics – Photonic crystals – Nano electro mechanical systems (NEMS) – Nanomaterials in energy conversion and storage – Nanomaterials as antibacterial agents–Nanomaterials as photocatalysts – Energy efficient windows – Nanomaterial in industrial applications – Bio-medicalapplications: Targeted drug delivery.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Potential applications of nanomaterials**:** CNTs Air and Water Filtration - Conductive Plastics – Conductive adhesives- CNT ceramic materials – Nano porous filters - Electron transport in semiconductors and nanostructures – Nanostructure devices.

REFERENCES:

1. K. Ravichandran, K. Swaminathan, P. K. Praseethaand P. Kavitha,Introduction to Nanotechnology (Jazym Publications, Tiruchirappalli, 2019).
2. R.Anand,Essentials of Nanotechnology (Scientific International, NewDelhi, 2017).
3. G. Cao, Nanostructures and Nanomaterials, Synthesis, Properties and Applications (World Scientific, Singapore, 2011).
4. K.P.Mathur,NanoscienceandTechnology(RajatPublications,NewDelhi,2009).
5. P.PooleandF.J.Owens, Introduction to Nanoscience and Nanotechnology (Wiley,NewDelhi,2020).
6. K.K.Chattopadhyay and A.N.Banerjee, Introduction to Nanoscience and Nanotechnology (Prentice Hall of India, New Delhi, 2014).
7. M.Ratner, Nanotechnology: A Gentle introduction (Pearson,NewDelhi,2006).
8. M. Wilson, K. Kannangara, G. Smith, M. Simmons and B. Raguse, Nanotechnology: Basic Science and Emerging Technologies (CRC Press, Boca Raton, 2002).
9. S. Edelstein and R. C. Cammaratra, Nanomaterials: Synthesis, Properties and Applications (Taylorand Francis,Oxford,1996).
10. J.H. Davies, The Physics of Low Dimensional Semiconductors (Cambridge UniversityPress,Cambridge1998).
11. V. V. Mitin, V. A.Kochelap and M. A. Stroscio, Introduction to Nanoelectronics (Cambridge University Press, Cambridge, 2012).
12. http://engineeringphysics.weebly.com/uploads/8/2/4/3/8243106/unit_8_nano_materials_1.pdf
13. https://nptel.ac.in/courses/118102003

COURSE OUTCOMES:

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

- Explain how the Nano-sized materials differ from bulk materials.
- Classify the synthesizing techniques suitable for different Nano-structured materials.
- Make use of the available instruments to study the properties of nanomaterials.
- Assess the effect of grain sizes on various properties of nanomaterials.
- Interpret the results of physical and chemical properties measurements.

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Second Year **ELECTIVE COURSE III** **Semester III**

3. **METHODS OF SPECTROSCOPY**

Code: P22PYE3B **(Theory)** **Credit:4**

COURSE OBJECTIVES:

- To give an exposure to the methods of spectroscopy.
- Make them understand the essential elements of spectroscopy and its applications.
- To impart knowledge on the applications of Spectroscopy.

UNIT1: ATOMIC AND MOLECULAR STRUCTURE

Molecular spectroscopy – Introduction – Experimental methods – Central field approximation – Spin – orbit interaction - Doublet separation – Intensities – Complex atoms – Coupling schemes – Energy levels – Selection rules and intensities in dipole transition – Heitler London theory – Atomic and molecular hybridorbitals – Hartree-Fock equations – Method of self-consistent field.

UNIT–II RAMAN AND IR SPECTROSCOPY:

FT Raman spectroscopy – Degree of depolarization- Basic principle – Quantum theory of Raman effect-Experimental techniques of Raman spectroscopy - IR spectra of polyatomic molecules - Experimental techniques of IR- IR imaging-vibrational frequencies analysis – determination of molecular structure – XY, XY2 and XY3 type molecules using IR and Raman spectra - Nonlinear Raman spectroscopy.

UNIT–III FLUORESCENCE AND PHOSPHORESCENCE SPECTROSCOPY:

Electronic excitation and vibrational analysis of diatomic molecules -Deslander's Table - Intensity distribution-Franck Condon principle - Electronic bands – Resonance and normal fluorescence – Intensities of transitions - Phosphorescence - Population of triplet state – Experimental methods – Applications of Fluorescence and Phosphorescence.

UNIT–IV NMR AND NQR SPECTROSCOPY:

NMR spectroscopy -Basic principles -Classical and quantum mechanical treatments – Bloch equations – Spin – spin and spin – lattice relaxation – Experimental technique – Single coil and double coil method - Principle and working of high resolution NMR spectrometer - Chemical shift - Applications.
NQR spectroscopy: Basic principle and fundamental requirements – Quadruple Hamiltonian – Nuclear quadruple energy levels for axial and non-axial symmetry.

UNIT–V ESR AND MOSSBAUER SPECTROSCOPY:

ESR spectroscopy - Basic principles - ESR spectrometer - Nuclear interaction and hyperfine structure – Relaxation effects - 'g' factor - Experimental set up for ESR-biological applications. Mossbauer spectroscopy: Mossbauer Effect – Recoil less emission and absorption – Doppler velocity shift – experimental arrangement–

Mossbauer spectrum - Chemical isomer shift - Magnetic hyperfine and electric quadrupole splitting – Applications.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Electron and neutron spectroscopy - Ultrafast laser spectroscopy - Respiratory gas analysis in hospitals - Gamma ray spectroscopy - Non-destructive elemental analysis by X-ray fluorescence (Introduction only) - Molecular photo physics– Laser spectroscopy.

REFERENCES:

1. B.P.StraughanandS.Walkar, Spectroscopy Vols.1,2 (ChapmanandHall, Boca Raton, 1994).
2. R.Chang, Basic Principles of Spectroscopy (Mc GrawHill, NewYork, 1980).
3. D.A.Long, Raman Spectroscopy (Mc GrawHill,NewYork,1977).
4. H.E.White, Introduction to Atomic Spectra (Mc GrawHill, NewDelhi, 2016).
5. S. L. Gupta, V. Kumar and H. V. Sharma, Elements of Spectroscopy (Pragati Prakashan, Mumbai, 2017).
6. C.N.Banwell,Fundamentals of Molecular Spectroscopy (Mc GrawHill,New Delhi, 2016)
7. G.Aruldhas, Molecular Structure and Spectroscopy (Prentic Hall of India, New Delhi, 2014).
8. M.Chandra, Atomic Spectra and Chemical Bond(Dream tech Press, New Delhi, 2019)
9. G.Herzberg,Molecular Spectra and MolecularStructure(Dover,NewYork, 2008).
10. P. C.PooleandH.A.Farach,TheoryofMagneticResonance(Wiley,New Delhi, 1987).
11. J.Workman and A.Springsteen, Applied Spectroscopy (Boston Academic Press, Massachusetts, 1998).
12. D.L.Andrews and R.H.Lipson, Molecular Photophysics and Spectroscopy (IOP Publishing, Bristol, 2021).
13. P.N.Ghosh,Laser Physics and Spectrocopy (CRCPress, Boca Raton, 2018).
14. https://resources.saylor.org/wwwresources/archived/site/wp-content/uploads/2012/07/Chapter1011.pdf
15. https://nptel.ac.in/courses/104106122

COURSE OUTCOME:

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

- Acquire knowledge and problem – solving skills in atomic and molecular spectroscopy.
- Understand the applications of spectroscopy in day-to-day life.
- Gain knowledge about the Quantum behavior of atoms in external electric and magnetic fields.
- Interpret the electromagnetic spectra and the interaction of radiation with matter.
- Get familiar with the light sources and spectroscopic techniques to explain the structure of materials.

Second Year **NON MAJOR ELECTIVEII** **Semester III**

RENEWABLE ENERGY SOURCES

Code: P22PYNME2 **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To understand the necessity of using solar energy.
- To learn the fundamentals of solar energy conversion systems.
- To comprehend the challenges in sustainable energy processes.

UNIT–I BASICS OF SOLAR ENERGY:

Energy resources - conventional and non-conventional energy sources - World's future energy - energy sources and their availability - prospects of renewable energy sources-Sun as a source of energy – Solar radiation – Effects of atmosphere on solar radiation – Solar radiation at the Earth's surface – Sun shine recorder – Importance of solar energy.

UNIT–II SOLAR THERMAL AND PHOTOVOLTAIC SYSTEMS:

Solarthermalpowerplant–OTEC-Solarcookers–Solarhotwatersystems– Solar greenhouses – Space heating - Conversion of solar energy into electricity – Photovoltaiceffect–Solarphotovoltaiccell–Electricalcharacteristics-Efficiency - Solar photovoltaic applications – Battery chargers – Domestic lighting –Street lighting–Waterpumpingandirrigation-Solarcooling.

UNIT–III WIND ENERGY:

Basic principles–Global wind–Local wind–Nature of wind-Basic components of wind energy conversion systems - Wind turbine sitting – Energy estimation -Major applications of wind power – Horizontal axis wind turbine – Environmental aspects.

UNIT–IV BIO MASS ENERGY:

Introduction – Useful forms of biomass, their composition and fuel properties – Bio mass resources–Bio mass gasification–Wet and dry process-Biogas production from waste biomass – Advantages of anerobic digestion-Availability of raw materials and gas yield.

UNIT–V GEO THERMAL ENERGY:

Introduction – Applications – Origin and distribution of geothermal energy – Tidal energy - Origin and nature of tidal energy – Limitations of tidal energy – Ocean thermal energy – Ocean thermal energy conversion technology-OTEC – Open cycle and closed cycle.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Recent power production techniques-from water - Hydrogen fuel cell -Alternate power production systems-Lithium ion battery-Water pumping and irrigation in India – Wind energy programme in India - Biomass energy programme in India – Advantages of OTEC.

REFERENCES:

1. F.KriethandJ.F.Kreider, Principles of Solar Engineering (Mc GrawHill, New York, 1978).
2. Meinel and A. P. Meinel, Applied Solar Energy (Addison Wesley, Massachusetts, 1976).
3. G.D.Rai, Solar Energy Utilization (Khanna Publishers, New Delhi, 1995).
4. S.P.Sukhatme, Solar Energy: Principles of Thermal Collection and Storage (Mc GrawHill, NewDelhi, 2009).
5. M.P.Agarwal, SolarEnergy (S.Chand,NewDelhi,1983).
6. P.Kothari,K.C.Singal and R.Ranjan, Renewable Energy Sources and Emerging Technology (Prentice Hall of India, New Delhi, 2016).
7. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications (Narosa, New Delhi, 2002).
8. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications (Prentice Hall of India, New Delhi, 2015).
9. Goel, M. A. Khot and S. Patil, Wind and Solar Energy (Technical Publications, Pune, 2021).
10. BH.Khan, Non-Conventional Energy Resources (Mc Graw Hill, New Delhi, 2016).
11. H.P.Garg, J.Prakash, Solar energy: Fundamentals and Applications (Mc Graw Hill, New Delhi, 2021).
12. R.S.Khurmi, Material Science (S.Chand, New Delhi, 2014).
13. https://nptel.ac.in/courses/121106014
14. http://www.ener-supply.eu/downloads/ENER_handbook_en.pdf

COURSE OUTCOMES:

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

- Design photovoltaic systems for different applications meeting residential and industrial needs.
- Understand the manufacturing processes of solar energy – based devices.
- Utilize solar energy for future energy needs.
- Use all sorts of energy.
- Expand the availability and proper utility of non-conventional energy sources.

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PROFESSIONAL ETHICS

Second Year **CORE COURSE VII** **Semester IV**

CRYSTAL GROWTH AND THINFILM PHYSICS

Code: P22PYCC41 **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To introduce the knowledge of crystal growth and its characterization.
- To understand the basic ideas of thinfilm fabrication.
- To impart knowledge about working principles of various analytical techniques.

UNIT–I NUCLEATION THEORIES:

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 – Becker and Doring concept on nucleation rate–Energy of formation of a spherical nucleus - Statistical theory on nucleation: Equilibrium concentration of critical nuclei, Free energy of formation.

UNIT–II CRYSTAL GROWTH TECHNIQUES:

Growth from low temperature solution: Selection of solvents and solubility– Meir's solubility diagram – Saturation and super saturation – Meta stable 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. Melt Growth Techniques: Bridgman technique – Czochralski technique– Verneuil method – Merits and demerits.

UNIT–III FUNDAMENTALS AND APPLICATIONS OF THIN FILMS:

Introduction – Advantages of thin film devices over their bulk counterparts – Thin film growth stages: Nucleation stage – Island stage – Coalescence stage–Channel, hole and continuous film stage–Properties of thinfilms: Sheet resistance – Porosity – Surface roughness – Adhesion – Applications of thin films: Thin films in photovoltaic technologies dye sensitised solar cells – Thin films in electronic devices – Thin films in disinfectant technologies – Optical coatings – Chemical and mechanical applications.

UNIT- IV PHYSICAL DEPOSITION AND CHEMICAL DEPOSITION METHODS:

Basics of vacuum – Physical Vapour Deposition (PVD) – Thermal evaporation – Electron beam evaporation – Pulsed Laser Ablation – Molecular Beam Epitaxy – Sputtering techniques - DC and RF sputtering – Ion plating Chemical methods – Electro deposition and electroless plating – Chemical bath deposition –Spray pyrolysis – Spin coating – Dip coating – SILAR – Electro spinning –Hydrothermal –Sol-gel synthesis–Metalorganic (Chemical vapour deposition).

UNIT–V CHARACTERISATION TECHNIQUES:

X- Ray Diffraction (XRD)–Powder and single crystal–Fourier transform Infrared – Raman analysis (FT-IR) –UV-Visible spectrometer – Photoluminescence - Vickers Microhardness-Chemical Etching-Surface Profilometry-Energy dispersive analysis of X-ray (EDAX) – Atomic force microscopy (AFM) – Thermo gravimetric analysis (TGA) – Differential thermal analysis (DTA).

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Demonstration of solution growth instruments and solubility measurements – Demonstration of vertical Bridgmann growth and Czochralski growth process and ampoule designing for Bridgmann growth - Demonstration of characterisation techniques.

REFERENCES:

1. J.C.Brice, *Crystal Growth Processes* (Wiley,NewYork,1986).
2. P.S.Ragavan and P.Ramasamy, *Crystal Growth Processes and Methods* (KRU Publications, Kumbakonam, 2001).
3. K. Ravichandran, K. Swaminathan, B. Sakthivel and A. T.Ravichandran, *Introduction to Thin Films and Crystal Growth* (Jazym Publications, Tiruchirappalli, 2019).
4. V. Markov, *Crystal Growth for Beginners: Fundamentals of Nucleation*, *Crystal Growth and Epitaxy* (World Scientific Publishing, Singapore, 2017).
5. S. Zhang, L. Li and A. Kumar, *Materials Characterization Techniques* (CRC Press, Bota Raton, 2009).
6. R. F. Bunshah, *Hand book of Deposition Technologies for Films and Coatings, Science, Technology and Applications* (Noyes Publications, New York, 1994).
7. M. Ohring, *Materials Science of Thin Films: Deposition and Structure* (Academic Press, Cambridge, 2002).
8. Goswami, *Thin Film Fundamental*s (New Age International, New Delhi, 1996).
9. T. S. Sudarsan, *Surface Modification Technologies*(The Minerals, Metals& Materials Society, Pittsburgh, 1989).
10. E.N.Kaufmann, *Characterization of Materials* (Wiley, NewDelhi, 2003)
11. K. Ravichandran, K. Swaminathan and B. Sakthivel, *Introduction to Thin Films* (Research India Publications, New Delhi, 2013).
12. http://www.issp.ac.ru/ebooks/books/open/Modern_Aspects_of_Bulk_Crystal_and_Thin_Film_Preparation.pdf
13. https://onlinecourses.nptel.ac.in/noc20_mm19/preview

COURSE OUTCOME:

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

- *Understand the various techniques of crystal growth.*
- *Acquire knowledge in the fields of thin films.*
- *Gain the knowledge of thinfilm preparation processe through physical and chemical methods.*
- *Know the working principles of characterization techniques.*
- *Comprehend the properties and applications of thinfilms.*

Second Year PROFESSIONAL ETHICS **Semester IV**

CORE COURSE VIII

NUCLEAR AND PARTICLEPHYSICS

Code: P22PYCC42 **(Theory)** **Credit:5**

COURSE OBJECTIVES:

- To understand the nature of nuclear forces.
- To have an idea of the nuclear shell model.
- To gain knowledge of nuclear reaction and Quark structure.

UNIT–I TWO BODY PROBLEM AND NUCLEAR FORCES:

Ground state of the Deuteron - Wave equation for the deuteron and itssolution. Excited states of the deuteron, Normalization of the deuteron wave Function, Low energy Neutron – Proton Scattering, Scattering length. Spin dependence of n-p Interaction,Effective range theory. Non-Central Force-Quadrupole moment of the deuteron, Magnetic moment of the deuteron. Neutron-Neutron scattering, Exchange interaction and saturation of the nuclear force.

UNIT–II NUCLEAR MODELS:

Constitution of the nucleus-Fermi gas model of the nucleus. Nuclear shell structure-single particle states in nuclei - Spin-orbit interaction. Applications of extreme single particle shell model. Single particle shell model-Individual particle model-Collective model. Liquid drop model-Bohr-Wheeler Theory.

UNIT–III RADIOACTIVITY:

Alpha-decay and barrier penetration- Gamow's theory of alpha decay. Beta decay-Pauli's hypothesis- Fermi's theory of β-decay-Selection rules-Parity in β-decay-Helicity of Neutrino-Electron capture.Gamma-rays-Interaction of γ rays with matter-Photo-electric absorption-Electron-Positron pair production-Multipole radiations-Selection rules-Conservation of parity-Internal conversion.

UNIT–IV NUCLEAR REACTION:

Types of nuclear reactions-Conservation laws-Nuclear reaction kinematics. Nuclear cross section-Classical analysis of cross-section. Partial wave analysis of reaction cross-section. Inverse reaction-Principle of detailed balance (Reciprocity theorem). Compound nucleus- Disintegration of a Compound nucleus. Resonance cross-sections:Bright-Wigner dispersion formula. Direct reactions-Plane wave Born Approximation Theory of direct interactions. Nuclear Shock waves. Nuclear Reactors-Production reactors, Power reactors-Peaceful Nuclear Explosions-Nuclear Power production in India.

UNIT–V ELEMENTARY PARTICLES:

Classification of elementary particles-Conservation laws-CPT Theorem. Graviton, Photon, Gluon. Muons -Production-Nature of muon decay-muon interaction-

muonium. Resonance particles,Symmetry classification of elementary particles-SU(2) Symmetry-SU(3) Symmetry-Gell-Mann-Okubo mass formula for SU(3) multiplets. Quark hypothesis-Quark structures of mesons and baryons. Quantum Chromodynamics. Charmed quark-Beauty and Truth. Higgs Bosons.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Neutrinos- Sources of neutrinos – Types of neutrino-Deduction of neutrino-Neutrino Oscillations in matter-Neutrino communication. Scintillation detectors–Positron Emission Tomography – X-ray Computed Tomography – Magnetic Resonance Imaging – Neutrino Telescopes.

REFERENCES:

1. S.N.Ghoshal, *Nuclear Physics*(S.Chand, NewDelhi,2018).
2. M.L.Pandya and R.P.S.Yadav, *Elements of Nuclear Physics* (KedarNath Ram Nath, Meerut, 2020).
3. D.C.Tayal,*Nuclear Physics* (Himalaya,Mumbai,2020).
4. Gupta and H.Roy, *Physics of the Nucleus*(Books and Allied, Kolkata, 2011).
5. J.Singh,*Fundamentals of Nuclear Physics*(Pragati Prakashan,Mumbai, 2012).
6. K.S. Krane,*Introductory Nuclear Physics*(Wiley, New York, 1987)
7. S.B.Patel,*Nuclear Physics: AnIntroduction*(Wiley,NewDelhi,1991).
8. R.D.Evans,*The Atomic Nucleus* (McGraw Hill,NewYork,1955).
9. R.A.SerwayandJ.W.Jewett,*Physics for Scientists and Engineers with Modern Physics* (Cengage, Massachusetts, 2010).
10. Beiser,*Concepts of Modern Physics* (McGraw Hill,NewYork,1995).
11. R. A. Powsner, M. R. Palmer and E. R. Powsner, *Essentials of Nuclear Medicine Physics, Instrumentation and Radiation Biology* (Wiley, New Jersey, 2021).
12. P.DeLos Heros, *Probing Particle Physics with Neutrino Telescopes*(World Scientific, Singapore, 2020).
13. https://nptel.ac.in/courses/115103101

COURSE OUTCOME:

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

- Know the ground state of deuteron and the nature of nuclear forces.
- Understand the nuclear models.
- Appreciate the theory behind the nuclear decay process.
- Comprehend the physics of nuclear reaction.
- Have some idea about the Symmetry classification of elementary particles and quarks.

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Second Year | **ENTREPRENEUSHIP / INDUSTRY BASED COURSE ANALYTICAL CHARACTERIZATION TECHNIQUES (Theory)** | **Semester IV**

Code: P22PYIBC | **Credit: 5**

COURSE OBJECTIVES:

- To provide fundamental features of analytical instrumentation to the students.
- To impart knowledge about the fundamental properties of the instrumental analysis and experimental and theoretical aspects of the characterization techniques.
- To know the basic theory of characterization techniques and application.

UNIT-I STRUCTURAL CHARACTERIZATION

Principle of X-ray spectrometer technique – Small angle X-ray scattering – X-ray photoelectron spectroscopy–Auger relation of core hole–Application, strength and limitations of X-ray photoelectron spectroscopy

UNIT–II SPECTRAL CHARACTERIZATION:

Laser sources–Laser Raman Spectrometer–Radiation sources–Fourier Transform Interferometer–NMR basic principles–NMR spectrometer–ESR basic principles–Instrumentation of ESR

UNIT–III OPTICAL CHARACTERIZATION:

Instruments for absorption photometry – Photoluminescence principles–Instrumentation and Application – Ultraviolet absorption spectroscopy – Principle behindIRspectroscopy–FourierTransformInfraredspectroscopy(FTIR)– Strength of FTIR spectroscopy

UNIT–IV THERMALANDMECHANICALCHARACTERIZATION:

Thermal methods – Thermogravimetric analysis – Differential Thermal analysis – Mechanical principles: Static and Dynamic measurement – Instrumentationof Extensometeranalysis–Bendingpropertiesofmaterials–In-PlaneImpacttesting

UNIT–V MORPHOLOGICALCHARACTERIZATION:

Basic principles – Instrumentations: Scanning Electron Microscopy (SEM)–Operation modes–Transmission Electron Microscopy (TEM)–Scanning Tunneling Microscopy (STM)

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Basic principles – Instrumentations: X-ray photoelectron spectroscopy (XPS)–Ultraviolet photoelectron spectroscopy (UPS)–Branauer Emett Teller (BET) theory.

Hall effect measurement system–Analytical scanning electron microscope–In-site electrical characterization–Neutron scattering.

REFERENCES:

1. N.Banwell, Fundamentals of Molecular and Spectroscopy (McGraw Hill, New Delhi, 2008).
2. P.S.Sindu,Molecular Spectroscopy (Newage, NewDelhi, 2006).
3. H.H.Willard and L.L.Merritretal,International Methods of Analysis (CBS Publication, New Delhi, 2008).
4. S.Zhang,L.Li and A.Kumar,Materials Characterization Techniques(CRC Press, Bota Racon, 2009).
5. E.N.Kaufmann, Characterization of Materials, Volume-I(Wiley,New Jersey, 2012).
6. M.Sardela, Practical Materials Characterization (Springer,Heidel berg, 2014).
7. P.R.Khangaonkar,An Introduction to Material Characterization(Penram, Mumbai, 2008).
8. Y. Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods (Wiley, New Jersey, 2008).
9. https://nptel.ac.in/courses/113105101

COURSE OUTCOMES:

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

- Understand the various processes of structural characterizations.
- Realize how to use the instruments practically and theoretically.
- Understand spectral, optical, and thermal characterizations.
- Use advanced characterizations for analyzing particles.
- Characterize the sample with appropriate characterization techniques.

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PROFESSIONAL ETHICS

Second Year **PROJECT** **Semester- IV**

Code: P22PYPW **Credit:5**

Each candidate shall be required to take up a Project Work and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the student in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT/EVALUATION/VIVA-VOCE:

1. PROJECT REPORT EVALUATION (Both Internal & External):

I. Plan of the Project	-20marks
II. Execution of the Plan/collection of Data / Organisation of Materials / Hypothesis, Testing etc and presentation of the report.	-45marks
III. Individual initiative	-15marks
2. VIVA-VOCE/INTERNAL & EXTERNAL	-20marks
TOTAL	**-100marks**

PASSING MINIMUM:

	Vivo-Voce20Marks 40% out of 20 Marks (i.e. 8 Marks)	**Dissertation 80 Marks** 40% out of 80 marks (i.e. 32marks)
Project		

A candidate shall be declared to have passed in the Project work if he/she gets not less than 40% in each of the Project Report and Viva-voce but not less than 50% in the aggregate of both the marks for Project Report and Viva-voce.

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Projectat the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

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Second Year **VALUE ADDED COURSE II** **Semester IV**

MEDICAL INSTRUMENTATION

Code: P22PYVAC2 **(Theory)** **Credit:5**

COURSE OBJECTIVES:

- To introduce the basic knowledge on Biomedical instrumentation.
- To know about measurement of certain important electrical and non-electrical parameters.
- To have a basic knowledge in life assisting and therapeutic devices.

UNIT – I HUMAN PHYSIOLOGICAL SYSTEMS AND BIO-POTENTIAL ELECTRODES

Transport of ions through the cell membrane–Resting and action potentials– Bio-electric potentials – Design of Medical instruments – Components of the biomedical instrument system – Half cell potential –Types of electrodes –Micro electrodes–Depth and needle electrodes–Surface electrodes–Transducers– Active transducers–magnetic induction type transducers (only).

UNIT – II BIO-SIGNAL ACQUISITION AND PHYSIOLOGICAL ASSIST DEVICES

Required conditions for physiological signal amplifiers–Isolation amplifiers–ECG Isolation Amplifier Circuit–Medical preamplifier design–Bio-signal analysis – Physiological Assist Devices: Pacemakers – Typical ranges of pacemaker parameters - External and implanted pacemakers (comparison) – Ventricular asynchronous pacemakers-Defibrillators–DC Defibrillator–Oxygenators– Bubble oxygenators.

UNIT–III BIO-POTENTIAL RECORDERS:

Biosignal Recorders: Characteristics of the recording system– Electrocardiography (ECG)–Physiological nature of ECG waveform–ECG Recording setup - Echocardiography – Electroencephalography (EEG) – Origin of EEG–Simple block diagram of EEG recording setup–Electroretinography (ERG).

UNIT–IV OPERATION THEATRE EQUIPMENT:

Surgical diathermy- Shortwave diathermy – Ventilators – Pressure limited ventilators – Anesthesia machine – Blood flow meters – Electromagnetic blood flow meter – Cardiac Output measurements – Fick's method – Spirometer – Gas analyzers–Infrared CO_2 analyzer–pHmeter–Oxymeters.

UNIT–V SPECIALIZED MEDICAL EQUIPMENTS:

Blood Cell counters – Automatic blood cell counter – Digital thermometer – Audiometers – X-rays tube – X-ray machine – Angiography – Bio-telemetry–Elements of Bio telemetry system–Design of Bio-telemetry system–Physiological

effects of 50Hz current passage – Micro shock and macro shock – Magnetic Resonance Imaging – principle – MRI Instrumentation.

UNIT–VI CURRENT CONTOURS (For continuous internal assessment only):

Radio graphic and fluoroscopic techniques – Computer tomography– Ultrasonography – Endoscopy – Thermography - Retinal Imaging - Imaging application in Biometric systems.

REFERENCES:

1. M. Arumugan, *Biomedical Instrumentation* (Anurada Agencies, Chennai, 1992).
2. R.S.Khandpur,*Hand book on Biomedical Instrumentation* (McGraw Hill,New Delhi, 2014).
3. J.G.WebsterandA. J.Nimunkar, *Medical Instrumentation Application and Design* (Wiley,Singapore,1999).
4. L.Cromwell,F.J.Weibell and E.A.Pfeiffer, *Biomedical Instrumentation and Measurements*(Pearson,NewDelhi,2016).
5. J.J.Carr and J.M.Brown, *Introduction to Biomedical Equipment Technology* (Pearson,NewDelhi,2001).
6. https://nptel.ac.in/courses/108105101
7. https://nptel.ac.in/courses/102105090

COURSE OUTCOMES:

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

- Gain knowledge on various sensing and measurement devices of electrical origin.
- Understand the Bio potential recorders.
- Learn modern methods of imaging techniques and their analysis.
- Explain the medical assistance/techniques and therapeutic equipments.
- Recognize the significance of biomedical instrumentation field of study.

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