LIST OF COURSES

S.No	Course Code	Name of the Course	Credits
1	17PH1001	Applied Physics	3:0:0
2	17PH1002	Applied Physics Lab	0:0:2
3	17PH1003	Physics for Agricultural Engineers	3:0:1
4	17PH2001	Mechanics and properties of matter	3:0:0
5	17PH2002	Semiconductor Physics-I	3:0:0
6	17PH2003	Heat and Thermodynamics	3:0:0
7	17PH2004	Semiconductor Physics-II	3:0:0
8	17PH2005	Semiconductor Physics Lab-I	0:0:2
9	17PH2006	Semiconductor Physics Lab-II	0:0:2
10	17PH2007	Semiconductor logic devices	3:0:0
11	17PH2008	Spectroscopy	3:0:0
12	17PH2009	Physics of semiconductor memories and microprocessors	3:0:0
13	17PH2010	Physics of linear integrated circuits and VLSI design	3:0:0
14	17PH2011	Photonics	3:0:0
15	17PH2012	Vacuum and thin film technology	3:0:0
16	17PH2013	Condensed matter physics	3:0:0
17	17PH2014	Properties of matter lab	0:0:2
18	17PH2015	Electricity and Magnetism	3:0:0
19	17PH3001	Classical Mechanics	3:0:0
20	17PH3002	Statistical Mechanics and Thermodynamics	3:0:0
21	17PH3003	Mathematical Physics I	3:1:0
22	17PH3004	Semiconductor Physics	3:0:0
23	17PH3005	Quantum Mechanics-I	3:0:0
24	17PH3006	Physical Optics	3:0:0
25	17PH3007	Mathematical Physics-II	3:1:0
26	17PH3008	Atomic and Molecular Spectroscopy	3:0:0
27	17PH3009	Electromagnetic Theory	3:0:0
28	17PH3010	Quantum Mechanics-II	3:0:0
29	17PH3011	Nuclear and Particle Physics	3:0:0
30	17PH3012	Spectroscopy	3:0:0
31	17PH3013	Solid State Physics	3:0:0
32	17PH3014	Physics of Nanomaterials	3:0:0
33	17PH3015	Photonics	3:0:0
34	17PH3016	Thin Film Technology	3:0:0
35	17PH3017	Renewable energy sources	3:0:0
36	17PH3018	Radiation Treatment and Planning	3:0:0
37	17PH3019	Medical Radiation Dosimetry	3:0:0
38	17PH3020	Research Methodology	3:0:0
39	17PH3021	Material characterization	3:0:0
40	17PH3022	Crystal Growth Techniques	3:0:0
41	17PH3023	Radiation Physics	3:0:0
42	17PH3024	Nanofluids	3:0:0
43	17PH3025	General Physics Lab-I	0:0:2
44	17PH3026	General Physics Lab-II	0:0:2
45	17PH3027	Advanced Physics Lab-I	0:0:4
46	17PH3028	Advanced Physics Lab-II	0:0:4
47	17PH3029	Materials characterization lab	0:0:2
48	17PH3030	Computational Physics lab	0:0:2
49	17PH3031	Simulations in statistical physics Lab	0:0:2
50	17PH3032	Heat and Optics lab	0:0:2
51	17PH3033	Astrophysics	3:0:0

17PH1001 APPLIED PHYSICS

Credit: 3:0:0

Course Objective:

- To impart knowledge on the basic concepts of quantum mechanics and its applications
- To impart knowledge on the working principle of various lasers and its application in
- fibre optics
- To impart knowledge on principles of acoustics and applications of ultrasonic waves,
- magnetic materials

Course Outcome:

The students will be able to

- Appreciate the quantum principles in microscopic techniques
- Demosnstrate laser working principles and types
- Apply Fibre optic principle in designing communication systems.
- Estimate the acoustical parameters of auditorium
- Apply the concepts of materials science in Superconductivity, magnetism.
- Design devices based on ultrasonic generators.

Unit I - QUANTUM PHYSICS: Wave nature of matter- De Broglie wave - De Broglie wavelength of Electrons - properties of matter waves - Experimental verification of matter waves: Davisson and Germer experiment - Heisenberg's uncertainty principle - Schrodinger's time independent wave equation - particle in a box - Application : Principle and working of Scanning Electron Microscope (SEM).

Unit II - LASERS: Principle of laser - Properties of laser beam- Einstein's quantum theory of radiation-Population inversion - Optical Resonator - Types of lasers: Nd :YAG, He:Ne - Application: Holography: Principle, recording and reconstruction.

Unit III - FIBRE OPTICS: Principle of optical fibre- Structure of optical fibres-Propagation in optical fibres-Acceptance angle and acceptance cone-Numerical aperture, Types of optical fibres based on material, mode and refractive index, Applications: Optical fibres for communication- Fibre endoscope.

Unit IV - ACOUSTICS AND ULTRASONICS: Classification of sound, Characteristic of musical sounds-Absorption coefficient- Reverberation time- Sabine's formula, Factors affecting acoustics of buildings and their remedies - Production of Ultrasonic waves: Magnetostriction and Piezoelectric methods- Applications: Acoustic grating - Pulse Echo Testing (NDT).

Unit V - MAGNETIC AND SUPERCONDUCTING MATERIALS: Dia, Para, Ferro magnetic materials properties, Hysteresis curve, Hard and soft magnetic materials - Application: Magnetic recording and reading. Superconductors: Properties of superconducting materials - Type I and Type II superconductors-
Application: Maglev.

Text Book

1. B.K.Pandey , S.Chaturvedi – Applied Physics, Cencage Learning India private Ltd. New Delhi, 2012.

Reference Books

1. Engineering Physics, V.Rajendran, 2016.
2. John W.Jewett, Jr., Raymond A.Serway - Physics for Scientists and Engineers with Modern Physics, Cenage Learning India Private Ltd, 2008
3. M.N. Avadhanulu, P.G. Kshirshagar – A Text Book of Engineering Physics-,S.Chand & Co. Ltd, 2008
4. Hitendra K Malik, A K Singh – Engineering Physics, McGraw –Hill Publishing company Ltd,2008
2. G.Aruldhas - Engineering Physics, PH1 Learning Pvt. Ltd , 2010

17PH1002 APPLIED PHYSICS LAB

Credits 0:0:2

Objective:

- To train engineering students on basis of measurements and the instruments
- To give practical training on basic Physics experiments which are useful to engineers
- To equip the students with practical knowledge in electronic, optics, and heat experiments

Outcome:

The students will be able to

- To demonstrate the measurement of frequency using Melde's apparatus.
- To demonstrate the measurement of light parameters using optical instruments
- To calculate the particle size through laser diffraction setup
- To estimate coefficient of viscosity of liquids using Poiseuille's apparatus
- To verify the planck's constant using Light emitting diodes
- To calculate the Numerical aperture

The faculty conducting the Laboratory will prepare a list of experiments [10/5 for 2/1 credit] and get the approval of HoD and notify it at the beginning of each semester.

17PH1003 PHYSICS FOR AGRICULTURAL ENGINEERS

Credits : 3:0:1

Course Objective:

- To know about the Basics of projectile and collision
- To learn about the properties of matter in different conditions
- To understand the viscosity of fluids and surface tension of liquids

Course Outcome:

The students will be able to

- Understanding of mechanics and properties of matter of materials
- Solve problems related to mechanics and properties of matter.
- Able to select materials for different applications
- Demonstrate the properties of materials through working models
- Appreciate the role of inertia in determining the properties of matter
- Differentiate between types of modulus and its applications

Unit I - PROJECTILE AND COLLISION: Projectile – range of a projectile on an inclined plane – collision between two bodies – impulse – laws of impact – coefficient of restitution – Elastic and inelastic collision – direct and oblique impact – transfer of energy in collisions between two equal masses.

Unit II - ELASTICITY: Introduction – Stress and strain – Hooke's law – Three types of Elasticity – Rigidity modulus – Young's modulus – Bulk modulus – Relation connecting elastic constants – Poisson's Ratio – Moment of Inertia :Moment of Inertia and its physical significance – Expression for moment of inertia – Radius of Gyration – Torque – General theorems on moment of inertia – Calculation of the moment of inertia of a body and its units.

Unit III - BENDING OF BEAMS: Bending of beams – Expression for bending moment – Uniform bending – Determination of Young's modulus by Uniform and Non Uniform bending using pin and microscope – Cantilever – Expression for depression at loaded end of cantilever.

Unit IV - VISCOSITY: Flow of liquids Rate of flow of liquid – Lines and Tubes of flow – Energy of the liquid – Bernoulli's theorem and its important applications – Viscosity – Co-efficient of viscosity – Critical velocity – Poiseuille's equation for flow of liquid – Stoke's method – Rotation viscometer.

Unit V

SURFACE TENSION: Surface Tension: Definition and dimensions of surface tension - Rise of liquid in capillary tube – Experimental determination of surface tension.

Text Books

1. 1.Elements of Properties of Matter by Mathur D.S., Shyamlal Charitable Trust, New Delhi,2008.

Reference:

1. Murugesan. R., 2007, Properties of Matter , S. Chand & Co Pvt. Ltd., New Delhi.
2. Gulati H.R.,1982, Fundamentals of General Properties of Matter, R. Chand & Co., New Delhi.
3. Subrahmanyam N. & Brij Lal, 1994, Waves & Oscillations, Vikas Publishing House Pvt. Ltd., New Delhi.
4. P.K. Chakrabarthy, 2001, Mechanics and General Properties of Matter, Books & Allied (P) Ltd.
5. D. Halliday, R.Resnick and J.Walker, 2001, Fundamentals of Physics, 6th Edition, Wiley, NY.
6. Gour R.K. and Gupta S.L., 2002, "Engineering Physics". Dhanpat Rai Publications, New Delhi.

17PH2001 MECHANICS & PROPERTIES OF MATTER

Credit: 3:0:0

Course Objectives

- To know about the Basic laws of Physics
- To learn about the properties of matter in different conditions
- To understand the mechanics of solids

Course Outcome

Students will be able to

- Gain knowledge and understand concepts related to mechanics and properties of matter.
- Understand earth's gravitation, elasticity of materials, mechanics of fluids.
- Solve problems related to mechanics and properties of matter.
- Differentiate between types of modulus and find its applications
- Apply the knowledge of properties of matter in solving problems associated with mechanics
- Appreciate the role of inertia in determining the properties of matter

Unit I - GRAVITATION: Kepler's laws – Newton's deductions from Kepler's laws – Newton's law of gravitation – Determination of gravitational constant – Law of Gravitation and theory of relativity – Gravitational potential at a point distant r from a body – Escape Velocity – Potential and Field intensity due to a solid sphere at a point inside the sphere and outside the sphere.

Unit II - PROJECTILE AND COLLISION: Projectile – range of a projectile on an inclined plane – collision between two bodies – impulse – laws of impact – coefficient of restitution – Elastic and inelastic collision – direct and oblique impact – transfer of energy in collisions between two equal masses

Unit III - ELASTICITY: Introduction – Stress and strain – Hooke's law – Three types of Elasticity – Rigidity modulus – Young's modulus – Bulk modulus – Relation connecting elastic constants – Department of Physics 2 Poisson's Ratio – Torsional pendulum –Moment of Inertia :Moment of Inertia and its physical significance – Expression for moment of inertia – Radius of Gyration – Torque – General theorems on moment of inertia – Calculation of the moment of inertia of a body and its units.

Unit IV - BENDING OF BEAMS: Bending of beams – Expression for bending moment – Uniform bending – Determination of Young's modulus by Uniform and Non Uniform bending using pin and microscope – Cantilever – Expression for depression at loaded end of cantilever

Unit V - VISCOSITY AND SURFACE TENSION: Flow of liquids Rate of flow of liquid – Lines and Tubes of flow – Energy of the liquid – Bernoulli's theorem and its important applications – Viscosity – Co-efficient of viscosity – Critical velocity – Poiseuille's equation for flow of liquid – Stoke's method – Rotation viscometer Surface Tension: Definition and dimensions of surface tension - Rise of liquid in capillary tube – Experimental determination of surface tension.

Text Books

2. 1.Elements of Properties of Matter by Mathur D.S., Shyamlal Charitable Trust, New Delhi,2008.
3. Properties of Matter by Murugeshan. R., S. Chand & Co Pvt. Ltd., New Delhi. 2007.
4. Properties of Matter by Brij Lal & Subramaniam. N, Eurasia publishing Co., NewDeihi, 1994.

Reference Books

1. Fundamentals of General Properties of Matter by Gulati H.R., R. Chand & Co., New Delhi, 1982.
2. Waves & Oscillations by Subrahmanyam N. & Brij Lal, Vikas Publishing House Pvt. Ltd., New Delhi, 1994.
3. Mechanics and General Properties of Matter by P.K. Chakrabarthy - Books & Allied (P) Ltd., 2001.
4. Fundamentals of Physics, 6th Edition, by D. Halliday, R.Resnick and J.Walker, Wiley, NY, 2001.
5. Physics, 4th Edition, VoIs. I, II & II Extended by D. Halliday, R.Resnick and K.S. Krane, Wiley, NY, 1994.

17PH2002 SEMICONDUCTOR PHYSICS-I

Credits: 3:0:0

Course Objective

- Fundamental concepts of electronic devices
- Amplifier and oscillators and Integrated Circuits, Measuring instruments
- Applications of Microprocessor and Various communication techniques.

Course Outcome

Students will be able to

- Define the concepts of electronic devices
- Relate the amplifier and oscillators
- Infer about the Integrated Circuits
- Appraise the microprocessor and its applications
- Assess the measuring Instruments.
- Interpret the various communication techniques.

Unit I - Introduction to electronics, Passive and active devices - semiconductor devices – Diode, FET, basic op-amp – op amp 741- BJT, CE, CC, CB configuration, transistor as an amplifier and a switch.
Unit II - Oscillator principles – Positive feedback analysis, Barkhausen criterion principle - Digital System, Logic gates and truth table – OR, AND, NOT, NOR, NAND, Ex-OR, Ex-NOR – Simple digital circuits.
Unit III - Semiconductor memory- volatile and Nonvolatile memory – Integrated circuits –Microprocessor- Block diagram and architecture - transducers – signal conditioning unit – telemetry circuits.
Unit IV - Virtual instrumentation– Measuring instruments- Analog - voltmeter, ammeter and digital- Voltmeter & Ammeter, Multimeter-block diagram analysis- Advanced measuring instruments- – Micro and Nano electronics.
Unit V - Introduction to Communication system – Transmitter and receiver –Introduction to Noise – modulation & demodulation techniques – Amplitude – Frequency and phase modulation techniques-antenna principle –receiver & transmitter (audio/video)- Satellite communication – Fiber optics communication.

Text Book

1. Albert Paul Malvino, " Electronic Principles", Tata McGraw Hill, 8th Edition, 2015.

Reference Books

1. Robert Boylestad and Louis Nashelsky,, "Electronic Devices & Circuit Theory", Ninth Edition, PHI, 2013
2. Roody & Coolen, "Electronic Communication", PHI, 1995
3. W.D. Cooper, A.D. Helfrick, "Modern Instrumentation and Measurement Techniques", 5th Edition, 2002.
4. V.K.Metha."Principles of Electronics",Chand Publications,2008.
5. Anokh Singh, "Principles of Communication Engineering" S.Chand Co., 2001
6. Muthusubramanian R, Salivahanan S, Muraleedharan Ka , "Basic Electrical Electronics & Computer Engineering "Tata Mc.Graw Hill, 2005.
7. Nanoelectronics and Nanosystems: From transistors to Molecular and Quantum Devices by K. Goser (Edition, 2004), Springer. London.

17PH2003 HEAT AND THERMODYNAMICS

Credit: 3:0:0

Course Objective

- Aims to gain fundamental understanding about the heat temperature and also energy and work.
- To understand thermo-physical properties of substances and introduce thermodynamics laws in system and control volumes.
- To gain knowledge on Energy and work relations.

Course Outcome

Students will be able to

- Appreciate the knowledge on thermodynamics in day-to-day life
- Gain the capability to evaluate thermo physical properties of substances
- Evaluate different thermodynamic systems
- Apply conservation of energy for the control mass and control volume processes
- Understand the second law of thermodynamics
- Understand Irreversibility's

Unit I - LOW TEMPERATURE PHYSICS: Ideal gas and real gas. Van der Waals equation of state. Porous-plug experiment and its theory. Joule-thomson expansion - expression for the temperature of inversion, inversion curve. Relation between Boyle temperature, temperature of inversion and critical temperature of a gas. Principle of regenerative cooling. Liquefaction of air by Linde's method. Adiabatic demagnetization.

Unit II - THERMODYNAMICS: Review of basic concepts, Carnot's theorem, thermodynamic scale of temperature and its identity with perfect gas scale. Clausius-Clapeyron first Latent heat equation, effect changes – Expression for work done , First law of Thermodynamics-mathematical formulation.

Unit III - SECOND LAW OF THERMODYNAMICS – Kelvin Planck statement and Clausius statement and their equivalence. The Carnot engine –expression for efficiency, The Carnot's theorem-its proof. Reversible and irreversible process, reversibility of carnot’s cycle, Refrigerators-principle of working and coefficient of performance. Thermodynamic scale of temperature and its identity with perfect gas scale, Clausius-Clapeyron first latent heat equation.

Unit IV - ENTROPY : The concept of Entropy, Change of entropy in reversible and irreversible cycles. Entropy and non-available energy. Principle of increase of entropy –Clausius inequality, Entropy and II law of Thermodynamics, Entropy of ideal gas, T-S diagram , Probability and Entropy - Boltzmann relation , Concept of absolute zero and the third law of thermodynamics

Unit V - THERMODYNAMIC POTENTIALS: Internal Energy, Enthalpy, Helmholtz function, Gibbs function, relations among these functions, Gibbs-Helmholtz equations. Maxwell's Thermodynamic Relations: Derivation of Maxwell's thermodynamic relations, Tds equations, Internal energy equations, Heat capacity equations. Change of temperature during Adiabatic process using Maxwell's relations.

Text Books

1. Brijlal ,N. Subramanyam P.S. Hemne: Heat Thermodynamics and Statistical Physics, 1st edition. S Chand Publishing, 2007.
2. Halliday and Resnick: Fundamentals of Physics, 9th edition, Wiley India, 2011.

Reference Books

1. R. H. Dittaman and M. W. Zemansky: Heat and Thermodynamics, 7th edition, The McGraw-Hill companies, 2007.
2. S. J. Blundell and K. M. Blundell: Concepts in Thermal Physics, 2nd edition, Oxford University Press, 2006.
3. S C Gupta: Thermodynamics, 1st edition, Pearson, 2005.
4. Satya Prakash: Optics and Atomic Physics, 11th, Ratan Prakashan Mandir, 1994.
5. C. L. Arora: Refresher Course in Physics Vol I, S Chand publishing, 2011.
6. S. R. Shankara Narayana: Heat and Thermodynamics, 2nd edition, Sulthan Chand and Sons, 1990.

17PH2004 SEMICONDUCTOR PHYSICS II

Credits: 3:0:0

Course Objective

To impart knowledge on

- Mechanisms of current flow in semi-conductors.
- Diode operation and switching characteristics of Special devices
- Advanced measuring instruments

Course Outcome

Students will be able to

- Define the mechanisms of current flow in semi-conductors.
- Relate the diode operation and its switching characteristics
- Infer about the various discrete electron devices
- Categorize the various displays and its applications
- Estimate the special devices and its applications
- Interpret an Advanced measuring instruments

Unit I - Theory of PN Diodes - Open circuit junction – Forward and Reverse Characteristics - Diode Equation- Applications: Half wave rectifier, full wave rectifier, Bridge rectifier - Hall Effect.

Unit II - Theory of BJT – CE, CB and CC configurations, I-V analysis, Field Effect Transistor, I-V analysis of FET, MOSFET – Enhancement and Depletion Mode MOSFET, I-V analysis.

Unit III - Current-Voltage analysis of UJT and Thyristor - Special Semiconductor Devices – Zener Diode, Gunn Diode, Varactor diode, Tunnel Diode.

Unit IV - Light Emitting Diode, OLED, crystalline solar cells – Liquid Crystal Display –function and Applications of optocouplers- Transducers –Passive and Active transducer.

Unit V - Digital Instruments - Digital Voltmeters and Multimeters, - Data Display and Recording System - Computer Controlled Test System - Microprocessor based measurements.

Text Books

1. Millman & Halkias, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2007.
2. W.D. Cooper, A.D. Helfrick, "Modern Instrumentation and Measurement Techniques", 5^{th} Edition, 2002.

Reference Books

1. Albert Paul Malvino, " Electronic Principles", Tata McGraw Hill, 8th Edition, 2015.
2. Rangan C.S., "Instrumentation Devices and Systems", Tata McGraw Hill, Second Edition, 1998.
3. Robert Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 9th Pearson Education Edition, 2009
4. Muthusubramanian R, Salivahanan S, Muraleedharan Ka , "Basic Electrical Electronics & Computer Engineering "Tata Mc.Graw Hill, 2005

17PH2005 SEMICONDUCTOR PHYSICS LAB I

Credit: 0:0:2

Course Objective

To impart practical knowledge on

- The Characteristics of diodes, and special diode
- I-V characteristics of BJT, FET and some special purpose devices.
- Rectifiers and regulators.

Course Outcome

Students will be able to

- Develop I-V characteristics of diodes
- Develop I-V characteristics of special diodes
- Built the I-V characteristics of BJT, FET
- Design circuits for rectifiers and regulators.
- Design and verify the digital circuits
- Analysis the attention of Fiber optic cable for the communication

The faculty conducting the Laboratory will prepare a list of 10 experiments and get the approval of HoD and notify it at the beginning of each semester

17PH2006 SEMICONDUCTOR PHYSICS LAB-II

Credit: 0:0:2

Course Objective:

To impart practical knowledge on

- Various Electron Devices and its operation
- Digital circuits design
- Programming of microprocessors.

Course Outcome:

Students will be able to

- Evaluate different electronic device characteristics
- Construct circuits using logic gates
- Built the combinational circuits
- Design the sequential circuits
- Design the communication circuits
- Programming of microprocessors.

Apply programming for various microprocessors' applications.

The faculty conducting the Laboratory will prepare a list of 10 experiments and get the approval of HoD and notify it at the beginning of each semester

17PH2007 SEMICONDUCTOR LOGIC DEVICES

Credits 3:0:0

Course objective:

To impart knowledge on

- Basic conversation systems and Digital circuit design methods
- Combinational logic circuits and Various flip flop
- Digital communications circuits

Course Outcome:

Students will be able to

- Define about basics of digital electronics
- Build the digital circuit design
- Develop the combinational circuits
- Design the digital communication circuits
- Identify about the various flip flop
- Construct synchronous and Asynchronous circuits

Unit I - Number Systems & Boolean Algebra - Karnaugh map - Quine Mcclusky method- Combinational Logic Design : Logic gates – Combinational Logic Functions Half adder, full adder, half subtractor, full subtractor– Sequential design and circuits.

Unit II - Encoders & Decoders logic circuits and lookup table analysis – Multiplexers (4X1) & De-multiplexers (1X4) logic and lookup table analysis – various Code Converters and its logical circuits – Comparator circuit.

Unit III - Combinational Adder circuit– Parallel Adder/Binary Adder – Parity Generator/Checker – Implementation of Logical Functions using Multiplexers.

Unit IV - INTRODUCTION TO FLIP FLOPS: RS, JK, D&T flip flops - Counters & Registers: Asynchronous Counters - Synchronous Counters.

Unit V - LOGIC FAMILIES: Resister Transistor Logic, Diode Transistor Logic, Transistor Transistor Logic (TTL) families, Programmable Array Logic– Programmable Gate Arrays – Field Programmable gate array.

Text Book

1. MorrisMano,"Digital logic and computer Design", 3rd edition Prentice Hall of India,2002.

Reference Books

2. A. Anand Kumar, "Fundamental of Digital Circuits", PHI, 2nd Edition 2009.
3. Jain R.P, "Modern Digital Electronics", Third edition, Tata Mcgraw Hill,2003
4. Floyd T.L., "Digital Fundamentals ", Prentice Hall, 9th edition, 2006.
5. V.K. Puri, "Digital Electronics: Circuits and Systems", Tata McGraw Hill, First Edition, 2006.

17PH2008 SPECTROSCOPY

Credit: 3:0:0

Course Objective

- To gain knowledge on different types of spectroscopy
- To understand the role of spectroscopy in determining the structure of molecules
- To understand the instrumentation part of different types of spectroscopy

Course Outcome

Students will be able to

- Students can understand how spectroscopic studies in different regions of the E.M spectrum probe different types of molecular transitions
- When the structure of the molecule is to be interpreted, students will apply suitable spectroscopic techniques
- To solve the structure of molecules using theory learned from the spectroscopic techniques
- To appreciate the advancements in instrumentation by overcoming the drawbacks in each spectroscopic technique
- To compare the spectroscopic techniques based on merits and demerits
- To identify the best method to solve the spectroscopic problems

Unit I - Atomic And Molecular Structure Central field approximation – Thomas – Fermi Statistical model – Spin-orbit interaction – Alkali atoms – Doublet separation – Intensities - Complex atoms – Coupling Schemes – Energy levels – Selection rules and intensities in dipole transition – Paschen back effect Hydrogen ion – Hydrogen molecule – Covalent bond – Heitler – London theory – Atomic and molecular hybrid orbitals.
Unit II - Raman Spectroscopy Semi classical treatment of emission and absorption of radiation: The Einstein Coefficients – Spontaneous and induced emission or radiation – Raman effect – Basic principles of Raman Scattering – Vibrational and Rotational Raman spectra – Experimental techniques of Raman spectroscopy – Molecular structural studies.
Unit III - Infrared And Microwave Spectroscopy Characteristic features of pure rotational, vibrational and Rotation – Vibration spectra of diatomic molecules – Theoretical considerations – Evaluation of molecular – constants – IR spectra of polyatomic molecules – Experimental techniques – dipole moment studies and molecular structural determinations – Microwave spectra of polyatomic molecules – experimental techniques - Maser principles – Applications of Masers.
Unit IV - Resonance Spectroscopy - I NMR – Basic principles – Classical and Quantum mechanical description – Bloch equation – Spin – Spin and spin lattice relaxation times – Experimental methods – Single Coil and double coil methods – Pulse method – ESR basic principles – High Resolution Karunya University ESR Spectroscopy – ESR spectrometer.
Unit V - Resonance Spectroscopy - II N Q R Spectroscopy – Basic Principles – Quadruple Hamiltonian Nuclear Quadrupole energy levels for axial and nonaxial symmetry – N Q R spectrometer – chemical bonding – molecular structural and molecular symmetry studies. Mossbauer spectroscopy: Principles of Mossbauer spectroscopy – Chemical shift – Quadrupole splitting – Applications.

Text Book

1. Elements of Spectroscopy, Gupta Kumar Sharma, Pragati Prakashan, 2006

Reference Books

1. Fundamentals of Molecular Spectroscopy, Banwell, Tata Mc Graw Hill, 1995
2. Spectroscopy, B.K.Sharma, Goel Publishing House, 2007.
3. Molecular Structure and Spectroscopy, G.Aruldhas, PHI Learning private Ltd. 2008

17PH2009 PHYSICS OF SEMICONDUCTOR MEMORIES & MICROPROCESSORS

Credits 3:0:0

Course Objective:
To impart knowledge on

- Various amplifier and oscillator circuits,
- Operational amplifier and its applications
- Microprocessor and its applications, Memory and other interfacing circuits

Course Outcome:
Students will be able to

- Identify the various amplifier and oscillator circuits
- Analyze an operational amplifier and its applications
- Examine the Microprocessor and its applications
- Evaluate the various Memories and other interfacing circuits
- Estimate the Data transfer schemes between peripherals and microprocessor
- Design the assembly programming language

Unit I - Introduction to Electronic Circuits – current voltage analysis of Zener diode and Zener regulator analysis - I.C regulator – Transistor Amplifier –– Power Amplifiers circuits – Class A, Class AB circuits.
Unit II - Oscillators – Barkihausen Criterion – Colpits oscillator-Wien bridge oscillator and phase shift oscillators analysis– Positive feedback analysis-OP-amp comparators.
Unit III - Block diagram of Microcomputer - Architecture of Intel 8085 - Instruction formats, Addressing methods-types of Instruction - Intel 8085 - Instruction set - Development of simple assembly language programs and examples.

Unit IV - Memory and I/O devices and interfacing RAM, ROM, EPROM –CRT terminals- Printers-I/O ports-Key boards-ADC/DACs-memory interfacing.
Unit V - Asynchronous and synchronous data transfer schemes-interrupt driven data transfer- DMA data transfer-Simple applications of Microprocessors.

Text Book

1. Ramesh.S.Gaonkar "Microprocessor Architecture, Programming & Applications With 8085/8080a", Penram International, 2006.
2. Albert Paul Malvino, " Electronic Principles", Tata McGraw Hill, 8th Edition, 2015.

Reference Book

1. Millman .J. &Halkias.C , "Electronic Devices And Circuits", Tata McGraw Hill, 2007.
2. Adithya P. Mathur, " Introduction to Microprocessor", Tata McGraw Hill, 3rd Edition, 2002.
3. Malvin Brown, Digital Computer Electronics (English) 3rd Edition, 2002.

17PH2010 PHYSICS OF LINEAR INTEGRATED CIRCUITS & VLSI DESIGN

Credits 3:0:0

Course objective:
To impart knowledge on

- Theoretical analysis of Operational amplifier and IC 741
- Basics of VLSI Design and analysis
- Various Design process of VLSI

Course outcome
Students will be able to

- Identify the Theoretical analysis of Operational amplifier
- Infer about the OP-Amp IC 741 and its analysis
- Develop the Various applications of IC 741
- Infer Basics of VLSI Design and analysis
- Build CMOS inverter circuit for various design
- Construct the Design process of VLSI

Unit I - Monolithic Integrated Circuit Technology – Planar process – Bipolar Junction Transistor fabrication – Fabrication of FET's – CMOS Technology – Monolithic diodes.
Unit II - OP-AMP Characteristics and Applications: Characteristics of ideal op-amp. Pin configuration of 741 op-amp – Applications: inverting and non-inverting amplifiers.
Unit III - Inverting and non-inverting summers of OP-AMP, Differential amplifier - 555 Timer functional diagram, monostable and astable operation. Applications.
Unit IV - VLSI Design Process – Architectural Design – Logical Design – Physical Design – Layout Styles – Full Custom Semi Custom Approaches.
Unit V - NMOS, PMOS Inverter, CMOS Inverter - MOS & CMOS Layers – stick diagram – design rules & layout - Finite state machine – Hardware description Language - FPGA.

Text Book

1. Roy Choudhury.D., Shail Jain, "Linear Integrated Circuits", New Age International Publications, 3rd Edition,2007.
2. Douglas A. Pucknell, "Basic Vlsi Design", Prentice-Hall Of India Pvt. Limited, 1994.

Reference Book

1. Gayakwad.A.R., "Op-Amps & Linear IC's", PHI, 4th Edition,2004
2. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers & LinearIntegrated Circuits", PHI 6th Edition, 2001.
3. Sergio Franco, "Design with Operational Amplifier and Analog Integrated Circuits",TMH, 3rd Edition, 2002.
   Millman & Halkias," Integrated Electronics", Mac Graw Hill, 1991

17PH2011 PHOTONICS

Credits 3:0:0

Course Objectives:

- To learn various processes involving in the development of laser.
- To understand the various applications using lasersTo know the working and fabrication of optical fibers
- To learn modern experimental techniques in optics and photonics in the context of learning about optical fiber communication systems.

Course Outcome:

Students will be able to

- Students can understand the fabrication and application of various lasers and optical fiber.
- define and explain the propagation of light in conducting and non-conducting media;
- define and explain the physics governing laser behaviour and light matter interaction;
- apply wave optics and diffraction theory to a range of problems;
- apply the principles of atomic physics to materials used in optics and photonics;
- calculate the properties of various lasers and the propagation of laser beams;

Unit I - PROPERTIES OF GAUSSIAN BEAMS: The paraxial wave equation, Gaussian beams, the ABCD law for Gaussian beams, Gaussian beam modes of laser resonators. Higher order Gaussian beam modes. Diffraction theory of laser resonators, unstable resonators for high power lasers.

Unit II - LASERS: Quantum theory of laser: Lasers – Einstein A-B Coefficients, round trip gain, matrix method, He-Ne laser, Ruby, Nd: YAG, Nd: glass lasers, liquid lasers and dye laser amplifiers. Theory of Q-switching and mode locking process, devices for Q-switching and mode locking, high power Co2 laser, Ti:Saphire laser. Theory of semiconductor lasers and devices. Laser, Applications:

Unit III - NONLINEAR OPTICS-I: Introduction to nonlinear optics, nonlinear polarization and wave equation, second harmonic generation, phase matching, three-wave mixing, parametric amplifications, oscillations, tuning of parametric oscillators, nonlinear susceptibilities, nonlinear susceptibility tensor, nonlinear materials

Unit IV - NONLINEAR OPTICS-II: Propagation of light through isotropic medium, propagation light through anisotropic medium, theory of electro-optic, magneto-optic and acousto-optic effects and devices, integrated optical devices and techniques.

Unit V - FIBER OPTICS: Overview of Optical Fibers: Structure of optical fibers. Step-index and graded index fibers; Single mode, multimode and W-profile fibers. Ray Optics representation. Meridional and skew rays. Numerical aperture and acceptance angle. Multipath dispersion materials – Material dispersion -Combined effect of material and multipath dispersion – RMS pulse widths and frequencyresponse - Model Birefringence - Attenuation in optical fibers - Absorption - Scattering losses -Radiative losses

Text Book

1. Laser Fundamentals: W. T. Silfvast, Cambridge University Press, (2003)

Reference Books

1. Laser Spectroscopy- Basic Concepts: W. Demtroder, Springer-Verlag, (2003)
2. The Elements of Fibre Optics: S.L.Wymer and Meardon (Regents/Prentice Hall), (1993)
3. Lasers and nonlinear Optics: B. B. Laud, New Age International (P) Ltd. (2007)

17PH2012 VACUUM AND THIN FILM TECHNOLOGY

Credits: 3:0:0

Course Objective:

- To introduces students to the theory and practice of high vacuum systems as well as thin film deposition
- To study the physical behavior of gases and the technology of vacuum systems including system operation and design
- To learn the Thin film deposition techniques including evaporation and sputtering techniques

Course Outcome:

The students will be able to

- Understand the importance of vacuum in thin film technology
- Identify the suitable pumping systems to obtain the required level of vacuum

- Appreciate the measurement of vacuum using suitable pressure gauges
- Understand the process of thin film growth
- Compare the vacuum and non-vacuum techniques for thin film deposition
- Apply thin film technologies in fabricating various metal and optical coatings

Unit I - PROPERTIES OF GASES AT LOW PRESSURES: Introduction - The concept of vacuum - degrees of vacuum - Gas Pressure – unit of measurements - mean free path – particle flux - interaction of gas molecules with surfaces - adsorption time - saturation pressure - surface coverage with gas molecules .
Unit II - PUMPS AND PUMPING SYSTEMS: General characteristics of vacuum pumps – rotary pump – Diffusion pumps –pumping mechanism– Turbomolecular pumps – pumping mechanism – turbomolecular pump designs – Cryogenic pumps - pumping mechanism – speed pressure and saturation.
Unit III - MEASUREMENT OF VACUUM: Classification of measurement methods – Direct pressure measurement – Indirect pressure measurement – Pressure gauges – Direct reading gauges – Diaphragm & Bourdon gauge - capacitance manometer – Indirect reading gauges – pirani gauge - Ionization gauges – hot cathode gauge – cold cathode gauge – gauge calibration.
Unit IV - THIN FILM GROWTH PROCESS: Evaporation –evaporation rate – alloys – compounds– sources – transport – deposition monitoring. Deposition – adsorption – surface diffusion – nucleation – structure development – interfaces – temperature control. Chemical vapor deposition – gas supply –Reaction – chemical equilibrium – surface processes – Diffusion – diffusion limited deposition.
Unit V - THIN FILM DEPOSITION TECHNIQUES: Molecular Beam Epitaxy – basic MBE process – sputter deposition – physical sputtering theory – plasmas and sputtering systems –electro plating – sol gel coating – laser ablation – spray pyrolsis.

Text Books

1. Vacuum Technique by L. N. Rozanov, Taylor and Francis, London, 2002, ISBN No: 0-415- 27351-x.
2. Thin film deposition Principles & Practice, Donald L. Smith, McGraw Hill, 1995, ISBN No: 0-07-058502-4.

Reference Books

1. A user's guide to Vacuum Technology, John F. O' Hanlon, 3rd Ed., John Wiley & Sons Inc, 2003.
2. Modern Vacuum Physics, Austin Chambers, Chapman & Hall/CRC, Taylor and Francis, London, 2005, ISBN No: 0-8493-2438-6.
3. Hand book of thin film deposition processes & technologies Krishna Seshan, Noyes publications/William Andrew publishing, 2nd Ed., 2002
4. The materials Science of thin films, Milton Ohring, Academic Press, 1992, ISBN No: 0-12-524990-x.
5. Thin film materials – stress, defect formation & surface evolution, L.B. Freund & S. Suresh, Cambridge University Press, 2003, ISBN No: 0-521-822815. 6. Thin film Device Applications, K.L Chopra, Plenum Press, NY, 1983

17PH2013 CONDENSED MATTER PHYSICS

Credit: 3:0:0

Course Objective:

- To provide fundamental physics behind different materials we commonly see in the world around us.
- To study the materials and their properties using different theoretical and experimental methods.
- The class will demonstrate the link between microscopic structure and bulk properties in a variety of systems in hard and soft condensed matter.

Course outcome:

The students will be able to

- Understand the band theory of solids
- Interpret the difference types of semiconductors
- Define and explain the properties of superconductors
- Gain knowledge on dielectrics
- Appreciate the properties of ferroelectrics
- Explain the different types of magnetic materials

The students will be able to understand how different kinds of matter are described mathematically and how material properties can be predicted based on microscopic structure.

Unit I - CONDUCTING MATERIALS: Introduction, Electron energies in metals and Fermi energy, Density of states, Band theory of solids, Effective mass of electron and concept of hole, Expression for electrical conductivity of conductors, Different types of conducting materials-zero resistivity, low resistivity and high resistivity materials.
Unit II - SEMICONDUCTING MATERIALS: Introduction, direct and indirect bandgap semiconductors, Intrinsic and extrinsic semiconductors, carrier concentration in n-type semiconductors and variation of Fermi level with temperature and concentration of donor atoms and carrier concentration in ptype and variation of Fermi level with temperature and concentration of donor atoms semiconductors, Hall effect and its applications.
Unit III - SUPERCONDUCTING MATERIALS: Superconductors-mechanism of superconductors, Meissner Effect, Type I and Type II Superconductors, BCS theory, Quantum tunnelling, Josephson's Tunneling, Theory of DC Josephson Effect, Applications.
Unit IV - DIELECTRIC PROPERTIES: The Microscopic concept of polarization, Internal field or local field in liquids and solids, Clausius mosotti relation, Ferroelectricity, Dipole theory of ferroelectricity, piezoelectricity, dielectric loss, effects of dielectrics.
Unit V - MAGNETIC PROPERTIES: Quantum theory of Paramagnetism, Weiss theory of ferromagnetism, Temperature dependence of magnetism, Exchange interaction, Ferromagnetic domains surfaces, Bloch Wall, Antiferromagnetism, Neel temperature, Ferrimagnetism.

Text Books

1. Introduction to Solid State Physics – Charles Kittel.7th edition 2000
2. Solid State Physics - S.O.Pillai – New Age International publishers.
3. Physics of semiconductor devices – S.M.Sze 2007

Reference Books

1. Basic Semiconductor Physics – Chihiro Hamaguchi 2nd Edition 2001
2. Complete guide to semiconductor devices – Kwok Kwok Ng, 2nd Edition 2002

17PH2014 PROPERTIES OF MATTER LAB

Credits 0:0:2

Course Objective:

- To train the students on various properties of matter experiments
- To learn about the refractive index and Newton's ring using light experiments
- To study about the rigidity modulus and moment of inertia of a disc

Course outcome:

Students will be able to

- Demonstrate the practical skills on measurements and instrumentation techniques through physics experiments.
- Describe the concepts and principles of light through practical experiments
- Analyze different measurements for effective understanding of the methods involved.
- Describe the concepts and principles of materials physical property analysis through experiments
- Workout the viscosity of various and its property analysis through experimental measurements and to bring results
- Apply the learned concepts for different applications related matter.

HoD can give any 10 relevant experiments at the beginning of the course in each semester.

17PH2015 ELECTRICITY AND MAGNETISM

Credits 3:0:0

Course Objectives

The course aims to provide

- To learn the basics of electricity and magnetism and equations governing them.
- To acquire knowledge of fundamentals of magnetism
- To know the Maxwell's equations

Course outcome

- Ability to solve the problems in different EM fields.
- Ability to design a programming to generate EM waves subjected to the conditions
- Applications of EM Waves in different domains
- Ability to Solve Electromagnetic Relation using Maxwell Formulae
- Ability to Solve Electro Static and Magnetic to Static circuits using Basic relations
- Ability to Analyse moving charges on Magnetic fields

Unit I - Introduction, fundamental theory of charged particles, Electric fields and Electric forces, Electric dipoles**,** Coulomb's Law, Gauss's Law, Electric flux, Charges on conductors, Applications of Gauss's Law, Problems
Unit II - Electrostatic potential energy and energy density, Potential Gradient, Calculating Electric potential, Equipotential surfaces, Point charge in the presence of grounded conducting sphere, Point charge in the presence of charged, insulated, conducting sphere, Ohms law, electric circuits, Direct current circuits, Resistors in series and parallel, Resistors in series parallel combinations, Kirchhoff's rules
Unit III - Theories of magnetic field, Biot-Savart's law, Faraday's law, Flux density, field strength and magneto motive force, Magnetic field of a moving charge and Magnetic field of current carrying conductor, Motion of a charged particle and magnetic force on a current carrying conductor, Force between parallel conductors, Ampere's law and its applications
Unit IV - Maxwell's displacement current, Maxwell's equations, Derivation of Maxwell's equation for free space
Unit V - Electromagnetic Induction Introduction, Magnetic flux and induced emf, Faraday's law, Lens law, Fleming right hand rule, Self inductance and Mutual Inductance, Magnetic field energy and circuits, Dynamo- working principle, Theory of transformer's and its types

Text Books

1. Classical Electrodynamics, Third Edition, John David Jackson, John Wiley & Sons, Inc. New York 1999
2. Electromagnetic waves and radiating systems: E.C. Jordan and K.G. Balmain, Printice-Hall of India

Reference Books

1. Electromagnetic waves and fields, V.V. Sarvwate, Wiley Eastern Ltd, or New Age International (1993)
2. Electromagnetic wave theory, J.R. Wait, Harper & Row

17PH3001 CLASSICAL MECHANICS

Credits: 3:0:0

Course Objective:

- To apply fundamental conservation principles to analyze mechanical systems with an emphasis on the central force problem and rigid body motion.
- To represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulations of classical mechanics.
- To develop the capability to apply theoretical techniques like variation principle, and Hamilton Jacobi theory, to analyze elementary mechanical systems.

Course Outcome:

Students will be able to

- Apply summary properties of Lagrangian to interpret the physical significance of conserved quantities (linear momentum, angular momentum and energy).
- Apply advanced mathematical methods to deal with physical quantities and interpreting mathematical results in physical terms
- Apply hamilton's equation of motion for a standard problems and be able to recognize the resulting reduction of dimensionality of the problem
- Apply the techniques and results of classical mechanics to real world problems and novel situations
- Effectively communicate problems and their solutions relevant to classical mechanics
- Apply canonical transformation to find a solutions for a simple problem

Unit I - Mechanics of a System of Particles: Constraints – Generalized co-ordinates – D'Alembert's principle and Lagrange's equations – Simple applications of the Lagrangian Formulations. Hamilton's Principle – Deduction of Largrange's equations from Hamilton's Principle, Applications.

Unit II - The Two Body Central Force Problem: Reduction to the equivalent one body problem – The equation of motion and first integral – Kepler Problem: Inverse square law of force – The motion in time in the Kepler problem – Scattering in a central force field.
Unit III - The Kinematics of Rigid Body Motion: The independent coordinates of a rigid body – orthogonal transformations – The Euler Angles – Symmetric top – Rate of change of a vector – angular velocity vector in terms of the Euler angles
Small Oscillation: Formulation of the problem – Eigen value equation and the principal axis transformation – frequencies of free vibration – Triatomic molecule.
Unit IV - The Hamilton Equations of Motion: Canonical Transformations and the Hamilton equation of motion – Cyclic coordinates – Routh's procedure and oscillations about steady motion – Derivation of Hamilton's equations from variational principle – The equations of canonical transformation – Examples of canonical transformation.
Unit V - Hamiltonian-Jacobi Theory: Hamilton-Jacobi equations for principle function-Harmonic Oscillator problem as an example of the Hamilton-Jacobi method-Hamilton-Jacobi equation for Hamilton's characteristic function- Actions angle variables in the Systems with one degree of freedom- The Kepler Problem in action angle variables

Reference Books

1. Classical Mechanics, H. Goldstein, Narosa publishing house, Second Edition 2001
2. Classical Mechanics- S.L.Gupta, V. Kumar & H.V.Sharma-Pragati Prakashan Meerut.,2003
3. Classical Mechanics, T. W. B. Kibble, Frank H. Berkshire, Imperial College Press, 2004
4. Classical Mechanics, J C Upadhyaya, Himalaya Publishing House, 2012
5. Introduction to Classical Mechanics, R. G. Takwale, P. S. Puranik, Tata McGraw-Hill, 2006
6. Classical Mechanics, John Robert Taylor, University Science Books, 2005
7. Classical Mechanics, Tai L.Chow, Taylor and Francis group, 2013

17PH3002 STATISTICAL MECHANICS AND THERMODYNAMICS

Credits 3:0:0

Course Objective:

- To explain the origin of the laws of thermodynamics from the fundamental principles of equilibrium statistical mechanics.
- To learn the basic principles of thermodynamics and statistical mechanics and apply them to describe equilibrium thermal properties of bulk matter.
- Creating a bridge between theory of the microworld (theory of individual molecules and their interactions) and theory of macroscopic phenomena

Course Outcome:

Students will be able to

- Knowing the basic concepts behind thermodynamics
- Understanding the laws of thermodynamics and their consequences
- Understanding the different types of thermodynamic systems
- Understanding the statistical approach towards thermodynamics
- Deriving the different types of statistical distribution
- Analyzing the thermal characteristics of the crystalline solids

Unit I - Review of the Laws of Thermodynamics and their Consequences: Energy and the first law of thermodynamics – Heat content and Heat capacity – Specific heat – Entrophy and the second law of thermodynamics – Thermodynamic potentials and the reciprocity relations – Maxwell's relations – Deductions – Properties of thermodynamic relations – Gibb's – Helmholtz relation – Thermodynamic equilibrium – Nernst's Heat Theorem and third law – Consequences of third law – Nernst's - Gibb's phase rule – Chemical potential.
Unit II - Statistical Description of Systems of Particles: Statistical formulation of the state system – phase space – Ensemble – average value – density of distribution in phase space – Liouville Theorem – Equation of motion and Liouville's theorem – Equal apriori probability – Statistical equilibrium – Ensemble representations of situations of physical interest – isolated system – Systems in contact.

Unit III - Simple Applications of Statistical Mechanics: General Method of approach – Partition functions and their properties – Ideal Monatomic Gas – Calculation of Thermodynamic quantities – Gibb's Paradox. The equipartition theorem and proof – application to harmonic oscillator.

Statistical Thermodynamic Properties of Solids: Thermal characteristics of crystalline solids – Einestein model – Debye modification –Limitations of Debye theory – Paramagnetism – General calculation of Magnetization.

Unit IV - Quantum Statistics of Ideal Gases: Maxwell – Boltzman statistics, Bose-Einstein statistics and Fermi Dirac statistics; Calculation of distribution functions from the partition function for M-B, B-E, and F-D statistics – Quantum statistics in the classical limit – ideal Bose Gas – Bose – Einstein condensation – Ideal Fermi Gas – Degnerate Electron Gas.

Unit V - Phase Transitions in Statistical Mechanics: General remarks on the problem of phase transitions – Non ideal classical gas – Calculation of partition function for low densities – Equation of state and virial coefficients – The Vander – Waal's equation – Phase transitions of the second kind – ferromagnetism.

Reference Books

1. Fundamentals of Statistical and Thermal Physics, Federick Reif, McGraw,Hill, 1985.
2. Statistical Mechanics – B. K. Agarwal and M. Einsner, John Wiley & Sons,1988
3. Statistical Thermodynamics – M.C. Gupta, Wiley Eastern Ltd, 1990
4. Thermodynamics and statistical mechanics, By John M. Seddon, Julian D. Gale Royal Society of Chemistry, 2001
5. Introduction to statistical mechanics – S.K.Sinha, Alpha Science International, 2005
6. Elements of Statistical Mechanics,Kamal Singh & S.P. Singh, S. Chand & Company, New, 1999
7. An Introduction to Statistical Thermodynamics By Terrell L. Hill, 2007

17PH3003 MATHEMATICAL PHYSICS I

Credits: 3:1:0

Course Objective:

- To review the basics of vector analysis and move on to the advanced level treatment of Vectors and matrices
- To enable the students to solve the first and second order differential equations and have a sound knowledge about special functions
- To make the students to solve the problems in physics using mathematical principles.

Course Outcome:

Students will be able to

- Master the basic elements of complex mathematical analysis, including the integral theorems, obtain the residues of a complex function and to use the residue theorem to evaluate definite integrals
- Solve linear systems and find matrix inverses , eigen values and eigenvectors
- Solve ordinary differential equations of second order that are common in the physical sciences
- Formulate and express a physical law in terms of tensors, and simplify it by use of coordinate transforms
- Student learn the theory of probability, various distribution functions and errors and residuals
- The students can understand apply the mathematical concepts to solve the problems in physics.

Unit I - VECTOR ANALYSIS: Addition, Subtraction, multiplication of vectors –Simple Problems –Magnitude of Vectors – Linear Combination of vectors –Simple problems – Product of two vectors – Triple product of vectors - Simple applications of vectors to Mechanics – Work done by force - Torque of a force-Force on a particle in magnetic field-Force on a charged particle- Angular velocity - Differentiation of vectors – Scalar and vector fields - Gradient, Divergence and Curl operators – Integration of vectors – Line, surface and volume integrals –Gauss's Divergence theorem – Green's theorem – Stoke's theorem

Unit II - MATRICES: Equality of matrices – Matrix Addition, multiplication and their properties –Special matrices –Definitions: Square matrix, Row matrix, Null matrix, Unit matrix, Transpose of a matrix, Symmetric and skew symmetric matrices, Conjugate of matrixAdjoint of matrix (Simple problems)- Unitary matrix, Orthogonal matrix (simple problems) –Inverse of matrix – Problems- Rank of matrix –Problems - Solutions of linear equations – Cramer's rule – Cayley-Hamilton Theorem – Eigen Values and Eigen vectors of matrices and their properties – Quadratic forms and their reduction - Diagonalisation of matrices

Unit III - TENSOR ANALYSIS: Definition of tensors – Transformation of coordinates – The summation convention and Kronecker Delta symbol –Covariant Tensors – Contravariant tensors – Mixed Tensors - Rank of a tensor – Symmetric and anti-symmetric tensors –Quotient law of tensor - Invariant Tensors - Algebraic operations of tensors - Addition, subtraction and multiplication(inner and outer product) of tensors Derivative of tensors

Unit IV - LINEAR DIFFERENTIAL EQUATIONS:
Linear differential equations of second order with constant and variable coefficients – Homogeneous equations of Euler type – Equations reducible to homogeneous form – method of variation of parameter – Problems.

Unit V - PROBABILITY AND THEORY OF ERRORS: Definition of probability – Compound Probability – Total Probability – The multinomial law – Distribution functions - Binomial, Poisson and Gaussian distribution– Mean (Arithmetic - Individual observations ,Discrete series, Continuous series) – Median (Individual observations ,Discrete series, Continuous series) – Mode (Individual observations ,Discrete series, Continuous series) -Mean Deviation and Standard Deviation(Individual observations ,Discrete series, Continuous series) – Different types of errors – Errors and residuals —The principle of Least squares fitting a
straight line.

Reference Books

1. Mathematical Physics – B.D.Gupta – Vikas Publishing House, 3rd edition, 2006
2. Mathematical Physics – B.S.Rajput – PragatiPrakashan – Meerut, 17th edition, 2004
3. Mathematical Methods for Engineers and Scientists – K.T.Tang – Springer Berlin Heidelberg New York ISBN,10 3,540,30273,5 (2007)
4. Mathematical Methods for Physics and Engineering – K.F.Riley, M.P.Hobson and S.J.Bence, Cambridge University Press – ISBN 0 521 81372 7 (2004)
5. Essential Mathematical Methods for Physicists – Hans J.Weber and George B.Arfken – Academic Press, U.S.A. – ISBN 0,12,059877,9 (2003)
6. Mathematical Physics Including Classical Mechanics, SatyaPrakash, Sultan Chand & Sons, New Delhi, ISBN,13: 9788180544668 (2007)

17PH3004 SEMICONDUCTOR PHYSICS

Credits: 3:0:0

Course Objective:

- To learn about the different semiconductor devices
- To understand the concept of manufacturing of resistors, diodes, capacitors and inductors in a chip for various applications
- To get a knowledge about the operational amplifiers and to know the architecture and functioning of 8085 microprocessor

Course Outcome:

Students will be able to

- Know about the semiconductor devices,
- Design IC manufacturing,
- Appraise different types of operational amplifiers,
- Program microprocessors
- Demonstrate the wave forms through multiplexers
- Design special purpose devices.

Unit I - Semiconductor Devices: Uni-Junction Transistor – Characteristics – Relaxation Oscillator FET Volt – Ampere Characteristics – MOSFET, N Channel – P Channel – FET as a voltage variable resistor –Common source amplifier – SCR – TRIAC – DIAC – Tunnel Diode – Characteristics – Basic applications.

Unit II - Fabrication of Integrated Circuits: Integrated circuits fabrication and characteristics – Integrated circuit technology, basic monolithic integrated circuits – epitoxial growth, masking and etching – Diffusion of impurities – Monolithic diodes, integrated resisters, integrated capacitors and inductors monolithic layout, addition isolation methods, large scale integration (LSI), medium scale integration (MSI) and small scale integration (SSI) – The metal semiconductor contact.

Unit III - Linear Integrated Circuits: Op. Amp characteristics – Parameters – Basic, application – summing – integrating Differentiating – Logarithmic – Antilogarithmic amplifier – Sinusoidal, square – Triangular and ramp wave generation – Multivibrator – Bistable – Monostable – Schmit trigger – Solution of differential equation – Analog computation.

Unit IV - Microwaves: Microwave generation and application, Klystron, Magnetron, travelling wave tube – Microwave propagation in rectangular and cylindrical wave guides. H01, E01 modes – Attenuators – Crystal detection – measurement of SWR.

Unit V - Digital Electronics: Boolean Algebra – Demorgan Theorem Arithmetic circuits Karnaugh map simplifications, (synchronous and asynchronous) counters registers – Multiplexures – Demultiplexures memories (EPROM, PROM, S-RAM) – LSI, VLSI Devices (PLD, PGAS)

Reference Books

1. Integrated Electronics – Millmaan. J. and Halkias C.C
2. Electronic Devices and Circuits – Allen Mottershead
3. Microwaves – Gupta K.C
4. Digital Principles and Applications – Malvino and Leach.

17PH3005 QUANTUM MECHANICS I

Credits 3:0:0

Course Objective:

- To understand the general formulation of quantum mechanics
- To acquire working knowledge of the postulate in quantum mechanics on the physical systems
- To get knowledge on the theoretical aspects of perturbation of atoms due to electric and magnetic fields

Course Outcome:

Students will be able to

- Gain an in depth understanding on the central concepts and principles of quantum mechanics: the Schrödinger equation, the wave function and its physical interpretation, stationary and non-stationary states and expectation values.
- Improved mathematical skills necessary to solve differential equations and eigenvalue problems using the operator formalism
- Quantum mechanical solution of simple systems such as the harmonic oscillator and a particle in a potential well
- Grasp the concepts of spin and angular momentum, as well as their quantization- and addition rules.
- Student forms a mental picture on the meaning of linear combination of states within quantum mechanics
- Solutions to perturbation problems and many electron systems

Unit I - GENERAL FORMALISM OF QUANTUM MECHANICS: Linear vector space- Linear operator- Eigenfunctions and Eigenvalues - Normalisation of wave function-Probability current density - Hermitian operator- Postulates of quantum mechanics- Simultaneous measurability of observables- General uncertainty relation- Dirac's notation- Expectation values - Equations of motion; Schrodinger, Heisenberg and Dirac representation- Momentum representation.

Unit II - ENERGY EIGEN VALUE PROBLEMS: Particle in a box – Linear Harmonic oscillator- Tunnelling through a barrier- particle moving in a spherically symmetric potential- System of two interacting particles-Rigid rotator- Hydrogen atom.

Unit III - ANGULAR MOMENTUM: Orbital angular momentum-Spin angular momentum-Total angular momentum operators- Commutation relations of total angular momentum with components-Ladder operators- Commutation relation of Jz with J+ and J- - Eigen values of J2, Jz - Matrix representation of J2, Jz, J+ and J- - Addition of angular momenta - Clebsch Gordon coefficients(no derivation) – properties.

Unit IV - APPROXIMATE METHODS: Time independent perturbation theory in non-degenerate case-Ground state of helium atom-Degenerate case-Stark effect in hydrogen – Spin-orbit interaction-Variation method & its application to hydrogen molecule- WKB approximation

Unit V - MANY ELECTRON ATOMS: Indistinguishable particles – Pauli principle- Inclusion of spin – spin functions for two electrons - The Helium Atom – Central Field Approximation - Thomas-Fermi model of the Atom - Hartree Equation- Hartree-Fock equation.

Reference Books

1. Quantum Mechanics – G. Aruldhas - Prentice Hall of India, 2006
2. Quantum mechanics, Satya Prakah & Swati Saluja, kedar Nath Ram Nath & Co,Meerut, 2007
3. A Text Book of Quantum Mechanics-P.M. Mathews & K. Venkatesan – Tata McGraw Hill 2007
4. Introduction to Quantum Mechanics – David J.Griffiths Pearson Prentice Hall 2005
5. Quantum Mechanics – L.I Schiff - McGraw Hill 1968
6. Principles of Quantum Mechanics-R.Shankar, Springer 2005

17PH3006 PHYSICAL OPTICS

Credits: 3:0:0

Course Objective

- To learn the working of various optical elements like lenses and mirrors.
- To understand the properties of light as a wave
- To learn the fundamental principles of classical physical optics.

Course Outcome

- Students demonstrate the usage of various optical elements like lenses and mirrors.
- Students apply the properties of light on research oriented problems.
- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design a optical system, component, or process to meet desired needs within realistic constraints such as economic, health and safety, manufacturability, and sustainability.
- An ability to identify, formulate, and solve optical physics and engineering problems.
- An ability to use the techniques, skills, and modern tools necessary for optical physics and engineering careers

Unit I - GEOMETRICAL OPTICS: Lenses- Thin Lens Equations- Mirrors- Mirror Formula-Prisms-Dispersing and Reflecting- Thick Lenses and Lens Systems-Analytical Ray Tracing-Matrix Methods for Lenses and Mirrors-Optical Cavity

Unit II - SUPERPOSITION OF WAVES: Addition of Waves of same Frequency- Addition of Waves of different Frequency- Group Velocity- Anharmonic Periodic Waves- Fourier Series

Unit III - POLARIZATION: Linear Polarization- Circular and Elliptical Polarization- Polarizers-Malus's Law-Dichroism- Birefringence- Polarization by Scattering and Reflection-Brewster's Law- Wave plates- Full- Wave, Half-Wave and Quarter-Wave Plates- Optical Activity

Unit IV - INTERFERENCE AND DIFFRACTION: Interference-General Considerations- Conditions for Interference- Temporal and Spatial Coherence- Amplitude-Splitting Interferometers-Michelson and Mach-Zehnder Interferometer- Multiple Beam Interference- Fabri-Perot Interferometer-Diffraction- Huygens- Fresnel Principle-Fraunhofer and Fresnel Diffraction- Fraunhofer Diffraction- Single, Double and Many Slits- Diffraction Grating-Fresnel Diffraction.

Unit V - FOURIER OPTICS: Fourier Transforms- One- and Two-Dimensional Transforms- Dirac Delta Function-Optical Applications- Spectra and Correlation

Reference Books

1. Optics: Eugene Hecht and A. R. Ganesan, Dorling Kindersely (India) (2008)
2. Optics: A. K. Ghatak, Tata McGraw Hill, (2008)
3. Principles of Physical Optics, Charles A. Bennett, Wiley, (2008)

17PH3007 MATHEMATICAL PHYSICS II

Credits 3:1:0

Course Objective:

- To impart a thorough knowledge about elements of complex analysis and transforms
- To grasp the idea of group theory and its implications.
- To have a thorough knowledge about numerical methods

Course Outcome:

Students will be able to

- Expand a function in terms of a Fourier series, with knowledge of the conditions for the validity of the series expansion
- Apply integral transform (Fourier and Laplace) to solve mathematical problems of interest in physics, use Fourier transforms as an aid for analyzing experimental data
- Solve partial differential equations of second order by use of standard methods like separation of variables, series expansion (Fourier series) and integral transforms
- Students should know the fundamental concepts of group theory.
- Be familiar with numerical interpolation and approximation of functions, numerical integration and differentiation
- The students can understand, apply the mathematical concepts to solve the problems in physics.

Unit I - COMPLEX VARIABLES: Functions of a complex variable– Analytic functions – Cauchy – Riemann conditions and equation – Conjugate functions – Complex Integration – Cauchy's integral theorem, integral formula – Taylor's series and Laurent Series – Poles, Residues and contour integration - Cauchy's residue theorem – Computation of residues - Evaluation of integrals.

Unit II - FOURIER SERIES AND FOURIER TRANSFORMS:
Fourier series – Dirichilet conditions – Complex representations – Sine and Cosine series – Half range series – Properties of Fourier Series – Physics applications of Fourier series – The Fourier Transforms – Applications to boundary value problems

Unit III - APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS & GREENS FUNCTION: Solutions of one dimensional wave equation- one dimensional equation of heat conduction-Two dimensional heat equations – Steady state heat flow in two dimensions – Green's Function – Symmetry properties - Solutions of Inhomogeneous differential equation - Green's functions for simple second order differential operators.

Unit IV - GROUP THEORY: Basic definition of a group – Subgroups – Classes – Isomorphism Homomorphism – Cayley's theorem – Endomorphism and automorphism – Important Theorems of Group representations – Unitary theorem – Schur's Lemma – Equivalent Theorem – Orthogonality Theorem – Some special groups – Unitary Group – Point Group – Translation Group – Homogenous and Inhomogenous Lorentz groups – Direct product group

Unit V - NUMERICAL METHODS: Finite Differences – Shifting Operator – Numerical Interpolations – Newton's forward and backward formula – Central Difference interpolation – Lagrange's Iterpolation – Numerical Differentiation – Newton's and Stirling's Formula – Numerical Integration – Trapezoidal Rule – Simpson's 1/3 and 3/8 rule – Numerical Solution of ordinary differential equations – Runge-Kutta methods – Piccard's Methods

Reference Books

1. B.D.Gupta – Mathematical Physics –Vikas Publishing House, 3rd edition, 2006
2. B.S.Rajput – Mathematical Physics –Pragati Prakashan – Meerut, 17th edition, 2004
3. K.T.Tang – Mathematical Methods for Engineers and Scientists –Springer Berlin Heidelberg New York ISBN,10 3,540,30273,5 (2007)
4. K.F.Riley, M.P.Hobson and S.J.Bence, Mathematical Methods for Physics and Engineering – Cambridge University Press – ISBN 0 521 81372 7 (2004)
5. Hans J.Weber and George B.Arfken – Essential Mathematical Methods for Physicists – Academic Press, U.S.A. – ISBN 0,12,059877,9 (2003)
6. Satya Prakash, Mathematical Physics Including Classical Mechanics, Sultan Chand & Sons, New Delhi, ISBN,13: 9788180544668 (2007).

17PH3008 ATOMIC AND MOLECULAR SPECTROSCOPY

Credits 3:0:0

Course Objective:

- Students will understand that physical and chemical properties of matter result from subatomic particles that behave according to physical rules not apparent in the behavior of macroscopic objects, and they must realize the importance of spectroscopy in establishing this behavior.
- Students must be able to know the need for spectroscopy in solving the structure of molecules
- Students will study the principles and the theoretical framework of different spectroscopic techniques.

Course Outcome:

Students will be able to

- Understand how spectroscopic studies in different regions of the E.M spectrum probe different types of molecular transitions
- Apply suitable spectroscopic techniques to interpret the structure of the molecule
- Solve the structure of molecules using theory learned from the spectroscopic techniques
- Appreciate the advancements in instrumentation by overcoming the drawbacks in each spectroscopic technique
- Compare the spectroscopic techniques based on merits and demerits
- Identify the best method to solve the spectroscopic problems

Unit I - Atomic and Molecular Structure: Central field approximation – Thomas – Fermi Statistical model – Spin-orbit interaction –Alkali atoms – Doublet separation – Intensities - Complex atoms – Coupling Schemes –Energy levels – Selection rules and intensities in dipole transition – Paschen back effect
Unit II - Microwave Spectroscopy - Rotation of molecules- Diatomic Molecules- Intensities of Spectral Lines- Effect of Isotope Substitution- Non-rigid Rotator- Polyatomic Molecules- Techniques and Instrumentation
Unit III - Infra-red Spectroscopy - Vibration of Diatomic Molecules- Anharmonic Oscillator- Vibrating Rotator- Vibration- Rotation Spectrum of Carbon Monoxide-Breakdown of Born-Opprenheimer Approxiamation- Vibration of Polyatomic Molecules- Vibration-Rotation Spectra of Polyatomic Molecules-Techniques and Instrumentation
Unit IV - Raman Spectroscopy: Quantum Theory of Raman Effect- Classical Theory- Molecular Polarizability- Rotational Raman Spectra-Vibrational Raman Spectra-Polarization of Light and Raman Effect- Structural Determination- Techniques and Instrumentation
Unit V - Electronic Spectroscopy: Electronic Spectra of Diatomic Molecules- Born-Oppenheimer Approximation- Franc-Condon Principle- Dissociation Energy- Rotational Fine Structure- Fortrat Diagram- Predissociation- Polyatomic Molecules- Re-emission from Excited Molecules.

Reference Books:

1. Modern Spectroscopy; J.M.Hollas, John Wiley, (2004)
2. Introduction to Atomic Spectra, Harvey Elliot White. McGraw-Hill, 1934
3. Fundamentals of Molecular Spectroscopy by C. N. Banwell, Tata McGraw-Hill Publ.Comp. Ltd. (2010)
4. Molecular Spectra and Molecular Structure: G. Herzberg Van Nostrand, 1950

17PH3009 ELECTROMAGNETIC THEORY

Credits 3:0:0

Course Objective
The course aims to provide
- To learn the basics of electricity and magnetism and equations governing them.
- To acquire the knowledge of Electromagnetic field theory that allows the student to have a solid theoretical foundation to be able in the future to design emission , propagation and reception of electro magnetic wave systems
- To identify , formulate and solve fields and electromagnetic waves propagation problems in a multi disciplinary frame individually or as a member of a group

Course outcome:
Students will be able to
- Solve the problems in different EM fields.
- Design a programming to generate EM waves subjected to the conditions
- Do the applications of EM Waves in different domains and to find the time average power density
- Solve Electromagnetic Relation using Maxwell Formulae
- Solve Electro Static and Magnetic to Static circuits using Basic relations
- Analyse moving charges on Magnetic fields

Unit I - ELECTRO STATICS: Electric field, Gauss Law – Scalar potential – Multipole expansion of electric fields – The Dirac Delta function – Poisson's equation – Laplace's equation – Green's theorem – Uniqueness theorem – electrostatic potential energy and energy density. Electrostatics in matter- Polarization and electric displacement vector- Electric field at the boundary of an interface- Clausius - Mossotti equation.

Unit II - MAGNETO STATICS: Biot and Savart law – Differential equations of magnetostatics and Ampere's law – The magnetic vector potential – The magnetic field of distant circuit – Magnetic moment – The magnetic scalar potential – Macroscopic magnetization – Magnetic field.
Unit III - TIME VARYING FIELDS: Electromagnetic induction – Faraday's law – Maxwell's equations – Displacement current – Vector and Scalar potentials – Gauge transformation – Lorentz gauge – Columb's gauge – Gauge invariance – Poynting's theorem.
Unit IV - PLANE ELECTROMAGNETIC WAVES: Plane wave in a non conducting medium – Boundary conditions – Reflection and refraction of e.m. waves at a plane interface between dielectrics – Polarization by reflection and total internal reflection - Waves in a conducting or dissipative medium.
Unit V - ELECTRODYNAMICS: Radiation from an oscillating dipole – Radiation from a half wave antenna – Radiation damping – Thomson cross section – Lienard – Wiechert Potentials – The field of a uniformly moving point charge.

Reference Books

1. Classical Electrodynamics, J. D. Jackson, John Wiley & Sons, 1998
2. Foundations of Electro Magnetic Theory – John R. Reits, Fredrick J. Milford & Robert W. Christy. Narosa Publishing House (1998)
3. Electromagnetics: B. B. Laud, New Age International 2nd Edition (2005)
4. Electromagnetic Waves and Radiating Systems, E. C. Jordan, K. G Balmain, PHI Learning Pvt. Ltd., 2008
5. Engineering Electromagnetics, W. H. Hayt, J. A., Buck, Tata McGraw-Hill, 2011.

17PH3010 QUANTUM MECHANICS II

Credits 3:0:0

Course Objective

- Learn how to apply quantum mechanics to solve problems in atomic physics
- Understand time dependent perturbation theory using quantum mechanics
- Get knowledge on the formulation of quantum field theory

Course Outcome:

Students will be able to

- Understand, evaluate and describe the theories, concepts and principles of the current knowledge for the chosen topic
- Ability to use the perturbation theory and other approximations to solve questions in atomic physics.
- Familiarity on the principles of adiabatic approximation and use these principles to explain time evolution in simple quantum systems
- Understanding of the advanced quantum mechanical concepts on scattering and radiation.
- Knowledge of quantum mechanical solution of relativistic problems and quantum fields
- Have appropriate skill in analytical, theoretical and/or practical techniques to further their understanding in the chosen topic.

Unit I - TIME DEPENDENT PERTURBATION THEORY: Time Dependent Perturbation Theory-First and Second Order Transitions-Transition to Continuum of States-Fermi Golden Rule-Constant and Harmonic Perturbation-Transition Probabilities-Selection Rules for Dipole Radiation-Collision-Adiabatic Approximation.
Unit II - SCATTERING THEORY: Scattering Amplitude - Expression in terms of Green's Function - Born approximation and its validity- Partial wave analysis - Phase Shifts - Scattering by coulomb and Yukawa Potential.
Unit III - THEORY OF RADIATION (SEMI CLASSICAL TREATMENT): Einstein's Coefficients-Spontaneous and Induced Emission of Radiation from Semi Classical Theory- Radiation Field as an Assembly of Oscillators-Interaction with Atoms-Emission and Absorption Rates-Density Matrix and its Applications.
Unit IV - RELATIVISTIC WAVE EQUATION: Klein Gordon Equation-Plane Wave Equation- Charge and Current Density-Application to the Study of Hydrogen Like Atom-Dirac Relativistic Equation for a Free Particle-Dirac Matrices -Dirac Equation in Electromagnetic Field -Negative Energy States.
Unit V - QUANTUM FIELD THEORY: Quantization of Wave Fields- Classical Lagrangian Equation- Classical Hamiltonian Equation - Field Quantization of the Non-Relativistic Schrodinger Equation-Creation, Destruction and Number Operators-Anti Commutation Relations- Quantization of Electromagnetic Field Energy and Momentum.

Reference Books

1. A Text Book of Quantum Mechanics -P.M. Mathews & K. Venkatesan-Tata McGraw Hill 2007
2. Quantum Mechanics – G Aruldhas - Prentice Hall of India 2006
3. Introduction to Quantum Mechanics – David J.Griffiths Pearson Prentice Hall 2005
4. Quantum mechanics, Satya Prakash & Swati Saluja, kedar Nath Ram Nath & Co,Meerut, 2007
5. Quantum Mechanics – L.I Schiff - McGraw Hill 1968
6. Quantum Mechanics - A.K. Ghatak and S. Loganathan-McMillan India,2004

17PH3011 NUCLEAR AND PARTICLE PHYSICS

Credits: 3:0:0

Course Objective:

- To help the students understand the basic properties and structure of the nucleus.
- To understand the basis of nuclear stability with relation to Weizsacker Semi Empirical mass formula and various nuclear models
- To make the students learn about various radioactive decay modes

Course Outcome:

Students will be able to

- Understand about the structure of nucleus
- Comprehend the forces inside the nucleus.
- Have knowledge about fission and fusion reactions
- Know various radioactive decay modes.
- Clearly understand the classification scheme of fundamental particles.
- Know about the the four fundamental forces of interaction.

Unit I - Nuclear Structure: Basic properties – magnetic moments – Experimental determination – Quadrupole moments – Experimental techniques – Systems of stable nuclei – Semi emperical mass formula of Weizsacker – Nuclear stability – Mass parabolas – liquid drop model – Shell model.

Unit II - Nuclear Forces: Ground state of Deutron – magnetic dipole moment of Deutron – charge independence and spin dependence of nuclear forces – Meson theory – Spin orbit and tensor forces – Exchange forces.

Unit III - Radio Activity: Alpha emission – Geiger – Nuttal law – Gamow's theory – Fine structure of alpha decay – Neutrino hypothesis – Fermi's theory of beta decay – Curie plot – Energies of beta spectrum – Fermi and G.T. Selection rules – Non-conservation of parity – Gamma emission – selection rules – Transition probability – Internal conversion – Nuclear isomerism.

Unit IV - Nuclear Reactions: Level Widths in nuclear reaction – Nuclear Reaction cross sections – Partial wave analysis – Compound nucleus model – Resonance Scattering – Breit – Wigner one level formula – Optical model – Direct reactions – Stripping and pick-up reactions – Fission and Fusion reactions: Elementary ideas of fission reaction – Theory of fission – Elementary ideas of fusion – Controlled Thermonuclear reactions, Swimming pool type reactor –Fusion power.

Unit V - Particle Physics: Classification of fundamental forces and elementary particles – Isospin, strangeness – Gell-Mann Nishijima's formula – Quark model, SU (3) Symmetry, CPT invariance in different interactions parity non conservation – K meson.

Reference Books

1. Concepts of Nuclear Physics – B.L. Cohen – McGraw-Hill – 2001.
2. Introduction to Nuclear Physics – H.A. Enge – Addision-Wesley, 1983.
3. Introduction to Particle Physics : M. P. Khanna Prentice Hall of India (1990)
4. Nuclear and particle Physics : W. Burcham and M. Jobes, Addision-wesley (1998)
5. S N Ghoshal, Nuclear Physics 1st Edition, S.Chand Publishing, 1994.
6. Irving Kaplan, Nuclear Physics 2nd Edition, Narosa Publishing House, 2002.
7. Kenneth S.Krane, Introductory Nuclear Physics 1st Edition, Wiley India Pvt Ltd, 2008.
8. S L Kakani, Nuclear and Particle Physics, Viva Books Pvt Ltd.-New Delhi, 2008.
9. Gupta, Verma, Mittal, Introduction to nuclear and particle physics, 3/E 3rd Edition, PHI Learning Pvt. Ltd-New Delhi, 2013.
10. Samuel S. M. Wong, Introductory Nuclear Physics 1st Edition, PHI Learning, 2010.

17PH3012 SPECTROSCOPY

Credits 3:0:0

Course Objective:

- Students will understand that physical and chemical properties of matter result from subatomic particles that behave according to physical rules not apparent in the behavior of macroscopic objects, and they must realize the importance of spectroscopy in establishing this behavior.
- Students must be able to know the need for spectroscopy in solving the structure of molecules
- Students will learn how the resonance spectroscopic techniques are used in atomic and molecular structure determination

Course Outcome:

Students will be able to

- Understand how spectroscopic studies in different regions of the E.M spectrum probe different types of molecular transitions
- When the structure of the molecule is to be interpreted, students will apply suitable spectroscopic techniques
- Solve the structure of molecules using theory learned from the spectroscopic techniques
- Appreciate the advancements in instrumentation by overcoming the drawbacks in each spectroscopic technique
- Compare the spectroscopic techniques based on merits and demerits
- Identify the best method to solve the spectroscopic problems

Unit I - NMR Spectroscopy: NMR – Basic principles – Classical and Quantum mechanical description – Bloch equation –Spin – Spin and spin lattice relaxation times – Experimental methods – Single Coil and double coil methods – Pulse method

Unit II - ESR Spectroscopy: ESR basic principles – High Resolution ESR Spectroscopy – Double Resonance in ESR- ESR spectrometer.

Unit III - Nuclear Quadruple Resonance Spectroscopy: N Q R Spectroscopy – Basic Principles – Quadruple Hamiltonian Nuclear Quadrupole energy levels for axial and nonaxial symmetry – N Q R spectrometer – chemical bonding – molecular structural and molecular symmetry studies.

Unit IV - Mossbauer Spectroscopy: Basic principles, spectral parameters and spectrum display, applications to the study of bonding and structure of Fe^{2+} compounds. Isomer shieft, quadruple spliting, hyperfine interaction, instrumentations and applications**.**

Unit V - Mass Spectroscopy: Introduction- ion production- fragmentation- ion analysis- ion abundance- common functional groups- high resolution mass spectroscopy- instrumentation and application.

Reference Books:

1. Fundamentals of Molecular Spectroscopy by C. N. Banwell, Tata McGraw-Hill Publ.
1. Comp. Ltd. (2010)
2. Modern Spectroscopy; J.M.Hollas, John Wiley, (2004)High Resolution NMR- Pople,
3. Schneidu and Berstein. McGraw-Hill, (1959)
4. Principles of Magnetic Resonance - C.P. Slitcher, Harper and Row, (1963)
5. Basic Principles of Spectroscopy R. Chang, R.E. Krieger Pub. Co.(1978)
6. Nuclear Quadrupole Resonance Spectroscopy - T.P. Das and Hahn , Supplement, (1958)

17PH3013 SOLID STATE PHYSICS

Credit: 3:0:0

Course Objective:

- To study about various solid state properties and its functions
- To understand the fundamental concepts of solid state physics and the methods available to determine their structure and properties
- To gain knowledge about the various theories of solid state physics in the development of materials and its properties

Course Outcome:
Students will be able to

- Describe the elementary models for bonding of atoms and molecules and the Classifications used in solid state physics; relate the general properties (electrical, thermal and optical) to the mechanical properties.
- Give a detailed description of the features of the vibrations of monatomic and of diatomic linear chains
- Describe various solid state phenomena theories and discuss the scattering of phonons, and the concepts of Brillouin zone, Density of States, Fermi energy, effective mass and holes
- Describe the theories involved in the magnetic and superconducting materials phenomena
- Distinguish between various types magnetic and superconducting materials and its applications
- apply the various solid state physical phenomena in the development of materials for specific applications

Unit I - Lattice Vibrations: Elastic vibration – Mono atomic lattice – Linear diatomic lattice – optic and acoustic modes – infrared absorption – localized vibration – quantization of lattice vibration – Phonon momentum. Band Theory of Solids Energy bands in solids – Nearly free electron model – Bloch's theorem – Kronig and Penny model – Tight bound approximation – Brillouin zone – Fermi surface – density of states – de Hass – Van Alphen effect.
Unit II - Dielectric And Ferroelectric Properties: Dielectric constant and polarisability – Local field – different types of polarization – Langevin function – Classius – Mosotti relation – Dipolar dispersion – Dipolar polarization in solids – Ionic Polarisability, Electronic Polarisability – Measurement of dielectric constant. Ferroelectricity – General properties – Dipole theory.
Unit III - Magnetic Properties: Quantum theory of Paramagnetism – Paramaganetism of ionic crystals – Rare earth ions – Ferromagnetism – Weiss theory – Temperature dependence of magnetism – Exchange interaction – Ferromagnetic domains surfaces – Bloch Wall – Antiferromagnetism – Molecular field theory – Neel temperature – Ferrimagnetism.
Unit IV - Optical Properties: Point defects in crystals - Colour centres – Photoconductivity – Electronic Transitions in photoconductors – Trap capture, recominations centres – General mechanism – Luminescence – Excitation and emission – Decay mechanism – Thermo luminescence and glow curves – Electroluminescence.
Unit V - Super Conductivity: Zero resistance – Behavior in magnetic field – Meissner effect – thermodynamics of super conductive materials – Electro dynamics – London equations – B.C.S. theory (qualitative) - Tunneling A.C. and D.C. Josephson effect – Type I and II superconductors – High Tc super conductors (basic ideas)

Reference Books

1. Introduction to Solid State Physics- Kittel, John wiley, 8th edition,2004
2. Elementary Solid State Physics, M. Ali Omar, Pearson Education, 2004
3. Introductory solid state Physics, H.P.Myers, Second edition, Taylor and Francis, 2009
4. Advanced Solid State Physics, P.Philips, Cambridge University Press, 2012
5. Solid State Physics, Neil W. Ashcroft, N. David Mermin, Cengage Learning, 2011
6. Solid State Physics, R.J.Sing, Pearson, 2012.
7. Introduction to Solid State Physics, Kittel, John Wiley, 8th edition, 2004
8. Solid State Physics, S.O. Pillai New Age Publications, 2002

17PH3014 PHYSICS OF NANOMATERIALS

Credits 3:0:0

Course Objective:

- To recall the Quantum concepts and density of states
- To compare the different thin film coating techniques
- To understand the theoretical concepts of nanomaterials

Course Outcome:
Students will be able to

- Apply the knowledge to prepare Nano materials
- Interpret different nano structures
- Examine the characteristics of nanomaterials
- Design nano devices for sensing

- Measure the properties of nanomaterials through diferent techniques
- Appraise the MEMS and NEMS technology

Unit I - INTRODUCTION TO NANO: Basic concepts of nano materials – Density of states of 1,2 and 3D quantum well, wire, dot-Schrodinger wave equation for quantum wire, Quantum well, Quantum dot-Formulation of super lattice- Quantum confinement- Quantum cryptography
Unit II - FABRICATION OF NANOSCALE MATERIALS: Top-down versus Bottom-up –Thin film deposition -Epitaxial growth -CVD, MBE, plasma - Lithographic, photo, e-beam - Etching -Synthesis -Colloidal dispersions - Atomic and molecular -manipulations –Self assembly -Growth modes, Stransky-Krastinov etc –Ostwald ripening
Unit III - ELECTRICAL AND MAGNETIC PROPERTIES : Electronic and electrical properties-One dimensional systems-Metallic nanowires and quantum conductance -Carbon nanotubes and dependence on chirality -Quantum dots –Two dimensional systems -Quantum wells and modulation doping -Resonant tunnelling –Magnetic properties Transport in a magnetic field - Quantum Hall effect. -Spin valves -Spin-tunnelling junctions -Domain pinning at constricted geometries -Magnetic vortices.
Unit IV - MECHANICAL AND OPTICAL PROPERTIES : Mechanical properties hardness – Nano indentation - Individual nanostructures -Bulk nanostructured materials-Ways of measuring- Optical properties-Two dimensional systems (quantum wells)-Absorption spectra -Excitons - Coupled wells and superlattices -Quantum confined Stark effect
Unit V - NANODEVICES : Background -Quantization of resistance -Single-electron transistors - Esaki and resonant tunneling diodes -Magnetic Nanodevices -Magnetoresistance –Spintronics- MEMS and NEMS

Reference Books

1. Introduction to Nanotechnology, Charles P.Poole, Jr. and Frank J.Owens, Wiley, 200
1. Silicon VLSI Technologies, J.D.Plummer, M.D.Deal and P.B. Griffin, Prentice Hall, 2000
2. Introduction to Solid State Physics, C.Kittel, a chapter about Nanotechnology, Wiley, 2004

17PH3015 PHOTONICS

Credits 3:0:0

Course Objectives:
- To learn various processes involving in the development of laser.
- To understand the various applications using lasersTo know the working and fabrication of optical fibers
- To learn modern experimental techniques in optics and photonics in the context of learning about optical fiber communication systems.

Course Outcome:
Students will be able to
- Understand the fabrication and application of various lasers and optical fiber
- Define and explain the propagation of light in conducting and non-conducting media
- Define and explain the physics governing laser behaviour and light matter interaction
- Apply wave optics and diffraction theory to a range of problems
- Apply the principles of atomic physics to materials used in optics and photonics
- Calculate the properties of various lasers and the propagation of laser beams

Unit I - PROPERTIES OF GAUSSIAN BEAMS: The paraxial wave equation, Gaussian beams, the ABCD law for Gaussian beams, Gaussian beam modes of laser resonators. Higher order Gaussian beam modes. Diffraction theory of laser resonators, unstable resonators for high power lasers.
Unit II - LASERS: Quantum theory of laser: Lasers – Einstein A-B Coefficients, round trip gain, matrix method, He-Ne laser, Ruby, Nd: YAG, Nd: glass lasers, liquid lasers and dye laser amplifiers. Theory of Q-switching and mode locking process, devices for Q-switching and mode locking, high power Co2 laser, Ti:Saphire laser. Theory of semiconductor lasers and devices. Laser, Applications
Unit III - NONLINEAR OPTICS-I: Introduction to nonlinear optics, nonlinear polarization and wave equation, second harmonic generation, phase matching, three-wave mixing, parametric amplifications, oscillations, tuning of parametric oscillators, nonlinear susceptibilities, nonlinear susceptibility tensor, nonlinear materials

Unit IV - NONLINEAR OPTICS-II: Propagation of light through isotropic medium, propagation light through anisotropic medium, theory of electro-optic, magneto-optic and acousto-optic effects and devices, integrated optical devices and techniques.
Unit V - FIBER OPTICS: Overview of Optical Fibers: Structure of optical fibers. Step-index and graded index fibers; Single mode, multimode and W-profile fibers. Ray Optics representation. Meridional and skew rays. Numerical aperture and acceptance angle. Multipath dispersion materials – Material dispersion -Combined effect of material and multipath dispersion – RMS pulse widths and frequencyresponse - Model Birefringence - Attenuation in optical fibers - Absorption - Scattering losses -Radiative losses.

Reference Books

1. Laser Spectroscopy- Basic Concepts: W. Demtroder, Springer-Verlag, (2003)
2. The Elements of Fibre Optics: S.L.Wymer and Meardon (Regents/Prentice Hall), (1993)
3. Lasers and nonlinear Optics: B. B. Laud, New Age International (P) Ltd. (2007)
4. Laser Electronics: J. T. Verdeyen, Prentice-Hall Inc. (1995).
5. Laser Fundamentals: W. T. Silfvast, Cambridge University Press, (2003)

17PH3016 THIN FILM TECHNOLOGY

Credits 3:0:0

Course Objective:

- To gain knowledge on vacuum pumps and its functioning
- To compare differnet vacuum measuring gauges
- ToAnalyse the growth process of thin film

Course Outcome:

Students will be able to

- To create vacuum to a particular order
- Measure the vacuum level
- Illustrate the mechanism behind thin film deposition
- Analyse the thin film characteristics through diffents tools
- Apply thin films in fabricating electronics devices
- Appraise the latest technology of MEMS and NEMS

Unit I - Vacuum system: Categories of deposition process, basic vacuum concepts, pumping systems- rotary, diffusion and turbo molecular , monitoring equipment **–**McLeod gauge, pirani, Penning , Capacitance diaphragm gauge - Evaporation – deposition mechanism, evaporation sources- tungstenhelical, hair pin, basket, molybdenum boat, process implementation, deposition condition
Unit II - Thin film coating techniques: Molecular beam epitaxy, sputtering - dc, rf, magnetron, chemical vapour deposition, electroplating- potentiostat, galvanostat, pulsed plating, sol gel coating, LASER ablation, spray Pyrolysis-Substrate materials, material properties – surface smoothness, flatness, porosity, mechanical strength, thermal expansion, thermal conductivity, resistance to thermal shock, thermal stability, chemical stability, electrical conductivity -Substrate cleaning, substrate requirements, buffer layer, metallization
Unit III - Growth process: Adsoption, surface diffusion, nucleation, surface energy, texturing, structure development, interfaces, stress, adhesion, temperature control - Epitaxy-semiconductor devices, growth monitoring, composition control, lattice mismatch, surface morphology
Unit IV - Structural, Optical and electrical studies on thin films: X- Ray Diffraction studies –Bragg's law – particle size – Scherrer's equation – crystal structure – UV Vis NIR Spectroscopy - absorption and reflectance- Optical constants of a thin film by transmission and reflectance at normal incidence for a system of an absorbing thin film on thick finite transparent substrate, Photoluminescence (PL) studies –Fourier Transform Infrared Spectroscopy(FTIR) - Electrical properties: dc electrical conductivity as a function of temperature - Hall effect – types of charge carriers – charge carrier density
Unit V - Thin film applications: Material selection, Design and Fabrication of Thin film resistor – Thin film capacitor – Thin film diode – Thin film transistor – Transparent conducting oxide Thin films – Semiconducting Thin films – Thin film solar cells – CdS and Cu2S based solar cells – CdS - Cu2S and CdS or Cu In Se2 solar cells – Thin film mask blanks for VLSI – Thin films sensors - for gas detectors. Magnetic sensors- storage device- magnetic thin films for MEMS and NEMS application

Reference Books

1. Thin Film Technology Handbook by Aicha Elshabini, Aicha Elshabini-Riad, Fred D. Barlow, McGraw-Hill Professional, 1998
2. Thin film Technology, Chopra, Tata McGraw-Hill, 1985
3. Handbook of Thin-film Deposition Processes and Techniques: Principles, Method,
4. equipment and Applications By Krishna SeshanWilliam Andrew Inc., 2002
5. Handbook of thin film technology, L.I.Maissel and R.Glang, McGraw Hill Book Company, New York (1983).
6. Thin-film deposition: principles and practice by Donald L. Smith, McGraw-Hill Professional, 1995
7. An Introduction to Physics and Technology of Thin Films by Alfred Wagendristel,

17PH3017 RENEWABLE ENERGY SOURCES

Credits 3:0:0

Course Objective:

- To give an overview of the energy problem faced by the current generation
- To give a thorough knowledge about various renewable energy technology and to give a glimpse of cutting edge research technology that is happening place in the field of renewable energy sources. Convert units of energy—to quantify energy demands and make comparisons among energy uses, resources, and technologies.
- Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

Course Outcome :

Students will be able to

- List and generally explain the main sources of energy and their primary applications in the world.
- Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
- Discuss remedies/potential solutions to the supply and environmental issues associated with
- Understand about fossil fuels and other energy resources.
- List and describe the primary renewable energy resources and technologies.
- Describe/illustrate basic electrical concepts and system components.

Unit I - BASIC CONCEPTS OF ENERGY SOURCES: Available Energy Sources – Classification of Energy Sources – Commercial and Noncommercial Energy Sources – Fossil Fuels and Climate Change issues – Renewable Energy Resources – Advantages and Limitations of Renewable Energy sources.

Unit II - SOLAR ENERGY: Solar radiation at the Earth's Surface – Solar Radiation Measurements – Solar Cell – Solar Energy Collectors – Flat-plate Collectors, Concentrating Collector: Focusing Type – Solar Energy Storage – Applications of Solar Energy – Solar Water Heating, Solar Pumping, Solar Furnace, Solar Cooking.

Unit III - WIND-ENERGY: Wind Energy Technology – Aerodynamics – Wind Energy Conversion – Basic Components Of a WECS (Wind Energy Conversion System) – Classification of WECS – Wind Energy Collectors – Wind Energy Storage – Applications of Wind Energy.

Unit IV - ENERGY FROM BIO-MASS: Photosynthesis Process – Bio Fuels – Bio mass Resources – Bio-mass Conversion Technologies – Wet processes and Dry Processes – Classification of Bio-gas plants – Bio-gas from plant Wastes – Materials Used For Bio-gas generation – Utilization if Bio-gas -- Methods for Obtaining energy from Bio-mass.

Unit-V - ENERGY FROM OTHER SOURCES: Energy From The Oceans – Energy And Power from the Waves – Tide and Wave Energy conversion – Advantages and Disadvantages Of Wave Energy – Ocean Thermal Energy Conversion - Geothermal Energy - Chemical Energy Sources – Fuel Cells and Batteries – Hydrogen Energy – Thermionic and Thermoelectric Generators – Micro Hydel Powers

Reference Books

1. Non-Conventional Energy Sources, G.D. Rai, Standard Publishers Distributors, ISBN 9788186308295 (2004)
2. Non-Conventional Energy Sources, B.H.Khan, Tata McGraw Hill (2006) ISBN 07- 060654-4

3. Renewable Energy, Godfrey Boyle, Oxford University Press in association with the Open University, (2004), ISBN 9780199261789
4. Renewable energy: sources for fuels and electricity, Thomas B. Johansson, Laurie Burnham, Island Press, (1993), ISBN 9781559631389
5. Renewable energy: sustainable energy concepts for the future, Roland Wengenmayr, Thomas Bührke, Wiley-VCH, (2008), ISBN 9783527408047
6. Renewable Energy: Sources and Methods, Anne Maczulak, Infobase Publishing, (2009), ISBN 9780816072033

17PH3018 RADIATION TREATMENT AND PLANNING

Credits: 3:0:0

Course Objective:
- To gain knowledge on radiotherapy machines
- To understand the interaction of photon beam on matter
- To learn about various calibration methods

Course Outcome:

Students will be able to
- The students will gain knowledge on radiotherapy machines
- The students will be able to understand the interaction of photon beam on matter
- The students will be enabled to undertake various calibration methods to ensure better quality treatment using machines.
- The students with be able to execute clinical treatment planning
- Various radiation treatment modalities will be learnt by the students.
- Knowledge on electron beam therapy and advanced radiotherapy treatment methods will have been learnt by the students.

Unit I - RADIOTHERAPY MACHINES: X-rays and Gamma rays - Linear accelerator-Components of modern linacs - Injection system - RF power generation system - Accelerating wave guide - Microwave power transmission - Auxiliary system - Electronic beam transport – Linac treatment head - Production of photon and electron beams from linac - Beam collimation - Cobalt-60 versus linac - Radiation therapy simulators.

Unit II - PHYSICAL ASPECTS OF EXTERNAL PHOTON BEAMS: Photon beam sources - Inverse square law - Penetration of photon beams into phantom or patient - Surface dose - Build up - Skin sparing effect - Percentage depth dose - Tissue air ration – Back scattering factor - Tissue phantom ratio - Tissue maximum ratio - Scatter air ratio - Total scatter factor - Isodose distribution in water phantom - Isodose charts and factors effecting – Correction of irregular counters - Missing tissue compensation - Correction of tissue inhomogeneity – Clarkson's method - Dose calculation.

Unit III - CLINICAL TREATMENT PLANNING IN PHOTON BEAMS AND RECENT ADVANCES: Treatment planning - Volume definition - ICRU 50, ICRU 62 concepts – GTV – CTV – ITV – PTV – OAR - Dose specification - Patient data acquisition – Simulation – Conventional simulation - Isodose curves - Wedge filters – Bolus - Compensating filters - Field separation

Unit IV - PHYSICAL ASPECTS OF ELECTRON BEAM THERAPY: Production of electron beams - Interaction of electron with matter - Range concept – Percentage depth dose - Electron energy specification - Scattering power - Rapid dose fall off – Electron shielding - Dose prescription and thumb rule - Field inhomogeneity - Dose build up – Photon contamination - Back scatter – Collimation - Virtual SSD - Oblique incidence.

Unit V - ADVANCED RADIOTHERAPY TREATMENT METHODS: Treatment planning system - Imaging in radiotherapy - Image fusion - CT simulation - Basics of 3-Dimensional conformal therapy - Beams eye view - Digitally reconstructed radiograph - 3-D Conformal Radiotherapy – Plan evaluation methods - Dose volume histograms – Treatment evaluation – Introduction to Intensity Modulated Radiotherapy and Image Guided Radiotherapy - Stereotactic Radiosurgery and Stereotactic Radiotherapy- Tomotherapy - Particle beam therapy.

Reference Books

1. Review of Radiation Oncology Physics - A Hand book for Teachers and Students, EB. Podgorsak, International Atomic Energy Agency, 2005
2. Radiation therapy Physics, WR. Hendee and GS. Ibbott, J. Wiley, 2004

3. The Physics of Radiation Therapy, FM. Khan, Wolters Kluwer, 2003
4. Treatment Planning in Radiation Oncology, FM. Khan and RA. Potish, Williams & Wilkins, 1998
5. Introduction to Radiological Physics and Radiation Dosimetry, FH. Attix, Wiley, 1986

17PH3019 MEDICAL RADIATION DOSIMETRY

Credit 3:0:0

Course Objective:

- To learn the basic concepts of atoms and nucleus
- To understand the different types of radiation emitted from nuclear sources
- To help the students understand the interaction of radiation with matter

Course Outcome:

Students will be able to

- Thorough with the basic concepts of atoms and nucleus
- Understand the different types of radiation emitted from nuclear sources
- Understand the interaction of radiation with matter and apply the same in novel applications for peaceful purposes.
- Learn about various basic units of radiation measurements.
- Have knowledge on radiation detection and measurement.
- Impart the types and applications about dosimetry systems

Unit I - BASIC RADIATION PHYSICS: Atoms and nuclei – Fundamental particles - Atomic andnuclear structure - Mass defect and binding energy – Radiation - Classification of radiation -Electromagnetic spectrum – Radioactivity - Alpha, beta and gamma rays - Methods of decay –Isotopes - Radiation sources.

Unit II - INTERACTION OF RADIATION WITH MATTER: Types of indirectly ionizingradiation - Photon beam attenuation – Types of photon interactions - Types of electroninteractions-Types on neutron interactions - Photo electric effect – Coherent scattering -Compton effect - Pair production - Photo nuclear disintegration - Effect following radiationinteraction.

Unit III - RADIATION QUANTITIES AND UNITS: Radiometric, interaction, protection anddosimetric quantities - Particle and energy fluence - Linear and mass attenuation coefficient -Stopping power – Linear energy transfer – Absorbed dose - Kerma – Exposure – Activity -Equivalent dose - Effective dose - Electronic or charged particle equilibrium – Bragg graycavity theory.

Unit IV - RADIATION DETECTION: Properties of dosimeters - Methods of radiation detection -Ionization chamber dosimetry system - Proportional counters - Geiger Muller counters –Semiconductor detector - Solid and liquid scintillation counters - Film dosimetry –Thermoluminiscent dosimetry - Calorimetry – Chemicaldosimetry

Unit V - CALIBRATION OF PHOTON AND ELECTRON BEAMS: Calibration chain – Ionizationchambers - Electro meter and power supply – Phantoms – Chamber signal corrections forinfluence quantities - Calibration of mega voltage photon beams based and mega voltageelectron beams based on standard national and international protocols.

Reference Books

1. Radiation Detection and Measurement, Glenn F. Knoll, John Wiley & Sons, 2010.
2. Review of Radiation Oncology - A Hand book for Teachers and Students by EB. Podgorsak, International Atomic Energy Agency, 2005
3. Radiation therapy Physics by WR. Hendee and GS. Ibbott, J. Wiley, 2004
4. Physics of Radiation Therapy by FM. Khan, Wolters Kluwer, 2003
5. Treatment Planning in Radiation Oncology by FM. Khan and RA. Potish, Williams & Wilkins, 1998
6. Introduction to Radiological Physics and Radiation Dosimetry by FH. Attix, Wiley, 1986

17PH3020 RESEARCH METHODOLOGY

Credits: 3:0:0

Course Objective

- To gain knowledge on various research tools available for carrying out research
- To identify the information source for literature review and data collection

- To develop understanding the basic framework and skills of research process.

Course Outcome

Students will able to

- Describe the microscopic and spectroscopic methods and various data analysis.
- Give detailed description of mathematical tools to solve various research problems.
- Apply different mathematical concepts in numerical and statistical problem solving skills
- Apply and solve problems with computer programming languages like c and c + +
- Solve quadratic equations and various first principle calculations
- Describe mathematical equations for effective research problem solving and analysis

Unit I - Structural Characterization: Production and properties of X-rays, X-ray analysis: X-ray diffraction; Effect of texture, particle size, micro and macro strain on diffraction lines. Scanning electron microscopy: construction, interaction of electrons with matter, modes of operation, image formation, Atomic probe microscopy and scanning tunneling microscopy: principles and practice

Unit II - Optical characterization: Ultraviolet and visible Spectroscopy:UV visible Spectrophotometers-Measurement of Absorption-Infrared Spectroscopy- Fluorescence and Phosphorescence : Measurement of Fluorescence-Spectrofluorometers – Photoluminiscence: light-matter interaction, instrumentation-Electroluminescence: instrumentation, Applications

Unit III - Statistical Methods: Correlation- comparison of two sets of data- comparison of several sets of data- Chi squared analysis of data- characteristics of probability distribution- some common probability distributions-Measurement of errors and measurement process – sampling and parameter estimation- propagation of errors- curve fitting- group averages – equations involving three constants- principle of least squares- fitting a straight line, parabola and exponentials curve method of moments

Unit IV - Numerical methods\: Solution of differential equations – simple iterative method- Newton Raphson method – Numerical by integration – Simpson rule – Gausian quadrature- solution of simultaneous equation – Gauss Jordon elimination method- Eigenvalue and eigenvectors by matrix diagnolization (Jacobian method)

Unit V - Application of Numerical and statistical methods using C++ Programming Solving quadratic equations –– solution of equation by Newton Raphson method – matrix diagnolization (Jacobian method) – Integration by Simpson's rule –Fitting of a straight line using principle of least square

Reference Books

1. B.K.Sharma,Spectroscopy Goel publishing house,2007
2. Elements of X-ray Diffraction by B.D. Cullity (II edition), Addison-Wesley Publishing Co. Inc., Reading, USA, 1978.
1. Electron Microscopy and Analysis by P.J. Goodhew and F.J. Humphreys, Taylor and Francis, London, 1988
2. Electron Microscopy: Principles And Fundamentals, S. Amelinckx, D. van Dyck, J. van Landuyt and G. van Tendeloo (Editors), VCH, Weinheim, 1997.
3. Atomic Force Microscopy / Scanning Tunneling Microscopy, S.H. Cohen and Marcia L. Lightbody (Editors), Plenum Press, New York, 1994.
4. Computer applications in Physics- Suresh Chandra, Narosa publishing hours (2003)
5. Numerical methods for Mathematics, Science and Engineering – John H. Mathews, Prentice Hall, India (2000)

17PH3021 MATERIAL CHARACTERIZATION

Credits: 3:0:0

Course Objective

- To introduce basic techniques for materials characterization.
- To introduce the working principles and instrumentation of main techniques.
- To understand the analysis of materials using electron microscopy and optical methods

Course Outcome

Students will be able to

- Identify suitable techniques for specific materials characterization.

- Use various instrumentations to scan and test materials for electrical, mechanical and thermal property analysis
- Analyse the structurual and compositional properties of materials using XRD, SEM, XPS, EDAX and AFM
- Apply the microscopic and macroscopic property analysis for various materials
- Analyse the magnetic properties of materials and functions
- Practice the testing of materials for various thermal property analysis.

Unit I - MICROSCOPIC METHODS: Optical Microscopy: Optical Microscopy Techniques – Bright & dark field optical microscopy- phase contrast microscopy- Differential interference contrast microscopy – Fluorescence Microscopy- Scanning probe microscopy (STM, AFM) – Scanning new field optical microscopy – X-Ray Diffraction methods - Rotating crystal- Powder method – Debye- Scherrer camera- Structure factor calculations- EBSD & ED.
Unit II - SPECTROSCOPIC METHODS: Principles and Instrumentation for UV-Vis-IR, FTIR Spectroscopy, Raman Spectroscopy, NMR, XPS, AES and SIMS-proton induced X-Ray Emission spectroscopy (PIME) – Rutherford Back Scattering (RBS) analysis – application.
Unit III - ELECTRON MICROCOPY AND OPTICAL CHARACTERISATION: SEM, EDAX, EPMA, TEM, STEM working principle and Instrumentation- sample preparation- data collection, processing and analysis- Photoluminiscence-light-matter interaction- instrumentation- Electroluminescence-instrumentation- Applications
Unit IV - THERMAL ANALYSIS: Introduction- Thermogravimetric analysis (TDA)- instrumentation- determination of weight loss and decomposition products- differential thermal analysis (DTA) – cooling curves – differential scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements – determination of thermomechanical parameters- Chromatography- Liquid & Gas Chromatography.
Unit V - ELECTRICAL, MECHANICAL & MAGNETIC ANALYSIS: Two probe and four probe methods- van der Pauw method- Hall probe and measurementscattering mechanism- C-V characteristics- Schottky barrier capacitance- impurity concentration- Mechanical and Magnetic Analysis: Vickers Hardness test - Vibrating Sample Magnetometer- Working principle of VSM- Instrumentation.

Reference Books

1. Atomic Force Microscopy/ Scanning Tunneling Microscopy, S.H.Cohen & Marcia L.Lightbody (Editors), plenum press, Newyork, 1994.
2. Principles of Thermal analysis and calorimetry by P.J.Haines (Editor), Royal Society of chemistry (RSC), Cambridge, 2002.
3. B.D.Cullity, “Elements of X,Ray diffraction” (II Edition) Addision Wesley publishing Co., 1978.
4. Lawrence E.Murr, Electron and Ion Microscopy and Microanalysis principles and Applications, Mariel Dekker Inc., Newyork, 1991.
5. B.D.Cullity, “Elements of X-Ray diffraction” (II Edition) Addision Wesley publishing Co., 1978
6. Lawrence E.Murr, Electron and Ion Microscopy and Microanalysis principles and Applications, Mariel Dekker Inc., Newyork, 1991.

17PH3022 CRYSTAL GROWTH TECHNIQUES

Credits 3:0:0

Course Objective
- To study the basic knowledge about the nucleation mechanism involved in crystal growth
- To understand the broad areas of crystal growth methods such as melt, solution, vapour transport.
- To understand some of the advanced crystal growth systems such as CVD and PVD.

Course Outcome:
Students will be able to
- Students can understand the different techniques used for growing crystals
- To review physics and chemistry in the context of materials science & engineering.
- To describe the different types of bonding in solids, and the physical ramifications of these differences.
- To describe and demonstrate diffraction, including interpretation of basic x-ray data.
- To describe introduction to metals, ceramics, polymers and electronic materials in the context of a molecular level understanding of bonding.

- To give an introduction to the relation between processing, structure and physical properties.

Unit I - FUNDAMENTALS OF CRYSTAL GROWTH: Importance of crystal growth – classification of crystal growth methods -Theories of nucleation – Classical theory – Gibbs Thomson equation for vapor solution and melt energy of formation of a nucleus –Adsorption at the growth surface – Nucleation – Homogeneous andHeterogeneous nucleation – Growth surface.

Unit II - GROWTH FROM LOW TEMPERATURE SOLUTIONS: Solution – selection of solvents – solubility and super solubility – Saturation and super saturation – Meir's solubility diagram – Metastable zone width – measurement and its enhancement – Growth by (i) restricted evaporation of solvent, (ii) slow cooling of solution and (iii) temperature gradient methods – Growth in Gel media, Electrocrystallization.

Unit III - GROWTH FROM FLUX AND HYDROTHERMAL GROWTH: Flux Growth – principle – choice of flux – Growth kinetics – phase equilibrium and phase diagram – Growth techniques – solvent evaporation technique – slow cooling technique - transport in a temperature gradient technique – Accelerated crucible rotation technique – Top seeded solution Growth – Hydrothermal Growth.

Unit IV - GROWTH FROM MELT: Basis of melt growth – Heat and transfer – Growth techniques – conservative processes – Bridgman – Stockbarger method – pulling from the melt – Czochralski method (CZ) – cooled seed Kyropoulos method – Non- conservative processes – zone refining – vertical, horizontal floatzone methods –Skull melting Process – Vernueil method – flame fusion, plasma and arc image methods.

Unit V - GROWTH FROM VAPOUR: Basic principle – physical vapour deposition (PVD) – Evaporation and Sublimation processes – sputtering – chemical vapour Deposition (CVD) – Advantages and disadvantages – chemical vapour transport – Fundamentals – Growth by chemical vapour transport (CVT) Reaction.

Reference books

1. Ichiro Sunagawa, Crystal Growth, Morphology and performance, Cambridge University press, (2005).
2. Mullin, J. N, 'Crystallization', Butternmths, London (2004)
3. Hand book of crystal growth, Volume 1, 2 & 3. Edited by D. T. J. Hurle North Holland – London (1993)
4. Brice, J. C. Crystal Growth processes – Halstesd press, John Wiley & sons, (1986)
5. Elwell. D and Scheel. H. J, crystal growth from High Temperature solutions, Academic press, London (1975)

17PH3023 RADIATION PHYSICS

Credits: 3:0:0

Course Objectives:

- To review the basic physics principles of atomic and nuclear physics
- To know about the basic radiation detection mechanisms and various types of detectors.
- To illustrate the importance of counting statistics and other statistical tools in radiation measurements.

Course Outcome:

Students will be able to

- Understand the basic physics principles of atomic and nuclear physics
- Know the basics of radiation physics and interaction of radiation with matter
- The various absorption mechanisms of radiation and particles will be known by the students.
- Know about the basic radiation detection mechanisms and various types of detectors.
- The importance of counting statistics and other statistical tools in radiation measurements will be learnt by the students.
- The peaceful applications of radiation will be understood by the students.

Unit I - REVIEW OF PHYSICAL PRINCIPLES : Mechanics – Units and dimensions – Work and energy – Relativity effects – Electricity – Electrical charge: the statcoulomb – ElectricPotential: the statvolt – Electric Field – Energy Transfer – Elastic and inelastic collision –Electromagnetic waves – Excitation and ionization – Periodic table of the elements – Thewave mechanics atomic model – The nucleus – The neutron and the nuclear force – Isotopes –The atomic mass unit – Binding energy – Nuclear models - Nuclear stability

Unit II - RADIOACTIVITY AND INTERACTION OF RADIATION WITH MATTER:
Radioactivity and decay mechanism – Kinetics of decay – The units of radioactivity – Seriesdecay – Alpha rays – Range-energy relationship – Energy transfer – Beta rays – Range energyrelationship – Mechanism of energy loss –

ionization and excitation – Gamma rays –Exponential absorption – Absorption mechanisms – Pair production – Compton scattering –Photoelectric effects – Neutrons – Production – Classification – Interaction

Unit III - METHODS OF MEASURING RADIATION: Gas filled detectors – Ionization chamber –Proportional counters – Geiger Muller Counter – Scintillation detection systems –Photomultipliers – Scintillators – Semiconductor detectors – Principles of operation –Charged particle detectors – Thermoluminescent detectors – High purity GermaniumDetectors – Track devices – Photographic emulsion – Track etch dosimeters – Spark countersand spark chambers – Miscellaneous detectors

Unit IV - COUNTING STATISTICS AND CALIBRATION OF INSTRUMENTS: Uncertainty inthe measuring process – Various types of distribution - Error Propagation – Accuracy ofcounting measurements – Significance of data from statistical view point - Calibration andstandards – Source calibration – Neutron sources – X-ray machines – Calibration of detection equipment

Unit V - RADIATION IN THE ENVIRONMENT AND THEIR APPLICATIONS : Types ofradiation sources – Natural radiation sources – Artificial sources of radiation – Applications ofradiations – Medical applications – Industrial applications – Radiation in food processingindustry – Agricultural applications – Isotope hydrology – Miscellaneous applications

Reference Books

1. Nicholas Tsoulfanidis, Sheldon Landsberger, Measurement and Detection of Radiation, Third Edition, CRC Press; 2010
2. Radiation Detection and Measurement, Glenn F. Knoll, John Wiley & Sons, 2010,
3. Radiation Physics for Medical Physicists, Ervin B. Podgorsak, Springer, New York (2010)
4. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed, Academic Press, Elsevier (2007)
5. Environmental Radioactivity From Natural, Industrial & Military Sources, MerrilEisenbud and and Thomas F. Gesell, Academic Press, (1997, Fourth Edition)
6. G.G.Eicholz and J.W.Poston, Principles of nuclear radiation detection, ANN Arbor Science, 1985

7PH3024 NANOFLUIDS

Credit: 3:0:0

Course Objective:

- To know the basics of nanofluids
- To understand the basics of conductive and convective heat transfer
- To learn the application of nanofluids

Course Outcome:

Students will be able to

- Understand the fundaments of cooling and thermal support
- Synthesis nanofluids
- Understand the conduction of heat transfer
- Analyses the fundamentals of convective heat transfer
- Know about boiling and various cooling mechanism
- Find the various industrial application of nanofluids

Unit I - INTRODUCTION TO NANOFLUIDS: Fundamentals of Cooling - Fundamentals of Nanofluids – Making Nanofluids – Materials for Nanoparticles and Nanofluids – Methods of Nanoparticle Manufacture – Dispersion – Milestones in Thermal conductivity measurements – Milestones in Convection Heat Transfer – Mechanism and Models for enhanced thermal support: Structure based Mechanism and Models – Dynamics based Mechanism and Models

Unit II - SYNTHESIS OF NANOFLUIDS: Single step method – Two step method – Synthesis of colloidal Gold nanoparticles : Turkevich method – Brust method – Microwave Assisted Synthesis – Sonolysis – Electrochemical Reduction – Thermal Decomposition – Chalcogenides – Solvothermal Synthesis – Magnetic Nanofluids – Inert Gas Condensation

Unit III - CONDUCTION HEAT TRANSFER IN NANOFLUIDS: Conduction Heat Transfer Steady Conduction: Conduction in slab – Hollow cylinder – composite cylinder- Transient conduction: Lumped-parameter method – One Dimension Transient Conduction - Measurement of Thermal Conductivity of Liquids : Guarded Hot

Plate method – Transient Hot wire – Temperature oscillation method (No derivation) – Thermal conductivity of Oxide nanofluids – Hamilton Crosser Theory (Al_2O_3 – Water and Al_2O_3 – Ethylene Glycol)

Unit IV - CONVECTION IN NANO FLUIDS: Fundamentals of Convective Heat Transfer – Newton's law of cooling – equations of fluid flow and heat transfer: Navier-Stokes equations, Reynolds number - Prandtl number - Nusselt number - Natural convection : Grashof number, Rayleigh number – Experimental study of natural convection - Convection in Suspensions and Slurries: Eulerian-Eulerian approach – Eulerian-Lagrangian approach

Unit V - POOL BOILING AND APPLICATION OF NANOFLUIDS: Fundamentals of Boiling : Nukiyama curve - Nucleate boiling –Experimental study of Pool Boiling of Water-Al_2O_3 Nanofluids – Applications of nanofluids: Vechile cooling , Transformer cooling, Biomedical applications

Reference Books

1. Nanofluids: Science and Technology, Sarit K. Das, Stephen U. Choi, Wenhua Yu, T. Pradeep, John wiley sons, 2007
2. Holman J.P., 'Heat Transfer', SI Metric Ed., Mc Graw Hill, ISE, 1972.
3. Heat and Mass Transfer, R.K. Rajput, S. Chand, 2008
4. Heat transfer Principles and applications, Binay K. Dutta, Prentice, Hall of India Pvt. Ltd, New Delhi, 2001.

17PH3025 GENERAL PHYSICS LAB I

Credits: 0:0:2

Course Objective:

- To get practical skill on basic optical experiments.
- To get practical skill on non-ideal elements, such as lasers and optics in experiments..
- To get practical skill on basic sound and ultrasonic experiments.

Course Outcome:

Students will be able to

- Apply knowledge on basic Physics experiments to solve practical problems.
- Apply experimental principles and error calculations to electromagnetism.
- Analyze basic quantities in electromagnetism.
- Present concepts and describe scientific phenomena.
- Design experiments, and analyze and interpret data.
- Get practical skill on analyzing the Magnetic properties of the material

HoD can give any 10 relevant experiments at the beginning of the course in each semester.

17PH3026 GENERAL PHYSICS LAB II

Credits: 0:0:2

Course Objective:

- To get practical skill on digital electronics.
- To get practical skill in studying the characteristics of low power semiconductor devices.
- To get practical skill on analyzing the characteristics of Diode and transistor.

Course Outcome:

Students will be able to

- Understand the practical difficulties in measuring the standard parameters.
- Architecture of microprocessors and methodology of programming
- Design basic electric circuits using software tools.
- Identify, formulate and sole engineering problems with simulation.
- Experience in building and troubleshooting electronic circuits.
- Write simple program using microprocessor for practical applications.

HoD can give any 10 relevant experiments at the beginning of the course in each semester.

17PH3027 ADVANCED PHYSICS LAB I

Credits: 0:0:4

Course Objective:

To learn practical skills on

- Thin film coating devices
- Operation of physical method of thin film preparation
- Synthesis of thin films through chemical route

Course Outcome:

Student will be able to

- Apply the knowledge prepation of thin films
- Demonstrate physical method of thin film preparation
- Demonstrate the chemical method of thin film preparation
- Evaluate the electrical properties of thin films
- Estimate the hall measuremets
- Characterize the optical properties and to find the band gap.

HoD can give any 10 relevant experiments at the beginning of the course in each semester.

17PH3028 ADVANCED PHYSICS LAB II

Credits 0:0:4

Course Objective:

- To get practical skill on various deposition techniques
- to prepare thin films and
- Crystals having nanostructures

Course Outcome:

Student will be able to

- Fabricate novel nano structures
- Fabricate nano thin films
- Fabricate nano devices
- Fabricate electronics devices
- solve the out put properties of the devices
- evaluate the efficiency of the devices

HoD can give any 10 relevant experiments at the beginning of the course in each semester.

17PH3029 MATERIALS CHARACTERIZATION LAB

Credit: 0:0:2

Course Objective:

To train the students to operate

- Spectro photometer
- X-Ray diffractometer
- Scanning electron microscope

Course outcome:

Students will be able to

- Demonstrate optical propertis through Spectrophotometer
- Evaluate the structure through XRD
- Identify the morphology through SEM
- Appraise the surface roughness through AFM
- Calculate the dielectric constant through Impedance analyser
- Plot the IV characteristics through NI work station.

HoD can give any 10 relevant experiments at the beginning of the course in each semester.

17PH3030 COMPUTATIONAL PHYSICS LAB

Credits: 0:0:2

Course Objective:

- To provide students with an opportunity to develop knowledge and understanding of the key principles of computational physics.
- Synchronising computational skills acquired with requirements of theoretical physics courses.
- Developing numerical, computational and logical skills relevant for solution of theoretical and experimental physics problems.

Course Outcome:

Students should be able to:

- Demonstrate knowledge in essential methods and techniques for numerical computation in physics
- Apply the programming skills to solve practical problems.
- Apply numerical and statistical problem solving skills and computer programming skills to solve research problems.
- Use appropriate numerical method to solve the differential equations governing the dynamics of physical systems
- Apply different methods to solve deterministic as well as probabilistic physical problems
- Employ appropriate numerical method to interpolate and extrapolate data collected from physics experiments

HoD can give any 10 relevant experiments at the beginning of the course in each semester.

17PH3031 SIMULATIONS IN STATISTICAL PHYSICS LAB

Credit: 0:0:2

Course Objective:

- To introduce nonlinear statistical modeling methods to the students.
- To understand the molecular simulation for various materials structures
- To give students both theoretical and practical capabilities to design and analyse various structural models

Course Outcome:

- Gain knowledge in simulation software and become expertise in molecular simulations
- Analyze the behavior of the structural models after simulation
- Identify the suitable simulation method for the selected structural model
- Provide statistical information through simulation and thereby aid in solving the practical problem
- To make student understand the advantages and limitations of various simulation
- To make student understand the advantages of methods commonly used in physics and engineering using simulation

HoD can give any 10 relevant experiments at the beginning of the course in each semester.

17PH3032 HEAT AND OPTICS LAB

Credit: 0:0:2

Course Objective:

- To train the students on Optics and Heat experiments to understand the basic concepts.
- To learn about the light and diffraction phenomena using prism experiment
- To study about the Heat experiments to understand the conduction phenomena

Course outcome:

Students will have the ability to

- Demonstrate the practical skills on measurements and instrumentation techniques through physics experiments.
- Describe the concepts and principles of heat through practical experiments

- Analyze different measurements for effective understanding of the methods involved.
- Describe the concepts and principles of light and its phenomena through practical experiments
- Workout calculations, property analysis of heat and optic measurements and to bring results
- Apply the learned concepts for different applications related heat and optics

HoD can give any 10 relevant experiments at the beginning of the course in each semester.

17PH3033 ASTROPHYSICS

Credits: 3:0:0

Course Objective:
- To impart the knowledge about ancient astronomy and solar system models
- To make the students understand about our immediate cosmic surroundings that is our solar system.
- To provide with a fundamental understanding about the stars and their properties

Course outcome:
- The students will have knowledge about ancient astronomy and solar system models
- The students will learn more intricate details about our solar system.
- The life cycle of a star, the birth, the life and a death of a star and different types of stars will be understood by the students.
- The students will have knowledge about various windows to explore the heavens.
- The students will understand cosmology on a larger scale like the evolution of a galaxy and clusters of galaxies.
- Various theorems regarding the formation of the universe till be learnt by the students.

UNIT I - THE SOLAR SYSTEM : Various Solar System Models – The Solar System in Perspective:Planets, Moons, Rings and Debris – Other Constituents of Solar System – Kepler's laws of planetary motion.
Unit II - THE STARS : The Sun – Important Properties of stars – Measuring the distances of a star –The Parallax Method – The Formation of Stars and Planets – Types of Stars – White dwarfs, Neutron Stars and Black Holes – Star Clusters – Supernovae and their types
Unit III - TELESCOPES AND DETECTORS : Optical Telescopes – The Hubble Space Telescope –Detectors and Image Processing: Photography, Phototubes, Charge Couple Devices, Signal toNoise – The New Generation of Optical Telescopes. – Other Windows to Heaven
Unit IV - THE MILKY WAY GALAXY : Interstellar Matter - The Shape and Size of the Galaxy –The Rotation and Spiral Structure of Galaxy – The Center of Galaxy – Stellar Populations –Different types of Galaxies – The Cosmological Distance Scale – The Local Group
Unit V - THE UNIVERSE: Clusters of Galaxies – Super Clusters of Galaxies - Hubble's Law –Cosmological Models – The Standard Big Bang Model – The Big Bounce Theory – The Fateof the Universe – The Big Crunch Theory – The Big Rip Theory – Life in the Universe

Reference Books

1. Michael Zeilik, Stephen .A.Gregory, Introductory Astronomy and Astrophysics, Fourth Edition, Saunders College Pub., Michigan, U.S.A, 1998 ISBN 9780030062285
2. A. B. Bhattacharya, S. Joardar, R. Bhattacharya, Astronomy and Astrophysics, Jones and Barlett Publishers, U.S.A., (2010) ISBN 978-1-934015-05-6
3. Martin V. Zombeck, Book of astronomy and Astrophysics, Cambridge University Press, U.K. (2007) ISBN 978-0-521-78242-5
4. ThanuPadmanabhan, Theoretical Astrophysics (Vol. I, II, II): Cambridge University Press, U.S.A., (2002) ISBN 0 521 56242 2
5. Wolfgang Kundt, Astrophysics: A new approach, Second edition, Springer, 2006
6. Introduction to AstroPhysics The Stars, Jean Dufay, Dover publications,2012
   AstroPhysics for Physicists, Chaudhuri, University Press,2010.

LIST OF COURSES

S.No.	Course Code	Name of the Course	Credits
1	16PH1001	Applied Physics for Engineers	3:0:1
2	16PH2001	Semiconductor Physics I	3:0:0
3	16PH2002	Properties of Matter Lab	0:0:2
4	16PH2003	Semiconductor Physics II	3:0:0
5	16PH2004	Semiconductor Logic Devices	3:0:0
6	16PH2005	Semiconductor Physics Lab-I	0:0:2
7	16PH2006	Semiconductor Physics Lab-II	0:0:2
8	16PH2007	Physics of Semiconductor Memories & Microprocessors	3:0:0
9	16PH2008	Physics of Linear Integrated Circuits & VLSI Design	3:0:0
10	16PH2009	Photonics	3:0:0

16PH1001 APPLIED PHYSICS FOR ENGINEERS

Credits: 3:0:1

Course objective

- To impart knowledge on aspects of applied physics in the areas of light, sound, electron wave, magnetism, superconductors and nuclear physics through experiments and hands on project.

Course outcome

Ability to

- Understand the uses of lasers
- Appreciate the acoustic and its use in buildings and medical field.
- To demonstrate the quantum mechanics in the applications of electron devices like LED's and in scanning electron microscopes.
- Appreciate the magnetic levitation and the applications of smart materials.
- Appreciate the applications of nuclear physics in power plants and radiation therapy.

Course Description

Light amplification in laser pointers, lasik surgery, Laser writing in compact disc. Propagation of light in optical fiber. fiber endoscope and optical fiber communication. Sound waves and musical instruments. acoustics of buildings, uses of ultrasound in medical scanning. Applications of quantum principles in light emitting diodes and display devices. Matter waves and its application in scanning electron microscope, magnetic properties of materials and storage devices, superconducting phenomena and magnetic levitation, shape memory alloys in arteries stent. Nuclear power plants based on nuclear fission, applications of nuclear concepts in radiation therapy and isotope dating.

References:

1. Jewet/Serway, Physics for Scientists and Engineers, 7th Edition, 2012.
2. Arthur Beiser, Shobhit Mahajan, Rai Choudry, Concepts of Modern Physics, 7th Edition, 2015.
3. Ashcroft, Mermin, Solid State Physics, 14th Edition, 2014.
4. W. Thomas Griffith, Juliet W.Brosing, The Physics of Every Day Phenamena, 8th Edition, 2014.
5. Rajendran, Engineering Physics, Tata McGraw Hill, 2014.

16PH2001 SEMICONDUCTOR PHYSICS I

Credits: 3:0:0

Course Objective:

To impart knowledge on

- Fundamental concepts in electronics and some electronic devices.
- Various analog communication techniques.

Course Outcome:

Ability to

- Understand about working mechanism of electronic devices.
- Gain knowledge about the semiconductor, integrated circuits
- Compare the various communication and its applications.

Course Description:

Basics of electronics - semiconductor devices, basic op-amp - transistor as an amplifier and a switch – oscillator principles - Digital System – Semiconductor memory – Integrated circuits -Microprocessor - transducers – signal conditioning unit – telemetry circuits – virtual instrumentation– Measuring instruments – communication system - Introduction to Noise – modulation & demodulation techniques – antenna principle –receiver & transmitter (audio/video) - Satellite communication – Fiber optics communication – Micro and Nano electronics.

Reference Books:

1. Albert Paul Malvino, " Electronic Principles", Tata McGraw Hill, 8th Edition, 2015.
2. Robert Boylestad and Louis Nashelsky,, "Electronic Devices & Circuit Theory", Ninth Edition, PHI, 2013
3. Albert Paul Malvino, Donald P Leach, "Digital Principles and Applications", Tata McGraw Hill, VII Edition, 2010.
4. Roody & Coolen, "Electronic Communication", PHI, 1995
5. W.D. Cooper, A.D. Helfrick, "Modern Instrumentation and Measurement Techniques", 5th Edition, 2002.
6. V.K.Metha."Principles of Electronics",Chand Publications,2008.
7. Anokh Singh, "Principles of Communication Engineering" S.Chand Co., 2001
8. Muthusubramanian R, Salivahanan S, Muraleedharan , "Basic Electrical Electronics & Computer Engineering "Tata Mc.Graw Hill, 2005.
9. Nanoelectronics and Nanosystems: From transistors to Molecular and Quantum Devices by K. Goser (Edition, 2004), Springer. London.

16PH2002 PROPERTIES OF MATTER LAB

Credits 0:0:2

Course Objective:

To impart practical knowledge on

- Basic measurements
- Interpreting physics principles

Course Outcome:

Ability to

- Demonstrate measurements for various materials

- Apply the knowledge in measuring different properties of materials

The faculty conducting the Laboratory will prepare a list of 10 experiments and get the approval of HoD and notify it at the beginning of each semester

16PH2003 SEMICONDUCTOR PHYSICS II

Credits: 3:0:0

Course Objective:
To impart knowledge on
- Mechanisms of current flow in semi-conductors.
- Diode operation and switching characteristics
- Various instrumental Measurements

Course Outcome:
Ability to
- Analyze the principle of operation, capabilities and limitation of various electronic devices.
- Design circuits and analyze various components with the instruments.
- Apply the electronics circuits to design their electronics projects for general applications

Course Description:
Theory of PN Diodes - Open circuit junction – Forward and Reverse Characteristics - Diode Equation-Applications: Half wave rectifier, full wave rectifier, Bridge rectifier - Hall Effect - Theory of BJT, FET, UJT and Thyristor - Special Semiconductor Devices – LED, OLED, crystalline solar cells – LCD – optocouplers – Gunn diodes - Varactor diode – Transducers - Digital Instruments - Digital Voltmeters and Multimeters, - Data Display and Recording System - Computer Controlled Test System - Microprocessor based measurements.

Reference Books:

1. Millman & Halkias, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2007.
2. Albert Paul Malvino, " Electronic Principles", Tata McGraw Hill, 8th Edition, 2015.
3. Rangan C.S., "Instrumentation Devices and Systems", Tata McGraw Hill, Second Edition, 1998.
4. W.D. Cooper, A.D. Helfrick, "Modern Instrumentation and Measurement Techniques", 5th Edition, 2002.
5. Robert Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 9th Pearson Education Edition, 2009
6. Muthusubramanian R, Salivahanan S, Muraleedharan K, "Basic Electrical Electronics & Computer Engineering", Tata Mc.Graw Hill, 2005

16PH2004 SEMICONDUCTOR LOGIC DEVICES

Credits 3:0:0

Course objective:
To impart knowledge on
- Number systems, binary codes and the basic postulates of Boolean algebra.
- Procedures for the analysis and design of combinational and sequential circuits
- Implementation of digital circuits in programmable logic devices and about different logic families.

Course Outcome:
Ability to

- Understands number systems, binary codes and the basic postulates of Boolean algebra.
- Acquire knowledge to design various combinational and sequential circuits.
- Implement digital circuits in programmable logic devices and different logic families

Course Description:
Number Systems & Boolean Algebra - Karnaugh map - Quine Mcclusky method- Combinational Logic Design : Logic gates – Combinational Logic Functions – Encoders & Decoders – Multiplexers & Demultiplexers –Code Converters – Comparator - Half Adder and Full Adder –
Parallel Adder/Binary Adder – Parity Generator/Checker – Implementation of Logical Functions using Multiplexers, Flip flops: RS, JK, D&T flip flops - Counters &Registers: Asynchronous Counters - Synchronous Counters.

Reference Books

1. MorrisMano,"Digital logic and computer Design", 3rd edition Prentice Hall of India,2002.
2. A. Anand Kumar, "Fundamental of Digital Circuits", PHI, 2nd Edition 2009.
3. Jain R.P, "Modern Digital Electronics", Third edition, Tata Mcgraw Hill,2003
4. Floyd T.L., "Digital Fundamentals ", Prentice Hall, 9th edition, 2006.
5. V.K. Puri, "Digital Electronics: Circuits and Systems", Tata McGraw Hill, First Edition, 2006.

16PH2005 SEMICONDUCTOR PHYSICS LAB-I

Credit: 0:0:2

Course Objective:
To impart practical knowledge on
- The Characteristics of diodes, BJT, FET and some special purpose devices.
- Rectifiers, amplifiers, oscillators and regulators.
- Basic Network theorems.

Course Outcome:
Ability to
- Understand the characteristics of diodes, BJT, FET and special purpose devices
- Design circuits for rectifiers, amplifiers and regulators.
- Analyze different Network theorems.

The faculty conducting the Laboratory will prepare a list of 10 experiments and get the approval of HoD and notify it at the beginning of each semester

16PH2006 SEMICONDUCTOR PHYSICS LAB-II

Credit: 0:0:2

Course Objective:
To impart practical knowledge on
- Various Electron Devices and its operation
- Digital circuits design and programming of microprocessors.

Course Outcome:
Ability to
- Evaluate different electronic device characteristics
- Construct circuits using logic gates
- Apply programming for various microprocessors' applications.

The faculty conducting the Laboratory will prepare a list of 10 experiments and get the approval of HoD and notify it at the beginning of each semester

16PH2007 PHYSICS OF SEMICONDUCTOR MEMORIES & MICROPROCESSORS
Credits 3:0:0

Course Objective
To impart knowledge on

- Various semiconductor devices, transducers and measuring Instruments
- Microprocessor architecture and its functionalities
- Microprocessor programming for different applications

Course Outcome
Ability to

- Design and Analyze different electronic circuits
- Write simple microprocessor based programs.
- Apply microprocessor program for a simple applications

Course Description:
Electronic Circuits – zener regulator-I.C – Transistor Amplifier – CB, CE, CC – Power Amplifiers – Oscillators – Barkihausen Criterion - Colpits-Wien bridge and phase shift oscillators-OP-amp comparators – Block diagram of Microcomputer - Architecture of Intel 8085 - Instruction formats, Addressing methods- types of Instruction - Intel 8085 - Instruction set - Development of simple assembly language programs and examples - Memory and I/O devices and interfacing RAM, ROM, EPROM –CRT terminals- Printers-I/O ports-Key boards-ADC/DACs-memory interfacing-Asynchronous and synchronous data transfer schemes-interrupt driven data transfer- DMA data transfer- Simple applications of Microprocessors.

Reference Books

1. Albert Paul Malvino, “ Electronic Principles”, Tata McGraw Hill, 8th Edition, 2015.
2. Adithya P. Mathur, “ Introduction to Microprocessor”, Tata McGraw Hill, 3rd Edition, 2002.
3. Gaonkar R. S. , “ Digital computer electronics”, Willey Eastern,1991
4. Malvin Brown, Digital Computer Electronics (English) 3rd Edition, 2002.

16PH2008 PHYSICS OF LINEAR INTEGRATED CIRCUITS & VLSI DESIGN
Credits 3:0:0

Course objective:
To impart knowledge on

- Operational amplifier and its applications.
- Timer IC and its applications.
- Basics of VLSI Design.

Course outcome
Ability to

- Analyze Operational Amplifiers for arithmetic operations.
- Analyze timer IC for various application
- Utilize knowledge on IC fabrication.

Course Description:

OP-AMP Characteristics and Applications: Characteristics of ideal op-amp. Pin configuration of 741 op-amp – Applications: inverting and non-inverting amplifiers - inverting and non-inverting summers- VLSI Design Process- Layout Styles – Full Custom Design-Semi Custom Approach – NMOS, PMOS Inverter, CMOS Inverter - MOS & CMOS Layers – stick diagram – design rules & layout - Finite state machine – Hardware description Language - FPGA.

Reference Books

1. Roy Choudhury.D., Shail Jain, "Linear Integrated Circuits", New Age International Publications, 3rd Edition,2007.
2. Gayakwad.A.R., "Op-Amps & Linear IC's", PHI, 4th Edition,2004
3. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers & LinearIntegrated Circuits", PHI 6th Edition, 2001.
4. Sergio Franco, "Design with Operational Amplifier and Analog Integrated Circuits",TMH, 3rd Edition, 2002.
5. Millman & Halkias," Integrated Electronics", Mac Graw Hill, 1991.

16PH2009 PHOTONICS

Credits: 3:0:0

Course Objective:

To impart knowledge on

- Basic principles of lasers and various types of lasers
- Basics of propagation of light in fibre optics.
- Photonics and its applications

Course Outcome:

Ability to

- Comprehend the laser principle and its applications.
- Demonstrate the photonics concepts in fiber optics and laser developments.

Course Description:

Characteristics of Lasers, Einstein's coefficients and their relations, Lasing action, Working principle and components of CO_2 Laser, Nd-YAG Laser, Semiconductor diode Laser, Excimer Laser and Free electron Laser, Applications in Remote sensing, holography and optical switching, Mechanism of Laser cooling and trapping, optical fibers, Basic structure and optical path of an optical fiber, Acceptance angle and acceptance cone, Numerical aperture(NA) (General), Modes of propagation, Number of modes and cut-off parameters of fibers, Attenuation in optic fibers, classification of optical fibers, Fiber optic communication , Fiber optic sensors, Important features of photonic crystals , Dielectric mirrors and interference filters, photonic crystal laser, Photonic crystal fibers (PCFs) - Photonic crystal sensing.

References:

1. Ghatak and Tyagrajan, Introduction to Fiber Optics, Cambridge University Press. 2009
2. V. Rajendran, Engineering Physics, McGraw Hill Publishing company Ltd, 2014.
3. E. A. Saleh, A. C. Teich, Fundamentals of Photonics, John Wiley and Sons, 193
4. M. K. Ohtsu, Kobayashi, T. Kawazoe, T. Yatsui, Principles of Nanophotonics, Optics and Optoelectronics, CRC press, 2003.
5. Alberto Sona, Lasers and their Applications, Gordon and Breach Science Publishers Ltd., 1976.

LIST OF SUBJECTS

Sub. Code	Subject name	Credits
15PH3001	Advanced Mechanics of Solids	3:0:0
15PH3002	Classical Mechanics	3:0:0
15PH3003	Statistical Mechanics and Thermodynamics	3:0:0
15PH3004	Mathematical Physics I	3:1:0
15PH3005	Semiconductor Physics	3:0:0
15PH3006	Quantum Mechanics I	3:0:0
15PH3007	Physical Optics	3:0:0
15PH3008	Mathematical Physics II	3:1:0
15PH3009	Atomic and Molecular Spectroscopy	3:0:0
15PH3010	Electromagnetic Theory	3:0:0
15PH3011	Quantum Mechanics II	3:0:0
15PH3012	Nuclear and Particle Physics	3:0:0
15PH3013	Spectroscopy	3:0:0
15PH3014	Solid State Physics	3:0:0
15PH3015	Physics of Nanomaterials	3:0:0
15PH3016	Advanced Statistical Mechanics	3:0:0
15PH3017	Photonics	3:0:0
15PH3018	Thin Film Technology	3:0:0
15PH3019	Principles of Renewable Energy	3:0:0
15PH3020	Physics of Nanoscale Systems	3:0:0
15PH3021	Radiation Treatment and Planning	3:0:0
15PH3022	Medical Radiation Dosimetry	3:0:0
15PH3023	Research Methodology	3:0:0
15PH3024	Material Characterization	3:0:0
15PH3025	Crystal Growth Techniques	3:0:0
15PH3026	Radiation Physics	3:0:0
15PH3027	Nanofluids	3:0:0
15PH3028	Physics of Advanced Materials	3:0:0
15PH3029	Solitons in Optical Fibers	3:0:0
15PH3030	General Physics Lab I	0:0:2
15PH3031	General Physics Lab II	0:0:2
15PH3032	Advanced Physics Lab I	0:0:2
15PH3033	Advanced Physics Lab II	0:0:2
15PH3034	Materials Characterization Lab	0:0:2
15PH3035	Computational Physics Lab	0:0:2
15PH3036	Simulations in Statistical Physics Lab	0:0:2
15PH3037	Heat and Optics Lab	0:0:2
15PH3038	Properties of Matter Lab	0:0:2
15PH3039	Simulations of Nanoscale Systems	3:0:0
15PH3040	Astrophysics	3:0:0

15PH3001 ADVANCED MECHANICS OF SOLIDS

Credit: 3:0:0

Course Objective:

- To understand the kinematics of rigid bodies regarding force, energy, Impulse and momentum
- To learn about the translational and rotational motion of rigid bodies
- To learn about mechanical vibration

Course Outcome:

- Ability to relate the knowledge on mechanics to real bodies in motion
- Ability to understand and predict the motion of rigid bodies in space
- Ability to relate mechanical vibration of dynamic systems

Course Description:

Reduction of a System of Forces to One Force and One Couple,, Equivalent Systems of Forces, Systems of Vectors, Equilibrium of a Rigid Body in Two and three Dimensions,. Partial Constraints, Center of Gravity of two and three Dimensional Body, Centroid of a Volume, Composite Bodies, Moments of Inertia of Areas, Mass Products of Inertia, Ellipsoid of Inertia, Translational motion, Rotational motion about a Fixed Axis, General Plane Motion, Three-Dimensional Motion of a Particle. Coriolis Acceleration, Frame of Reference, Angular Momentum in Plane Motion, D'Alembert's Principle, Principle of Work and Energy, Principle of Impulse and Momentum for the Plane Motion, Conservation of Angular Momentum, Impulsive Motion, Eccentric Impact, Motion of an Asymmetrical Body, Mechanical vibration

Reference Books

1. Ferdinand P.Beer, E.Russell Johnston Jr. Phillip J. Cornwell, Vector Mechanics for Engineers :Statics and Dynamics, Ninth edition, McGraw-Hill, Higher education, 2010.
2. C. Goyal and G.S. Raghuvanshi, Engineering Mechanics, Second Edition, PH1 Learning, 2011.
3. J. L. Meriam, L. G. Kraige, Engineering Mechanics: Dynamics, John Wiley, 2012.
4. R. C. Hibbeler, Ashok Gupta Engineering Mechanics - Statics and Dynamics, Eleventh Edition**,** Pearson India, 2009.
5. R. S. Khurmi**,** A Textbook of Engineering Mechanics, S. Chand Publication, 2012

15PH3002 CLASSICAL MECHANICS

Credits: 3:0:0

Course Objective:

- To increase in the conceptual understanding of classical mechanics and develop problem solving skills
- To gain more experience and increased ability with the mathematics associated with Classical Mechanics

Course Outcome:

- To apply the techniques and results of classical mechanics to real world problems
- Effectively communicate problems and their solutions relevant to classical mechanics
- To apply physics principles to novel situations

Course Description

Constraints, Generalized coordinates, D'Alembert's principle and Lagrange's equations, Hamilton's Principle, Calculus of variation, Deduction of Lagrange's equations from Hamilton's Principle, applications, Reduction to the equivalent one body problem, differential equations of orbit, integrable power-law potentials, Kepler's problem: motion under inverse square fore, Scattering in a central force field, The independent coordinates of a rigid body, orthogonal transformations, The Euler Angles, angular velocity vector in terms of the Euler angles, Small oscillation, Eigenvalue equation and the principal axis transformation, frequencies of free vibration, Triatomic molecule, Canonical transformations and the Hamilton equation of motion, Cyclic coordinates, Routh's procedure, Derivation of Hamilton's equations from variational principle, The equations of canonical transformation, Examples of canonical transformation, Hamilton-Jacobi equations for principle function, Harmonic Oscillator problem, Action angle variable.

Reference Books

1. Classical Mechanics, H. Goldstein, Narosa publishing house, Second Edition 2001
2. Classical Mechanics, S.L.Gupta, V. Kumar & H.V.Sharma,Pragati Prakashan, Meerut., 2003
3. Classical Mechanics, T. W. B. Kibble, Frank H. Berkshire, Imperial College Press, 2004
4. Classical Mechanics, J C Upadhyaya, Himalaya Publishing House, 2012
5. Introduction to Classical Mechanics, R. G. Takwale, P. S. Puranik, Tata McGraw-Hill, 2006
6. Classical Mechanics, John Robert Taylor, University Science Books, 2005
7. Classical Mechanics, Tai L.Chow, Taylor and Francis group, 2013

15PH3003 STATISTICAL MECHANICS AND THERMODYNAMICS

Credits 3:0:0

Course Objective:

- To explain the origin of the laws of thermodynamics from the fundamental principles of equilibrium statistical mechanics.
- To learn the basic principles of thermodynamics and statistical mechanics and apply them to describe equilibrium thermal properties of bulk matter.

Course Outcome:

- Students will understand the laws of thermodynamics and their consequences.
- Students will know about the applications of Statistical mechanics in thermodynamics

Course Description:

Laws of thermodynamics and their consequences, thermodynamic potentials, Maxwell Relations, Chemical potential, phase equilibria, Gibb's – Helmholtz relation, Nernst's, Gibb's phase rule, Phase space, micro and macrostates, Microcanonical, canonical, and Grand,canonical ensembles, Liouville theorem, Equal A priori Probability, partition Functions, properties, Ideal mono atomic gas, calculation of thermodynamic quantities, Gibbs paradox, Equipartition thoerem,proof, Thermal characteristics of crystalline solids, Einstein and Debye model, Classical and Quantum statistics: Maxwell,Boltzmann statistics, Bose,Einstein statistics, Fermi,Dirac statistics, Black body radiation and Planck's distribution law, Bose,Einstein condensation, Ideal Fermi gas, degenerate electron gas, First order and second order phase transitions;

Reference Books

1. Fundamentals of Statistical and Thermal Physics, Federick Reif, McGraw,Hill, 1985.
2. Statistical Mechanics – B. K. Agarwal and M. Einsner, John Wiley & Sons,1988
3. Statistical Thermodynamics – M.C. Gupta, Wiley Eastern Ltd, 1990
4. Thermodynamics and statistical mechanics, By John M. Seddon, Julian D. Gale Royal Society of Chemistry, 2001
5. Introduction to statistical mechanics – S.K.Sinha, Alpha Science International, 2005
6. Elements of Statistical Mechanics,Kamal Singh & S.P. Singh, S. Chand & Company, New, 1999
7. An Introduction to Statistical Thermodynamics By Terrell L. Hill, 2007

15PH3004 MATHEMATICAL PHYSICS I

Credits 3:1:0

Course Objective:

- To review the basics of vector analysis and move on to the advanced level treatment of Vectors
- To give the students enough problems in matrices so as to prepare them for competitive exams
- To impart on the students the elementary knowledge about Tensors
- To enable the students to solve the first and second order differential equations and have a sound knowledge about special functions
- To give a basic understanding about the theory of probability and theory of errors.

Course Outcome:

- The students can understand apply the mathematical concepts to solve the problems in physics.

Course Description

Vector analysis, Applications of vectors to Mechanics, Gauss's Divergence theorem, Green's theorem, Stoke's theorem, Matrices, Solutions of linear equations, Eigenvalues and Eigenvectors of matrices and their properties, Tensors, The summation convention and Kronecker Delta symbol, Covariant Tensors, Contra variant tensors, Mixed Tensors, Rank of a tensor, The Fourier Transforms, Applications to boundary value problems, Solutions of one dimensional wave equation, Green's Function, Solutions of Inhomogeneous differential equation, Green's functions for simple second order differential operators. Analytic functions, Cauchy – Riemann conditions and equation, Complex Integration, Cauchy's integral theorem, integral formula, Taylor's series and Laurent Series, Poles, Residues and contour integration, Cauchy's residue theorem, Special functions,Greens functions, Laplace transforms.

Reference Books

1. Mathematical Physics – B.D.Gupta – Vikas Publishing House, 3rd edition, 2006
2. Mathematical Physics – B.S.Rajput – PragatiPrakashan – Meerut, 17th edition, 2004
3. Mathematical Methods for Engineers and Scientists – K.T.Tang – Springer Berlin Heidelberg New York ISBN,10 3,540,30273,5 (2007)
4. Mathematical Methods for Physics and Engineering – K.F.Riley, M.P.Hobson and S.J.Bence, Cambridge University Press – ISBN 0 521 81372 7 (2004)
5. Essential Mathematical Methods for Physicists – Hans J.Weber and George B.Arfken – Academic Press, U.S.A. – ISBN 0,12,059877,9 (2003)
6. Mathematical Physics Including Classical Mechanics, SatyaPrakash, Sultan Chand & Sons, New Delhi, ISBN,13: 9788180544668 (2007)

15PH3005 SEMICONDUCTOR PHYSICS

Credits: 3:0:0

Course Objective:

- To learn about the different semiconductor devices
- To understand the concept of manufacturing of resistors, diodes, capacitors and inductors in a chip for various applications
- To get a knowledge about the operational amplifiers and to know the architecture and functioning of 8085 microprocessor
- To acquire the knowledge about the Boolean algebra and different memories

Course Outcome:

- Students gain knowledge about the semiconductor devices, IC manufacturing, different types of operational amplifiers, microprocessors and Boolean theorems.

Course Description

Fermi-level energy band diagrams, Uni-Junction Transistor, Relaxation Oscillator, FET, MOSFET, Common source amplifier, SCR, TRIAC, DIAC, Tunnel Diode, Integrated circuit technology, Basic monolithic integrated circuits, Monolithic diodes, integrated resistors, integrated capacitors and inductors large scale integration (LSI), medium scale integration (MSI) and small scale integration (SSI), Op. Amp characteristics, summing, integrating, Differentiating, Logarithmic, Antilogarithmic amplifier, wave generation, Multivibrators, Schmit trigger, Solution of differential equation, Analog computation, Microprocessor (μP) 8085 Architecture, Assembly language programming, Instruction classification, addressing modes, op code and operand, fetch and execute cycle, timing diagram, machine cycle, instruction cycle and T states, Boolean Algebra, Karnaugh map simplifications, counters, registers, Multiplexers, Demultiplexers.

Reference Books

1. Millman's Electronics Devices & Circuits by Jacob Millman, Christos C Halkias, Satyabrata, Tata McGraw-HillPublishing Company Pvt. Ltd. 2008
2. Integrated Electronics – Millmaan. J. and Halkias C.C, McGraw Hill, 2004
3. Electronic Devices and Circuits – Allen Mottershead, Prentice Hall of India, 2009
4. Digital Principles and Applications – Malvino and Leach, Tata McGraw Hill,Co. 2008.
5. Principles of Electronics by V.K.Metha, Rohit Metha. 2006

15PH3006 QUANTUM MECHANICS I

Credits 3:0:0

Course Objective:

- To understand the general formulation of quantum mechanics
- To solve eigenvalue equations for specific physical problems
- To understand the operator concept of angular momentum, ladder operators and applications
- To get knowledge on the theoretical aspects of perturbation of atoms due to electric and magnetic fields
- Understand the theory of many electron systems

Course Outcome:

- Improved mathematical skills necessary to solve differential equations and eigenvalue problems using the operator formalism
- Quantum mechanical solution of simple systems such as the harmonic oscillator and a particle in a potential well.
- Solutions to perturbation problems and many electron systems

Course Description

Linear vector space, Linear operator, Normalisation of wavefunction, Probability current density, Hermitian operator, Postulates of quantum mechanics, General uncertainty relation, Dirac's notation, Expectation values, Equations of motion: Schrodinger, Heisenberg and Dirac representation, Momentum representation, Particle in a box, Linear Harmonic oscillator, Tunneling through a barrier, particle moving in a spherically symmetric potential, System of two interacting particles, Rigid rotator, Hydrogen atom, Orbital, Spin and Total angular momentum operators, Commutation relations of total angular momentum with components, Ladder operators, Commutation relation of J_z with J_+ and J_-, Eigenvalues of J^2, J_z, Matrix representation of J^2, J_z, J_+ and J_-,Time independent perturbation theory in nondegenerate case, Ground state of helium atom, Degenerate case, Stark effect in hydrogen atom, Spin-orbit interaction, Variation method & its application to hydrogen molecule, WKB approximation, Indistinguishable particles, Pauli principle, Inclusion of spin, spin functions for two electrons, Central Field Approximation, Thomas Fermi model of the Atom, Hartree Equation, Hartree Fock equation.

Reference Books

1. G. Aruldhas, Quantum Mechanics, Prentice Hall of India, 2006
2. A Text Book of Quantum Mechanics,P.M. Mathews & K. Venkatesan – Tata McGraw Hill 2007
3. Quantum mechanics, Satya Prakah & Swati Saluja, Kedar Nath Ram Nath & Co,Meerut, 2007
4. Introduction to Quantum Mechanics – David J.Griffiths Pearson Prentice Hall 2005
5. Principles of Quantum Mechanics, R.Shankar, Springer 2005
6. Quantum mechanics, K.T. Hecht, Springer, 2000
7. Quantum mechanics theory and applications, Ajoy Ghatak and Lokanathan . S, Macmillan, 2004.

15PH3007 PHYSICAL OPTICS

Credits: 3:0:0

Course Objective

- To learn the working of various optical elements like lenses and mirrors.
- To understand the properties of light as a wave

Course Outcome

- Students demonstrate the usage of various optical elements like lenses and mirrors.
- Students apply the properties of light on research oriented problems.

Course Description

Analytical Ray Tracing, Matrix Methods for Lenses and Mirrors, Optical Cavity**,** Group Velocity, Anharmonic Periodic Waves, Linear Polarization, Circular and Elliptical Polarization, Polarizers, Birefringence, Polarization by Scattering and Reflection, Wave plates, Optical Activity, Interference, Conditions for Interference, Temporal and Spatial Coherence, Amplitude, Splitting Interferometers, Michelson and Mach Zehnder Interferometer, Multiple Beam Interference, Fabri-Perot Interferometer, Holography. Fraunhofer and Fresnel Diffraction, Single, Double and Many Slits, Diffraction Grating, Kirchhoff's Scalar Diffraction Theory. Fourier Transforms, One and Two, Dimensional Transforms, Optical Applications, Spectra and Correlation

Reference Books

1. Charles A. Bennett, Principles of Physical Optics, Wiley, (2008)
2. Eugene Hecht and A. R. Ganesan, Optics, Dorling Kindersely (India) (2008)
3. A. K. Ghatak, Optics, Tata McGraw Hill, (2008).
4. A.Lipson, S.G.Lipson and H.Lipson, Optical Physics, FRS, Cambridge University Press, 2011

15PH3008 MATHEMATICAL PHYSICS II

Credits: 3:1:0

Course Objective:

- To impart a thorough knowledge about elements of complex analysis
- To train the students in Fourier, series and Transforms and enable them to solve physics problems
- To give an understanding about integral Transforms and to understand Green's function and its applications to physics problems.
- To grasp the idea of group theory and its implications.
- To have a thorough knowledge about numerical methods

Course Outcome:

- The students can understand apply the mathematical concepts to solve the problems in physics.

Course Description

Analytic functions, Cauchy – Riemann conditions and equation, Complex Integration, Cauchy's integral theorem, integral formula, Taylor's series and Laurent Series, Poles, Residues and contour integration, Cauchy's residue theorem, Fourier series, The Fourier Transforms, Applications to boundary value problems, Solutions of one dimensional wave equation, Green's Function, Solutions of Inhomogeneous differential equation, Green's functions for simple second order differential operators. Subgroups, Isomorphism Homomorphism, Cayley's theorem, Orthogonality Theorem, Direct product group, Finite Differences, Numerical Interpolations – Newton's forward and backward formula, Central Difference interpolation, Lagrange's Interpolation, Numerical Differentiation, Newton's and Stirling's Formula, Numerical Integration, Trapezoidal Rule, Simpson's 1/3 and 3/8 rule, Runge-Kutta methods, Piccard's Methods

Reference Books

1. B.D.Gupta – Mathematical Physics –Vikas Publishing House, 3rd edition, 2006
2. B.S.Rajput – Mathematical Physics –Pragati Prakashan – Meerut, 17th edition, 2004
3. K.T.Tang – Mathematical Methods for Engineers and Scientists –Springer Berlin Heidelberg New York ISBN,10 3,540,30273,5 (2007)
4. K.F.Riley, M.P.Hobson and S.J.Bence, Mathematical Methods for Physics and Engineering – Cambridge University Press – ISBN 0 521 81372 7 (2004)
5. Hans J.Weber and George B.Arfken – Essential Mathematical Methods for Physicists – Academic Press, U.S.A. – ISBN 0,12,059877,9 (2003)
6. Satya Prakash, Mathematical Physics Including Classical Mechanics, Sultan Chand & Sons, New Delhi, ISBN,13: 9788180544668 (2007)

15PH3009 ATOMIC AND MOLECULAR SPECTROSCOPY

Credits 3:0:0

Course Objective:

- To learn how these spectroscopic techniques are used in atomic and molecular structure determination
- To understand the principles and the theoretical framework of different Spectroscopic techniques
- To know the instrumental methods of different spectroscopic techniques

Course Outcome:

- Students can understand how spectroscopic studies in different regions of the E.M spectrum probe different types of molecular transitions

Course Description:

Electronic angular momentum, Spectrum of Hydrogen, Helium and Alkaline atoms, LS & JJ coupling, Zeeman, Paschen Bach and Stark effect, Hyperfine structure, Photoelectron spectroscopy, Characteristic of X-ray spectra and Moseley's law. Line broadening mechanisms, Fourier transform spectroscopy, Rotation of molecules, Diatomic and polyatomic molecules, Intensities of spectral Lines, Effect of Isotopic substitution, Non-rigid rotator, Simple Harmonic oscillator, Anharmonic oscillator, vibrating rotator, vibration of polyatomic molecules, vibration rotation-spectra of polyatomic molecules, Classical and Quantum Theory of Raman Effect, Rotational Raman spectra, Vibrational Raman spectra –Vibrational study of surfaces, Electronic Spectra of Diatomic Molecules, Vibrational Coarse structure, Franck,Condon Principle, Dissociation Energy, Rotational Fine Structure, Fortrat Diagram, Pre-dissociation, Electronic spectra of Polyatomic Molecules, Electronic spectroscopy of surfaces, Introduction to resonance spectroscopy

Reference Books:

1. C. N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, 5th Edn. Tata McGraw-Hill Pub. Company Ltd. 2013
2. J.M.Hollas, Modern Spectroscopy; 4th Edition; John Wiley & Sons Ltd, 2004
3. G.Aruldhas, Molecular Structure and Spectroscopy; Prentice Hall of India Pvt. Ltd., New Delhi, 2008
4. S.Wartewig; IR and Raman Spectroscopy: Fundamental Processing. WILEY-VCH Verlag GmbH & Co. 2003.
5. Pavia, Lapman and Kriz; Introduction to Spectroscopy; Thomson Learning Inc. 2001
6. B.H.Bransden and C.J.Joachain Physics of Atoms and Molecules, 2nd edition, Pearson Education, 2003.
7. P.Larkin, IR and Raman Spectroscopy; Principles and Spectral Interpretation, Elsevier Pub. 2011,
8. B.Stuart, Infrared Spectroscopy: Fundamentals and Applications; John Wiley & Sons, Ltd, 2004
9. Yong, Cheng Ning, Interpretation of organic spectra ; John Wiley & Sons (Asia) Pvt. Ltd., 2011
10. Peter Larkin; Infrared and Raman spectroscopy: principles and spectral interpretation; Elsevier Inc. 2011

15PH3010 ELECTROMAGNETIC THEORY

Credits 3:0:0

Course Objective

The course aims to provide

- To learn the basics of electricity and magnetism and equations governing them.
- To acquire knowledge of fundamentals of magnetism
- To know the Maxwell's equations
- To learn about the electromagnetic waves.

Course outcome:

- Students can know about the use of the fundamental concepts of electricity and
- magnetism in day to day life

Course Description:

Gauss Law, Scalar potential, Multipole expansion of electric fields, The Dirac Delta function, Poisson's equation, Laplace's equation, Green's theorem; Biot,Savart law; Ampere's law, Magnetic vector potential; Electromagnetic induction, Faraday's law, Displacement current, Maxwell's equations, Gauge transformations, Poynting's theorem; Plane wave in vacuum, Boundary conditions, Reflection and refraction of e.m. waves at a plane interface between dielectrics, Polarization by reflection and total internal reflection, E.M. Waves in a conducting and dissipative medium. Radiation from an oscillating dipole, Radiation from a half wave antenna, Radiation damping, Thomson cross section, Lienard- Wiechert Potentials.

Reference Books

1. J.D. Jackson.Classical electrodynamics, 3rd Edition, John & Wiley Sons, Inc. 2014.
2. David J. Griffiths. Introduction to Electrodynamics, 3rd Edition, Prentice-Hall, 2012.
3. Ashok Das Lectures on Electromagnetism,2nd Edition, World Scientific, 2013.
4. Mathew N.O. Sadiku, Principles of Electromagnetics, 4th Edition, Oxford University Press, 2010.
5. William Hayt and John A Buck, Engineering Electromagnetics, 8th Edition, Mc-Graw Hill, 2006.
6. Jordon and Balmain Electromagnetic waves and radiatingsystems, 2nd Edition, Prentice Hall, 2001.
7. David K Cheng, Fundamental of electromagnetic, 2nd Edition, Pearson International Publishers, 2014.

15PH3011 QUANTUM MECHANICS II

Credits 3:0:0

Course Objective

Students will be able to

- understand time dependent perturbation theory using quantum mechanics get knowledge on theory of scattering and induced emission and absorption of radiation
- Understand the formulation of relativistic wave equation
- Get knowledge on the formulation of quantum field theory

Course Outcome:

Students will attain

- Understanding of advanced quantum mechanical concepts on perturbation, scattering and radiation
- Knowledge of Quantum mechanical solution of relativistic problems and quantum fields

Course Description:

Time Dependent Perturbation Theory, Transition to Continuum of States, Fermi Golden Rule, Transition Probabilities, Selection Rules for Dipole Radiation, Collision, Adiabatic Approximation; Scattering Amplitude, Born Approximation and Its validity, Partial wave analysis, Phase Shifts, Scattering by coulomb and Yukawa Potential; Semi Classical Theory, Radiation Field, Density Matrix and its Applications; Relativistic Schrödinger equations, Dirac Relativistic Equation for a Free Particle, Dirac matrices, Quantization of wave fields, Field Quantization of the Non-Relativistic Schrodinger Equation, Creation, Destruction and Number Operators, Anti Commutation Relations, Quantization of Electromagnetic Field Energy and Momentum.

Reference Books

1. P.M. Mathews & K. Venkatesan, A Text Book of Quantum Mechanics, Tata McGraw Hill 2007
2. G Aruldhas, Quantum Mechanics Prentice Hall of India 2006
3. David J.Griffiths, Introduction to Quantum Mechanics Pearson Prentice Hall 2005
4. Addison-Wesley- Richard L. Liboff, Introductory Quantum Mechanics (4th edition ed.). (2002).
5. E. Merzbacher, Quantum Mechanics, 3rd Edition, John & Wiley Sons. Inc. 1998
6. Ashok Das, Lectures on Quantum Mechanics, 2nd Edition, Taylor & Francis, 2012
7. A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer-Verlag 2004

15PH3012 NUCLEAR AND PARTICLE PHYSICS

Credits: 3:0:0

Course Objective:

- To make the students understand the constituent particles and the forces existing inside the nucleus
- To give an idea about the nuclear reaction and nuclear reactors
- To give a brief idea about the elementary particles

Course Outcome:

- Students will understand about the structure of nucleus and the forces inside the nucleus. They learn about fission and fusion reactions and conditions for the controlled nuclear reaction which are applied in the reactors.

Course Description:

Nuclear Structure, Basic properties, Quadrupole moments, Systems of stable nuclei, Weizsacker Semi-emperical mass formula, Nuclear stability, Nuclear Models, Nuclear Forces, Ground state of Deutron, charge independence and spin dependence of nuclear forces, Meson theory, Spin orbit and tensor forces, Exchange forces, Radio Activity, Gamow's theory of Alpha decay, Neutrino hypothesis, Fermi's theory of beta decay, Energies of beta spectrum, Gamma emission, selection rules, Nuclear isomerism. Nuclear Reactions, Level Widths in nuclear reaction, Nuclear Reaction cross sections, Partial wave analysis, Compound nucleus model, Resonance Scattering, Breit–Wigner one level formula, Optical model, Direct reactions, Stripping and pick-up reactions, Theory of fission and fusion, Controlled Thermonuclear reactions, Classification of fundamental forces and elementary particles, Isospin, strangeness, Gell-Mann Nishijima's formula, Quark model, SU (3) Symmetry, CPT invariance in different interactions, parity non-conservation, K meson.

Reference Books

1. Concepts of Nuclear Physics – B.L. Cohen – McGraw-Hill – 2001.
2. Introduction to Nuclear Physics – H.A. Enge – Addision-Wesley, 1983.
3. Introduction to Particle Physics : M. P. Khanna Prentice Hall of India (1990)
4. Nuclear and particle Physics : W. Burcham and M. Jobes, Addision-wesley (1998)
5. S N Ghoshal, Nuclear Physics 1^{st} Edition, S.Chand Publishing, 1994.
6. Irving Kaplan, Nuclear Physics 2^{nd} Edition, Narosa Publishing House, 2002.
7. Kenneth S.Krane, Introductory Nuclear Physics 1^{st} Edition, Wiley India Pvt Ltd, 2008.
8. S L Kakani, Nuclear and Particle Physics, Viva Books Pvt Ltd.-New Delhi, 2008.
9. Gupta, Verma, Mittal, Introduction to nuclear and particle physics, 3/E 3^{rd} Edition, PHI Learning Pvt. Ltd-New Delhi, 2013.
10. Samuel S. M. Wong, Introductory Nuclear Physics 1^{st} Edition, PHI Learning, 2010.

15PH3013 SPECTROSCOPY

Credits 3:0:0

Course Objective:

- To learn how the resonance spectroscopic techniques are used in atomic and molecular structure determination
- To understand the principles and the theoretical framework of different Spectroscopic techniques
- To know the instrumental methods of different spectroscopic techniques

Course Outcome:

- Students will gain a fundamental understanding of the different resonant spectroscopic techniques as the most important tool in understanding molecular structure and its characteristics

Course Description:

Symmetry operations and symmetry elements in molecules, Matrix representation of symmetry operations, reducible and irreducible representations, the Great Orthogonality Theorem, Construction of character tables for point groups C2v, and C3v . The nature of spinning particles, Interaction between spin and a magnetic field, Larmor Precession, Relaxation times, Bloch equations, The Chemical shift, The Coupling constant, Nuclei other than hydrogen exhibiting NMR, Continuous wave N.M.R and Fourier Transform N.M.R spectroscopy, N.M.R in Medicine. The position of ESR absorptions – Hyperfine structure of E.S.R absorptions, Double resonance in E.S.R, The fine structure of E.S.R spectra, Principle of Nuclear Quadrupole Resonance, Quadrupole Hamiltonian Nuclear Quadrupole energy levels for axial and non-axial symmetry, NQR in the study of chemical bonding, Halogen, Minerals and Nitrogen, Principles of Mossbauer Spectroscopy, The isomer shift, quadrupole splitting, Magnetic hyperfine Interaction, Principle of Mass spectrometry, ion production, fragmentation, ion analysis.

Reference Books

1. Fundamentals of Molecular Spectroscopy by C. N. Banwell and E.M. McCash, 5th Edn. Tata McGraw-Hill Pub. Company Ltd. 2013
2. Molecular Structure and Spectroscopy; G.Aruldhas, Prentice,Hall of India Pvt. Ltd., New Delhi, 2008
3. Molecular structure and symmetry; R L Carter; Wiley India Pvt. Ltd., 2012
4. Introduction to Spectroscopy; Pavia, Lapman and Kriz; Thomson Learning Inc. 2001
5. A Basic Guide to NMR; James N. Shoolery; 3rd edn, Varian Associates, 2008
6. Fundamentals of contemporary Mass Spectrometry; Chhabil Dass; John Wiley & Sons, Inc, 2007
7. A complete introduction to NMR spectroscopy; R.S.Macomber, Wiley Inter-science pub; NewYork,1998
8. Understanding NMR Spectroscopy; J. Keeler, Wiley Interscience, 2002.
9. Interpretation of organic spectra ; Yong,Cheng Ning, John Wiley & Sons (Asia) Pvt. Ltd., 2011

15PH3014 SOLID STATE PHYSICS

Credit: 3:0:0

Course Objective:

- To get knowledge on band theory of solids
- To understand theoretical aspects of dielectric, magnetic and optical properties of solids
- To gain knowledge on the principle of super conductivity

Course Outcome:

- To apply the theory of solids to explain the properties of materials

Course Description

Elastic vibration, Mono and Linear diatomic lattice, optic and acoustic modes, infrared absorption, localized vibration, quantization of lattice vibration, Phonon momentum, Energy bands in solids, Nearly free electron model, Bloch's theorem, Kronig and Penny model, Tight bound approximation, Brillouin zone, Fermi surface, density of states, Dielectric constant and polarisability, Local field, different types of polarization, Langevin function, Classius-Mosotti relation, Ionic and Electronic Polarisability, Ferroelectricity, Dipole theory, Quantum theory of Paramagnetism, Ferromagnetism, Weiss theory, Temperature dependence of magnetism, Exchange interaction, Ferromagnetic domains surfaces, Bloch Wall, Antiferromagnetism, Molecular field theory, Neel temperature, Ferrimagnetism, Point defects in crystals, Colour centres, Photoconductivity, Trap capture, recombination centres, Luminescence, Excitation and emission, Decay mechanism, Electroluminescence, Zero resistance, Behavior in magnetic field, Meissner effect, thermodynamics of superconducting materials, London equation, B.C.S. theory (qualitative), Tunneling A.C. and D.C. Josephson effect, Type I and II superconductors, High T_c superconductors

Reference Books

1. Elementary Solid State Physics, M. Ali Omar, Pearson Education, 2004
2. Introductory solid state Physics, H.P.Myers, Second edition, Taylor and Francis, 2009
3. Advanced Solid State Physics, P.Philips, Cambridge University Press, 2012
4. Solid State Physics, Neil W. Ashcroft, N. David Mermin, Cengage Learning, 2011
5. Solid State Physics, R.J.Sing, Pearson, 2012.
6. Introduction to Solid State Physics, Kittel, John Wiley, 8th edition, 2004
7. Solid State Physics, S.O. Pillai New Age Publications, 2002

15PH3015 PHYSICS OF NANOMATERIALS

Credits 3:0:0

Course Objective:
- To understand the theoretical concepts of nanomaterials
- To gain knowledge on preparation and characterization techniques
- To get knowledge on few nanodevices

Course Outcome:
- Students apply the knowledge to prepare and characterize novel nanomaterials

Course Description:
Introduction to Quantum well, wire and dots, Density of states, Schrodinger wave equation of 1, 2 and 3D structures, super lattice, Quantum confinement, Thin film deposition, patterning and etching. Colloidal dispersions, Self-assembly, Growth modes, Ostwald ripening, Metallic nanowires and quantum conductance, Carbon nanotubes and its properties, electrical properties of Quantum dots and wells, Quantum Hall effect. hardness, Nano indentation, Absorption spectra, Excitons, Coupled wells and Superlattices, Quantum confined Stark effect, nanodevices, Single-electron transistors, Esaki and quantum mechanical tunneling diodes, Magnetic Nanodevices, Magnetoresistance, Spintronics, MEMS and NEMS.

Reference Books

1. Introduction to Nanotechnology, Charles P.Poole, Jr. and Frank J.Owens, Wiley, 2003
2. Silicon VLSI Technologies, J.D.Plummer, M.D.Deal and P.B. Griffin, Prentice Hall, 2000
3. Introduction to Solid State Physics, C.Kittel, a chapter about Nanotechnology, Wiley, 2004

15PH3016 ADVANCED STATISTICAL MECHANICS

Credits 3:0:0

Course Objectives
- To learn about different ensembles and their applications
- To know the basic principles of statistical mechanics
- To gain expertise in Monte Carlo methods

Course Outcomes
- Acquiring skills on the basic principles of statistical mechanics
- Apply principles of statistical mechanics to Molecular dynamics
- Apply the Bose-Einstein distribution for understanding the formation of Bose-Einstein condensation

Course Description
Phase space volume, microcanonical ensemble, introduction to molecular dynamics, Harmonic oscillator and oscillator baths; integrating equations of motion: finite difference methods; the canonical ensemble; application of canonical ensemble to molecular dynamics; grand canonical ensemble; grand canonical phase space and partition function; Application of grand canonical ensemble to ideal gas; Monte Carlo method; the central limit theorem; Wang-Landau sampling; free energy perturbation theory; adiabatic dynamics; metadynamics; quantum ensembles and the density matrix; Fermi-Dirac and Bose-Einstein statistics; Bose-Einstein condensation; the Feynman path integral technique; Ising model

Reference books

1. Statistical Mechanics: theory and molecular simulation, Mark Tuckerman, Oxford University Press, New York, 2010
2. Statistical Mechanics, R K Pathria, Elsevier, 2001
3. Fundamentals of Statistical and Thermal Physics, F. Reif, Waveland Press, Inc. 2009
4. Statistical Mechanics, K. Haung, John Wiley and Sons, 1987
5. Introductory Statistical Mechanics, R.B. Mariana, Oxford Science publications, 2007
6. An introductory course of Statistical Mechanics, P.B. Pal, Narosa, 2009
7. Elementary Statistical Physics, C. Kittel, Dover Publications, 2004

15PH3017 PHOTONICS

Credits 3:0:0

Course Objectives:

- To learn various processes involving in the development of laser.
- To understand the various applications using lasers
- To know the working and fabrication of optical fibers

Course Outcome:

- Students can understand the fabrication and application of various lasers and optical fiber.

Course Description:

The paraxial wave equation, Gaussian beams, the ABCD law for Gaussian beams, Diffraction theory of laser resonators; Theory of Lasers, principle and working of different lasers. Theory of Q-switching and mode locking process; Introduction to nonlinear optics, nonlinear polarization and wave equation, second harmonic generation, phase matching, three-wave mixing, parametric amplifications, nonlinear susceptibilities, nonlinear materials; Propagation of light through isotropic medium, anisotropic medium, theory of electro-optic, magneto-optic and acousto-optic effects and devices, integrated optical devices and techniques; Overview of optical fibers. Ray optics representation. Multipath dispersion materials Combined effect of material and multipath dispersion, Modal birefringence, Attenuation in optical fibers

Reference Books

1. Lasers and nonlinear Optics: B. B. Laud, New Age International (P) Ltd. (2007)
2. Laser Electronics: J. T. Verdeyen, Prentice,Hall Inc. (1995).
3. Laser Fundamentals: W. T. Silfvast, Cambridge University Press, (2003)
4. Optics and Photonics: An Introduction, John & Wiley Sons, Inc. 2007--- F. Graham Smith, Terry A. King, Dan Wilkins
5. Optical solitons: From Fibers to Photonic Crystals, G.P. Agrawal and Y. Kivshar, Elsevier Academic Press, 2003
6. Applications of Nonlinear Fiber Optics, G.P. Agrawal, Elsevier Academic Press, 2008
7. Photonics: Optical Electronics in Modern Communications, The Oxford Series in Electrical and Computer Engineering, 2007---Amnon Yariv and Pochi Yeh

15PH3018 THIN FILM TECHNOLOGY

Credits 3:0:0

Course Objective:

- To gain knowledge on vacuum systems, Thin film coating techniques
- To understand the growth process of thin film
- To study on characterization techniques and thin film applications

Course Outcome:

- To apply the knowledge of thin film coating techniques to prepare thin films by various methods
- To do characterization studies on thin films and fabricate thin film devices

Course Description

Basic vacuum concepts, pumping systems, monitoring equipment, vacuum and non-vacuum thin film deposition techniques, Substrate materials and its properties, Substrate cleaning, buffer layer, metallization, growth process, Adsorption, surface diffusion, nucleation, surface energy, texturing, structure development, interfaces, stress, adhesion, epitaxy, growth monitoring, composition control, lattice mismatch, surface morphology, Structural and optical characterizations, dc electrical conductivity as a function of temperature, Hall effect, types of charge carriers, charge carrier density, Material selection, Design and Fabrication of Thin film resistor, capacitor, diode and transistor, Thin film solar cells, Thin film mask blanks for VLSI, Thin films sensors, magnetic thin films for MEMS and NEMS application.

Reference Books

1. Thin Film Technology Handbook by Aicha Elshabini, Aicha Elshabini,Riad, Fred D. Barlow, McGraw,Hill Professional, 1998
2. Thin film Technology, K.L.Chopra, Tata McGraw, Hill, 1985
3. An Introduction to Physics and Technology of Thin Films by Alfred Wagendristel, Yu Ming Wang, World Scientific, 1994
4. Handbook of Thin,film Deposition Processes and Techniques: Principles, Method, equipment and Applications By Krishna SeshanWilliam Andrew Inc., 2002
5. Handbook of thin film technology, L.I.Maissel and R.Glang, McGraw Hill Book Company, New York (1983).
6. Thin,film deposition: principles and practice by Donald L. Smith, McGraw,Hill Professional, 1995

15PH3019 PRINCIPLES OF RENEWABLE ENERGY

Credits 3:0:0

Course Objective:

- To give an overview of the energy problem faced by the current generation
- To highlight the limitations of conventional energy sources that affect the climate
- To underline the importance of renewable energy sources
- To give a thorough knowledge about various renewable energy technology and to give a glimpse of cutting edge research technology that is happening place in the field of renewable energy sources.

Course Outcome:

- The students will understand the problems of conventional energy sources. They will realize the importance of renewable energy sources and try to find solutions to non,conventional energy sources by research.

Course description

Classification of Energy Sources, Advantages and Limitations of Renewable Energy sources, Solar radiation at the Earth's Surface, Solar Radiation Measurements, Solar Energy Collectors, Flat plate Collectors, Concentrating Collector, Solar Energy Storage, Solar Water Heating, Solar Pumping, Solar Furnace, Solar Cooking, Wind Energy, Basic Components Of a WECS (Wind Energy Conversion System), Classification of WECS, Wind Energy Collectors and Storage, Photosynthesis Process, Bio Fuels, Bio-mass Conversion Technologies, Wet processes and Dry Processes, Classification of Bio-gas plants, Bio-gas from plant Wastes, Energy From The Oceans, Tidal Wave Energy conversion, Ocean Thermal Energy Conversion, Chemical Energy Sources, Fuel Cells and Batteries, Hydrogen Energy, Thermionic and Thermoelectric Generators.

Reference Books

1. Non,Conventional Energy Sources, G.D. Rai, Standard Publishers Distributors, ISBN 9788186308295 (2004)
2. Non,Conventional Energy Sources, B.H.Khan, Tata McGraw Hill (2006) ISBN, 07, 060654,4
3. Renewable Energy, Godfrey Boyle, Oxford University Press in association with the Open University, (2004), ISBN 9780199261789
4. Renewable energy: sources for fuels and electricity, Thomas B. Johansson, Laurie Burnham, Island Press, (1993), ISBN 9781559631389
5. Renewable energy: sustainable energy concepts for the future, Roland Wengenmayr, Thomas Bührke, Wiley,VCH, (2008), ISBN 9783527408047
6. Renewable Energy: Sources and Methods, Anne Maczulak, Infobase Publishing, (2009), ISBN 9780816072033

15PH3020 PHYSICS OF NANOSCALE SYSTEMS

Credits: 3:0:0

Course Objective:

- To learn the various modern technologies used in nano devices and sensors.
- To know about the Semiconductor, bio and Photonics based sensors and its electronic properties of such nanostructure devices.
- To understand the effect of the reduced dimensionality on the electronic charge transport.

Course Outcome:

- To apply the operating principle of various nanodevices and its single atom manipulation

Course Description

Electronic level modification of 0D, 1D, 2D -Esaki and resonant tunneling diodes, Mott-wannier excitons - molecular electronics, molecular switching, Schottky devices, Mesoscopic Devices, Metal Insulator Semiconductor devices, MOSFET characteristics - NanoFET - Single Electron Transistors, Resonant Tunneling Devices, Carbon Nanotube based logic gates, optical devices. Connection with quantum dots, quantum wires, and quantum wells. biosensor, micro fluids, Sensors for aerospace and defense: Accelerometer, Pressure Sensor, Night Vision System, Nano tweezers, nano-cutting tools, Integration of sensor with actuators and electronic circuitry as diagnostic tool, Biosensors- generation, characteristics and applications, conducting Polymer based sensor, DNA Biosensors, optical sensors and Biochips, Magnetoresistance, Spintronics, MEMS and NEMS -Fabrication, Modeling Applications MEMS and NEMS, Packaging and characterization of sensors, Method of packaging at zero level, dye level and first level Sensors. Photonic Nanodevices-Semiconductor quantum dots, Photonic crystals, Metamaterials.

Reference Books

1. Sensors: Micro & Nanosensors, Sensor Market trends (Part 1&2) by H. Meixner.2008
2. Between Technology & Science: Exploring an emerging field knowledge flows & networking on the nanoscale by Martin S. Meyer.2007
4. Nanoscience & Technology: Novel structure and phenomea by Ping Sheng, Talylor and Francis,2003
3. Nano Engineering in Science & Technology : An introduction to the world of nano Design by Michael Rieth,2003
4. Enabling Technology for MEMS and nano devices -Balles, Brand, Fedder, Hierold,John Wiley and sons, 2004
5. Optimal Synthesis Methods for MEMS- G. K. Ananthasuresh,Klower Academic publisher,2003

15PH3021 RADIATION TREATMENT AND PLANNING

Credits: 3:0:0

Course Objective:

- To gain knowledge on radiotherapy machines
- To understand the interaction of photon beam on matter
- To learn about the clinical treatment planning
- To gain knowledge on electron beam therapy and advanced radiotherapy treatment methods

Course Outcome:

- To demonstrate overall knowledge on radiotherapy treatment planning

Course Description

Radiotherapy Machines, X-rays and Gamma rays, Linear accelerator, Accelerating wave guide, Microwave power transmission, Auxiliary system, Electronic beam transport, LINAC treatment head, Production of photon and electron beams from linac, Beam collimation, Cobalt-60 versus LINAC, Radiation therapy simulators, Physical Aspects Of External Photon Beams, Photon beam sources, Inverse square law, Surface dose, Skin sparing effect, Percentage depth dose, various ratios, Total scatter factor, Isodose distribution in water phantom, Isodose charts and factors effecting, Correction of irregular counters, Missing tissue compensation, Correction of tissue inhomogeneity, Clarkson's method, Dose calculation, clinical Treatment Planning In Photon Beams And Recent Advances, Treatment planning, Volume definition, ICRU 50, ICRU 62 concepts, Dose specification, Patient data acquisition, Simulation, Conventional simulation, Isodose curves, Wedge filters, Bolus, Compensating filters, Field separation Physical Aspects Of Electron Beam Therapy, Production of electron beams, Interaction of electron with matter, Range concept, Electron shielding, Dose prescription and thumb rule, Field inhomogeneity, Photon contamination, Virtual SSD, Oblique incidence, Advanced Radiotherapy Treatment Methods, Treatment planning system, Imaging in radiotherapy, CT simulation, Basics of 3-D conformal therapy, 3-D Conformal Radiotherapy, Introduction to Intensity Modulated Radiotherapy and Image Guided Radiotherapy, Stereotactic Radiosurgery and Stereotactic Radiotherapy, Tomotherapy, Particle beam therapy.

Reference Books

1. Review of Radiation Oncology Physics - A Hand book for Teachers and Students, EB. Podgorsak, International Atomic Energy Agency, 2005
2. Radiation therapy Physics, WR. Hendee and GS. Ibbott, J. Wiley, 2004
3. The Physics of Radiation Therapy, FM. Khan, Wolters Kluwer, 2003
4. Treatment Planning in Radiation Oncology, FM. Khan and RA. Potish, Williams & Wilkins, 1998
5. Introduction to Radiological Physics and Radiation Dosimetry, FH. Attix, Wiley, 1986

15PH3022 MEDICAL RADIATION DOSIMETRY

Credit 3:0:0

Course Objective:

- To learn the basic concepts of radiation
- To understand the interaction of radiation with matter
- To understand Kema, dose activity
- To gain knowledge on dosimetry systems

Course Outcome:

- To demonstrate knowledge on radiation and Dosimetry systems

Course Description

Basic Radiation Physics, Atoms and nuclei, Fundamental particles, Atomic and nuclear structure, Mass defect and binding energy, Radiation, Classification of radiation, Electromagnetic spectrum, Radioactivity, Alpha, beta and gamma rays, Methods of decay, Isotopes, Radiation sources. Interaction Of Radiation With Matter, Types of indirectly ionizing radiation, Photon beam attenuation, Types of photon interactions, Types of electron interactions, Types on neutron interactions, Photo electric effect, Coherent scattering, Compton effect, Pair production, Photo nuclear disintegration, Effect following radiation interaction, Radiation Quantities And Units, Radiometric, interaction, protection and dosimetric quantities, Particle and energy fluence, Linear and mass attenuation coefficient, Stopping power, Linear energy transfer, Absorbed dose, Exposure, Activity, Equivalent dose, Effective dose, Electronic or charged particle equilibrium, Bragg gray cavity theory, Radiation Detection, Properties of dosimeters, Methods of radiation detection, Ionization chamber dosimetry system, Proportional counters, Geiger Muller counters, Semi conductor detector, Solid and liquid scintillation counters, Film dosimetry, Thermoluminiscent dosimetry, Calorimetry, Chemicaldosimetry, Calibration of Photon and Electron Beams, Ionization chambers, Electro meter and power supply, Phantoms, Chamber signal corrections for influence quantities, Calibration of mega voltage photon beams

Reference Books

1. Radiation Detection and Measurement, Glenn F. Knoll, John Wiley & Sons, 2010.
2. Review of Radiation Oncology - A Hand book for Teachers and Students by EB. Podgorsak, International Atomic Energy Agency, 2005
3. Radiation therapy Physics by WR. Hendee and GS. Ibbott, J. Wiley, 2004
4. Physics of Radiation Therapy by FM. Khan, Wolters Kluwer, 2003
5. Treatment Planning in Radiation Oncology by FM. Khan and RA. Potish, Williams & Wilkins, 1998
6. Introduction to Radiological Physics and Radiation Dosimetry by FH. Attix, Wiley, 1986

15PH3023 RESEARCH METHODOLOGY

Credits: 3:0:0

Course Objective

- To gain knowledge on various research tools available for carrying out research
- To gain understanding on numerical and statistical methods to solve research problems
- To solve simple statistical and numerical problems using C++ programming

Course Outcome

- To apply various techniques for practical problems
- To apply numerical and statistical problem solving skills and computer programming
- skills to solve research problems

Course Description

X ray studies, Microscopic and spectroscopic methods, Correlation, comparison of two sets of data, comparison of several sets of data, Chi squared analysis of data, characteristics of probability distribution, some common probability distributions, Measurement of errors and measurement process, sampling and parameter estimation, propagation of errors, curve fitting, group averages, equations involving three constants, principle of least squares, fitting a straight line, parabola and exponentials curve method of moments, Solution of differential equations, simple iterative method, Newton Raphson method, Numerical by integration, Simpson rule, Gausian quadrature, solution of simultaneous equation, Gauss Jordon elimination method, Eigenvalue and eigenvectors by matrix diagnolization (Jacobian method), Application of numerical and statistical methods using C++ programming; Solving quadratic equations, solution of equation by Newton Raphson method, matrix diagnolization (Jacobian method), Integration by Simpson's rule, Fitting of a straight line using principle of least square

Reference Books

1. B.K.Sharma, Spectroscopy Goel publishing house, 2007
2. Computer applications in Physics, Suresh Chandra, Narosa publishing hours (2003)
3. Numerical methods for Mathematics, Science and Engineering, John H. Mathews Prentice Hall, India (2000)

15PH3024 MATERIAL CHARACTERIZATION

Credits: 3:0:0

Course Objective

- To know about the Microscopic and Spectroscopic methods
- To understand the analysis of materials using electron microscopy and optical methods
- To learn the instrumentations of Thermal, Electrical, Mechanical and Magnetic methods of characterization.

Course Outcome

- To understand various methods available for characterizing the materials.

Course Description

Optical Microscopy, Optical Microscopy Techniques, Bright & dark field optical microscopy, phase contrast microscopy, Differential interference contrast microscopy, Fluorescence Microscopy, Scanning probe microscopy (STM, AFM), Scanning new field optical microscopy X,Ray Diffraction methods, Rotating crystal, Powder method, Debye, Scherrer camera, Structure factor calculations, EBSD & ED, Principles and Instrumentation for UV,Vis,IR, FTIR Spectroscopy, Raman Spectroscopy, NMR, XPS, AES and SIMS,proton induced X,Ray Emission spectroscopy (PIME), Rutherford Back Scattering (RBS) analysis, application. SEM, EDAX, EPMA, TEM, STEM working principle and Instrumentation, sample preparation, data collection, processing and analysis, Photoluminiscence, light matter interaction, instrumentation, Electroluminescence, instrumentation, Applications, Thermogravimetric analysis (TDA), instrumentation, determination of weight loss and decomposition products, differential thermal analysis (DTA), cooling curves, differential scanning calorimetry (DSC), instrumentation, specific heat capacity measurements, determination of thermomechanical parameters, Chromatography, Liquid & Gas Chromatography. Two probe and four probe methods, van der Pauw method, Hall probe and measurement, scattering mechanism, C,V characteristics, Schottky barrier capacitance, impurity concentration, Mechanical and Magnetic Analysis, Vickers Hardness test, Vibrating Sample Magnetometer, Working principle of VSM, Instrumentation.

Reference Books

1. Atomic Force Microscopy/ Scanning Tunneling Microscopy, S.H.Cohen & Marcia L.Lightbody (Editors), plenum press, Newyork, 1994.
2. Principles of Thermal analysis and calorimetry by P.J.Haines (Editor), Royal Society of chemistry (RSC), Cambridge, 2002.
3. B.D.Cullity, "Elements of X,Ray diffraction" (II Edition) Addision Wesley publishing Co., 1978.
4. Lawrence E.Murr, Electron and Ion Microscopy and Microanalysis principles and Applications, Mariel Dekker Inc., Newyork, 1991.

15PH3025 CRYSTAL GROWTH TECHNIQUES

Credits 3:0:0

Course Objective

- To study the basic knowledge about the nucleation mechanism involved in crystal growth
- To understand the broad areas of crystal growth methods such as melt, solution, vapour transport.
- To understand some of the advanced crystal growth systems such as CVD and PVD

Course Outcome:

- Students can understand the different techniques used for growing crystals

Course Description

Importance of crystal growth, classification of crystal growth methods,Theories of nucleation, Classical theory, Gibbs Thomson equation for vapor solution and melt energy of formation of a nucleus, Adsorption at the growth surface, Nucleation, Homogeneous and Heterogeneous nucleation, Growth surface. Solution, selection of solvents, solubility and super solubility, Saturation and super saturation, Meir's solubility diagram, Metastable zone width, measurement and its enhancement, Growth by (i) restricted evaporation of solvent, (ii) slow cooling of solution and (iii) temperature gradient methods, Growth in Gel media, Electrocrystallization. Flux Growth, principle, choice of flux, Growth kinetics, phase equilibrium and phase diagram, Growth techniques, solvent evaporation technique, slow cooling technique, transport in a temperature gradient technique, Accelerated crucible rotation technique, Top seeded solution Growth, Hydrothermal Growth. Melt growth, Heat and transfer, Growth techniques, conservative processes, Bridgman, Stockbarger method, pulling from the melt, Czochralski method (CZ), cooled seed Kyropoulos method, Non, conservative processes zone refining, vertical, horizontal floatzone methods, Skull melting Process, Vernueil method, flame fusion, plasma and arc image methods. Basic principle, physical vapour deposition (PVD), Evaporation and Sublimation processes, sputtering, chemical vapour Deposition (CVD), Advantages and disadvantages, chemical vapour transport, Fundamentals, Growth by chemical vapour transport (CVT) Reaction .

Reference books

1. Ichiro Sunagawa, Crystal Growth, Morphology and performance, Cambridge University press, (2005).
2. Mullin, J. N, 'Crystallization', Butternmths, London (2004)
3. Hand book of crystal growth, Volume 1, 2 & 3. Edited by D. T. J. Hurle North Holland, London (1993)

15PH3026 RADIATION PHYSICS

Credits: 3:0:0

Course Objectives:

- To review the basic physics principles of atomic and nuclear physics
- To study the basics of radiation physics and interaction of radiation with matter
- To know about the basic counting statistics, calibration and methods of measuring radiation
- To understand the sources of radiation in the environment and their applications

Course Outcome:

- The students will become familiar with the basics of radiation physics and their sources in the environment, their methods of detection and the application of different types of radiations.

Course Description:

Review Of Physical Principles, Mechanics, Units and dimensions, Energy Transfer, Elastic and inelastic collision, Electromagnetic waves, The wave mechanics atomic model, The nucleus, The neutron and the nuclear force, Isotopes, The atomic mass unit, Binding energy, Nuclear models, Nuclear stability, Radioactivity And Interaction Of Radiation With Matter, The units of radioactivity, Series decay, Alpha rays, Range-energy relationship, Energy transfer, Beta rays, Range energy relationship, Mechanism of energy loss, ionization and excitation, Gamma rays, Exponential absorption, Absorption mechanisms, Neutrons, Production, Methods Of Measuring Radiation, Gas filled detectors, Scintillation detection systems, Semiconductor detectors, Thermoluminescent detectors, High purity Germanium Detectors, Track devices, Spark counters and spark chambers, Miscellaneous detectors, Counting Statistics And Calibration Of Instruments, Uncertainty in the measuring process, Various types of distribution, Error Propagation, Accuracy of counting measurements, Significance of data from statistical view point, Calibration and standards, Source calibration, Neutron sources, X-ray machines, Radiation In The Environment And Their Applications, Types of radiation sources, Natural radiation sources, Artificial sources of radiation, Applications of radiations

Reference Books

1. Nicholas Tsoulfanidis, Sheldon Landsberger, Measurement and Detection of Radiation, Third Edition, CRC Press; 2010
2. Radiation Detection and Measurement, Glenn F. Knoll, John Wiley & Sons, 2010,
3. Radiation Physics for Medical Physicists, Ervin B. Podgorsak, Springer, New York (2010)
4. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed, Academic Press, Elsevier (2007)
5. Environmental Radioactivity From Natural, Industrial & Military Sources, Merril Eisenbud and and Thomas F. Gesell, Academic Press, (1997, Fourth Edition)
6. G.G.Eicholz and J.W.Poston, Principles of nuclear radiation detection, ANN Arbor Science, 1985

15PH3027 NANOFLUIDS

Credit: 3:0:0

Course Objective:

- To know the basics of nanofluids
- To learn the nanofluid synthesis methods
- To understand the basics of conductive and convective heat transfer
- To learn the application of nanofluids

Course Outcome:

- Students can understand the basics and industrial application of nanofluids

Course Description

Fundamentals of Cooling, Making Nanofluids, Materials for Nanoparticles and Nanofluids, Methods of Nanoparticle Manufacture, Mechanism and Models for enhanced thermal support, Structure based Mechanism and Models, Dynamics based Mechanism and Models, Synthesis of nanofluids, Synthesis of colloidal Gold nanoparticles, Turkevich method, Brust method, Microwave Assisted Synthesis, Solvothermal Synthesis,Magnetic Nanofluids, Inert Gas Condensation, Conduction Heat Transfer, Lumped,parameter method, One Dimension Transient Conduction, Guarded Hot Plate method, Transient Hot wire, Thermal conductivity of Oxide nanofluids, Hamilton Crosser Theory, Convective Heat Transfer, Newton's law of cooling, equations of fluid flow and heat transfer, Navier,Stokes equations, Experimental study of natural convection, Eulerian,Eulerian approach, Eulerian,Lagrangian approach,

Fundamentals of Boiling, Nukiyama curve, Vehicle cooling, Transformer cooling, Biomedical applications.

Reference Books

1. Nanofluids: Science and Technology, Sarit K. Das, Stephen U. Choi, Wenhua Yu, T. Pradeep, John wiley sons, 2007
2. Holman J.P., 'Heat Transfer', SI Metric Ed., Mc Graw Hill, ISE, 1972.
3. Heat and Mass Transfer, R.K. Rajput, S. Chand, 2008
4. Heat transfer Principles and applications, Binay K. Dutta, Prentice, Hall of India Pvt. Ltd, New Delhi, 2001

15PH3028 PHYSICS OF ADVANCED MATERIALS

Credit: 3:0:0

Course Objective:

At the completion of this course, students should be able to:

- Distinguish various classes of advanced materials which includes semiconducting and nano materials for technological applications,
- to learn new terms and information on variety of materials like metamaterials, biomaterials, photonic crystal fibers, coatings and thin films, composites etc.
- Understanding high temperature refractory material, to identify various classes of composite materials, their properties and applications.

Course Outcome

- Understand the advanced development in materials emphasizing the production /structure /property /function relation and application of a number of advanced materials for technological applications.

Course Description

Introduction, Overview Of Crystal Strucutres, Strucutre - Property Relations, Phase Transitions, Semiconducting Materials For Thin Films And Epitaxy, Renewable Energy Materials, Nanomaterials, Ceramic materials, Composite Materials Classes And Its Applications, Metamaterials And Its Applications, Photonic Crystal Fibers, Polymers and Biomaterials, Nonlinear Optical Materials, Dielectric Materials, Magnetic And Superconducting Materials, Plasmonics, Materials For Energy Storage Applications, Refractory Materials And Coatings For High Temperature Applications.

Reference Books:

1. The Handbook of Advanced Materials: Enabling New Designs, James K. Wessel, Wiley-Interscience; 1 edition (April 27, 2004)
2. M Ohtsu, K Kobayashi, T Kawazoe and T Yatsui, Principals of Nanophotonics (Optics and Optoelectronics), University of Tokyo, Japan (2003).
3. Buddy Ratner. Biomaterials Science. Second edition. Orlando, Academic Press, 2000
4. Bharath Bhusan, Springer Handbook of Nanotechnology, 3rd edition, Springer-Verlag (2009)
5. Analysis of polymers an introduction- T.R.Crompton. Smithers Rapra Technology Pvt Ltd, SY4 4NR,UK,2008
6. Handbook of Composites by G. Lubin, Van Nostrand, New York, 1982.
7. Francis de Winter, Solar Collectors, Energy Storage, and Materials (Solar Heat Technologies), MIT Press, USA (1991)
8. Physics and Applications of negative refractive index materials, S. A. Ramakrishna and T.M. Grzegorczyk, CRC Press, 2009
9. Foundations of Photonic Crystal Fibres, World Scientific, Frédéric Zolla et al, 2005

15PH3029 SOLITONS IN OPTICAL FIBERS

Credit: 3:0:0

Course Objectives:

- To learn about the world of nonlinear Schrödinger equation and ordinary solitons
- To know the utility of dispersion managed solitons
- To study in detail the soliton interactions

Course Outcomes:

- Acquiring skills to find exact solutions for nonlinear Schrödinger equation
- Apply the knowledge of solitons for propagation through optical fibers
- Demonstrate the soliton concept through numerical simulations

Course Description

The nonlinear Schrödinger equation and ordinary solitons; Fiber dispersion and nonlinearity; derivation of nonlinear Schrödinger equation and fundamental consequences; Origin of soliton; Soliton transmission in dispersion tapered fibers; numerical solution of nonlinear Schrödinger equation using split-step Fourier algorithm; dispersion managed solitons; pulse behavior in maps having gain or loss; Erbium doped fiber amplifiers; Gordon-Hauss effect; Gordon-Hauss effect for dispersion managed solitons; measurement of timing jitter; soliton interactions; soliton-soliton collision in wavelength division multiplexing; applications of inverse scattering transform; wavelength division multiplexing with ordinary solitons; wavelength division multiplexing with ordinary dispersion managed solitons; polarization and its effects; hardware and measurement techniques for solitons.

Reference books

1. Solitons in Optical Fibers, L.F. Mollenauer and J.P. Gordon, Academic Press, San Diego, CA, 2006
2. Optical Solitons in Fibers, A. Hasegawa and M. Matsumoto, Springer-Verlag, Berlin, 2001
3. Optical solitons: From Fibers to Photonic Crystals, G.P. Agrawal and Y. Kivshar, Elsevier Academic Press, 2003
4. Applications of Nonlinear Fiber Optics, G.P. Agrawal, Elsevier Academic Press, 2008
5. Fiber-Optic Communication Systems, G.P. Agrawal, Wiley, 2010
6. Light Propagation in Gain media: Optical Amplifiers, G.P. Agrawal and M.Premaratne, Cambridge University Press, 2011
7. Nonlinear Fiber Optics, G.P. Agarwal, Elsevier Academic Press, 2013

15PH3030 GENERAL PHYSICS LAB I

Credits: 0:0:2

Course Objective:

- To get practical skill on basic optical, electrical and electronic experiments.
- To understand the advance experiments on properties of matter.

Course Outcome:

- To apply the knowledge on basic Physics experiments to solve practical problems.

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

15PH3031 GENERAL PHYSICS LAB II

Credits: 0:0:2

Course Objective:

- To get practical skill on experiments related to properties of matter and heat.
- To understand the architecture of microprocessors and methodology of programming.

Course Outcome:

- To apply the practical skill in heat and properties of matter to various applications.
- Student will be able to write simple program using microprocessor for practical applications.

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

15PH3032 ADVANCED PHYSICS LAB I

Credits: 0:0:4

Course Objective:

- To get practical skills on advance experiments on optics, electricity and magnetism.

Course Outcome:

- Student will be able to apply the knowledge on advance Physics experiments to solve Research problems.

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

15PH3033 ADVANCED PHYSICS LAB II

Credits 0:0:4

Course Objective:

- To get practical skill on various deposition techniques to prepare thin films and grow Crystals having nanostructures
- To get practical training on some basic characterization techniques of nanostructure thin films and crystals

Course Outcome:

- To apply the practical knowledge to fabricate novel nano devices to solve research Problems

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

15PH3034 MATERIALS CHARACTERIZATION LAB

Credit: 0:0:2

Course Objective:

- To train the students to operate advanced equipments and to understand the basic concepts of Nanotechnology
- To equip the students with practical knowledge about Nano Materials

Course outcome:

- To demonstrate the practical skill on measurements and instrumentation techniques of some Nano physics experiments.

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

15PH3035 COMPUTATIONAL PHYSICS LAB

Credits: 0:0:2

Course Objective:

- To gain programming skills to solve simple problems using C++ Programming.
- To solve simple statistical and numerical problems using C++ programming.

Course Outcome:

- To apply the programming skills to solve practical problems.
- To apply numerical and statistical problem solving skills and computer programming skills to solve research problems.

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

15PH3036 SIMULATIONS IN STATISTICAL PHYSICS LAB

Credit: 0:0:2

Course Objective:

- To understand the molecular simulation for various materials structures

Course Outcome:

- Student will get knowledge in simulation software and expertise in molecular simulations

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

15PH3037 HEAT AND OPTICS LAB

Credit: 0:0:2

Course Objective:

- To train the students on Optics and Heat experiments to understand the basic concepts.
- To equip the students with practical knowledge in Optics and heat experiments

Course outcome:

- Demonstrate the practical skill on measurements and instrumentation techniques of some physics experiments.

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

15PH3038 PROPERTIES OF MATTER LAB

Credit: 0:0:2

Course Objective:

- To train the students on Properties of matter and waves to understand the basic concepts.
- To equip the students with practical knowledge in properties of matter and waves experiments

Course outcome:

- Demonstrate the practical skill on measurements and instrumentation techniques of some physics experiments.

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

15PH3039 SIMULATIONS OF NANOSCALE SYSTEMS

Credit: 3:0:0

Course Objectives:

- To introduce the molecular simulation techniques, with special focus on molecular
- dynamics and Monte Carlo.
- To develop their own codes and utilize the learned methods towards solving a problem of their interest in Nanotechnology Applications.

Course Outcome:

- To solve the Nanoscience and the technology problems using the molecular stimulation

Introduction to Molecular Simulations-Computer Experiments and Modelling, Examples of molecular simulations, Monte Carlo-Molecular Dynamics- Newton's equation of motion. Degrees of Freedom, Constraints, Lennard Jones Potentials, Short and Long Range Potentials, Force Fields, Bonded and Non-Bonded Interactions Ensembles- Micro canonical Ensemble (NVE), Canonical ensemble (NVT), Isothermal-Isobaric Ensemble, Grand canonical ensemble, Observables-Temperature, Pressure, Thermostats, Barostats-Andersen- Berendsen, Nose-Hoover implementations. Ensembles- Microcanonical Ensemble (NVE), Canonical ensemble (NVT), Isothermal-Isobaric Ensemble, Grand canonical ensemble, Observables-Temperature, Pressure, Thermostats, Barostats-Andersen- Berendsen, Nose-Hoover implementations. Monte Carlo (MC) formulation, MC, structural characterization,MC, applications, Random Number generation- Lattice-Crystal structure, Simple MC Open Source Simulations tools. Molecular dynamics (MD) formulation, MD dynamic information, MD applications, Euler-Verlet algorithms, Analysis trajectories, Correlations functions, Autocorrelations function (ACF), Structure Correlations Function (SCF). MD-Open Source Simulations tools.

Reference Books

1. D. Frenkel, B. Smit, Understanding Molecular Simulation: From Algorithms to Applications, Academic Press, 2002.
2. J. M. Haile, Molecular Dynamics Simulation: Elementary Methods.
3. M.P.Allen, D.J. Tildesley, Computer Simulation of Liquids, Clarendon Press, Oxford, 1987
4. D.J. Evans, G.P. Morriss Statistical Mechanics of Nonequilibrium Liquids, Second Edition, Cambridge University Press.
5. D.C. Rapaport, The Art of Molecular Dynamics Simulations, 2nd Edition, Cambridge University Press, 2004

15PH3040 ASTROPHYSICS

Credits: 3:0:0

Course Objective:

- To provide with a fundamental understanding about the stars and their properties
- To provide knowledge of the instruments used to explore the cosmos
- To give an overview of the giant scale structure of the universe such as galaxy and clusters of galaxies
- To know about the origin and fate of the universe

Course outcome:

- Able to demonstrate the mechanisms of different telescopes.
- Able to apply the knowledge of astrophysics in identifying stars and galaxies

Course Description:

Introduction to Solar systems and various models, laws of planetary motions, the formation of stars and planets, properties of stars, spectral classification of stars, Hertzprung Russell diagram, distant measurements of stars, life cycle of stars, neutron stars, black holes and supernovae, theory of telescope and detectors, new generation optical telescopes, The Milkyway, galaxy, interstellar medium, stellar population, different types of galaxies, the cosmological distant scale, The Universe, Cosmological models, the standard Big bang theory, big bounce theory, life in the universe.

Reference Books

1. Michael Zeilik, Stephen . A.Gregory, Introductory Astronomy and Astrophysics, Fourth Edition, Saunders College Pub., Michigan, U.S.A, 1998 ISBN 9780030062285
2. A. B. Bhattacharya, S. Joardar, R. Bhattacharya, Astronomy and Astrophysics, Jones and Barlett Publishers, U.S.A., (2010) ISBN 978-1-934015-05-6
3. Martin V. Zombeck, Book of astronomy and Astrophysics, Cambridge University Press, U.K. (2007) ISBN 978-0-521-78242-5
4. Thanu Padmanabhan, Theoretical Astrophysics (Vol. I, II, II): Cambridge University Press, U.S.A., (2002) ISBN 0 521 56242 2
5. Wolfgang Kundt, Astrophysics: A new approach, Second edition, Springer, 2006
6. Introduction to AstroPhysics The Stars, Jean Dufay, Dover publications,2012
   AstroPhysics for Physicists, Chaudhuri, University Press,2010

LIST OF SUBJECTS

Subject Code	Subject Name	Credits
14PH1001	Applied Physics	3:0:0
14PH1002	Applied Physics Lab	0:0:2
14PH2001	Physics for Computer Science and Engineering	3:0:0
14PH2002	Physics for Civil and Mechanical Engineering Sciences	3:0:0
14PH2003	Physics for Electrical Engineering Sciences	3:0:0
14PH2004	Physics for Biotechnology	3:0:0
14PH2005	Physics for Media	3:0:0
14PH2006	Mechanics and Properties of Matter	3:0:0
14PH2007	Heat and Thermodynamics	3:0:0
14PH2008	Electricity and Magnetism	3:0:0
14PH2009	Optics	3:0:0
14PH2010	Vacuum and Thin film Technology	3:0:0
14PH2011	Semiconductor Physics	3:0:0
14PH2012	Spectroscopy	3:0:0
14PH2013	Electromagnetic Theory	3:0:0
14PH2014	Solar cells and its applications	3:0:0
14PH2015	Principles of medical diagnostic techniques	3:0:0
14PH2016	Thin film technology for Engineers	3:0:0
14PH2017	Astro Physics	3:0:0
14PH2018	Renewable Energy sources	3:0:0
14PH2019	Condensed Matter Physics	3:0:0
14PH2020	Nuclear Energy for Sustainable development	3:0:0
14PH2021	Lasers and Fiber Optics	3:0:0
14PH2022	Nanophysics Lab	0:0:2
14PH3001	Nanophotonics	3:0:0
14PH3002	Quantum Mechanics	3:0:0
14PH3003	Solid State Physics	3:0:0
14PH3004	Laser Technology	3:0:0
14PH3005	Thin film Lab	0:0:2
14PH3006	Thermodynamics and Quantum Mechanics for Nanoscale Systems	3:0:0

14PH1001 APPLIED PHYSICS

Credits 3:0:0

Course Objective:

- To impart knowledge on the basic concepts of quantum mechanics and its applications
- To understand the working principle of various lasers and its application in fibre optics
- To study the principles of acoustics and applications of ultrasonic waves
- To get more knowledge on engineering materials and its applications

Course Outcome:

- To apply physics principles of latest technology to solve practical problems in engineering.

Course Description:

De-broglie hypothesis, Heisenberg uncertainty principle, Experimental verification of matter waves, Schrodinger's wave equations and its application, Scanning Electron Microscope (SEM), Principle of Laser, Nd :YAG, He:Ne, CO_2 and Semiconductor lasers , Holography, Propagation of light in optical fibres, Classification of Optical fibres , Fibre optic communication system, Fibre endoscope, Acoustics, Absorption coefficient, Reverberation time, Sabine's formula, Acoustics of buildings, Production of Ultrasonic waves, Acoustic grating , Pulse Echo Testing, Magnetic materials, types, properties, Hysteresis, Magnetic recording and reading. Superconductors, types , properties, Maglev.

Reference Books

1. V. Rajendran – Engineering Physics, McGraw –Hill Publishing company Ltd, Publication, 2011.
2. John W.Jewett, Jr., Raymond A.Serway - Physics for Scientists and Engineers with Modern Physics, Cenage Learning India Private Ltd, 2008
3. M.N. Avadhanulu, P.G. Kshirshagar – A Text Book of Engineering Physics- S.Chand & Co. Ltd, 2008
4. Hitendra K Malik, A K Singh – Engineering Physics, McGraw –Hill Publishing company Ltd,2008
5. G.Aruldhas - Engineering Physics, PH1 Learning Pvt. Ltd , 2010
6. A.Marikani, Engineering Physics, PHI learning Private Limited, 2009

14PH1002 APPLIED PHYSICS LAB

Credits 0:0:2

Course Objective:

- To train engineering students on basis of measurements and the instruments
- To give practical training on basic Physics experiments which are useful to engineers
- To equip the students with practical knowledge in electronics, optics, and heat experiments

Course Outcome:

- To demonstrate the practical skill on measurements and instrumentation techniques of some Physics experiments.

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD and notify it at the beginning of each semester.

14PH2001 PHYSICS FOR COMPUTER ENGINEERING SCIENCES

Credits : 3:0:0

Course Objective:

- To know about the Basic laws of Physics
- To learn about the principles of solid state devices
- To learn about the principle of laser

Course Outcome:

- Better understanding of theory of electronic devices
- Able to select materials for different applications
- Able to understand the classification of lasers and its efficiency
- Able to demonstrate lasers in industrial applications

Course Description:

Semiconductors fundamentals, Thermistors and piezo resistors, phosphorescence and fluorescence; Gunn effect and Thermoelectric effect, Radiative transitions ,LEDs, LCDs, semiconductor laser and its characteristics, Photoconductors, photodiodes, avalanche photodiode, phototransistor, Integrated circuit technology, Basic monolithic integrated circuits, epitaxial growth, masking and etching , Diffusion of impurities, Monolithic diodes, integrated resistors, integrated capacitors and inductors, monolithic circuit layout, additional isolation methods, large scale integration (LSI), medium scale integration (MSI) and small scale integration (SSI),The metal semiconductor contact, Basic Operational Amplifier characteristics, Basic Applications of operational amplifier, Sinusoidal, square, Triangular and ramp wave generators, Solution of differential equation, Analog computation, Magnetic and Digital memory devices, Principles and Applications, Magnetic recording heads.

Reference Books:

1. Jacob Millman, Christos C Halkias, Satyabrata , Millman's Electronics Devices & Circuits, Tata McGraw-HillPublishing Company Pvt. Ltd. 2008
2. Millmaan. J. and Halkias C.C, Integrated Electronics, McGraw Hill, 2004
3. Allen Mottershead, Electronic Devices and Circuits, Prentice Hall of India, 2009
4. Malvino and Leach, Digital Principles and Applications, Tata McGraw Hill,Co. 2008.
5. V.K.Metha, Rohit Metha, Principles of Electronics, 2006
6. A.Marikani, Engineering Physics, PHI learning Private Limited, 2009

14PH2002 PHYSICS FOR CIVIL AND MECHANICAL ENGINEERING SCIENCES

Credits : 3:0:0

Course Objective:

- To know about the Basic laws of Physics
- To learn about the properties of matter in different conditions
- To understand the propagation of waves and thermodynamics

Course Outcome:

- Better understanding of mechanics and properties of matter of materials
- Able to select materials for different applications
- Demonstrate the properties of materials through working models

Course Description

Theory of Projectiles, Laws of impact, impulse, Coefficient of restitution Elastic and inelastic collision, direct and oblique impact, velocity and kinetic energy on impact, Laws of kinetic energy, relative masses of colliding bodies, Theory of elasticity and experimental methods, Moment of inertia and its applications, Theory and applications of bending of beams, Torsional pendulum, cantilever, Flow of liquids, Coefficient of viscosity, Critical velocity, poiseuillie's equation of flow of liquids, stokes method, surface tension, definition, angle of contact, rise of liquid in capillary tube, Oscillatory motion, Wave motion in one dimension. Wave equation and travelling wave solutions. Wave velocity, group velocity and dispersion. Shallow water waves. Earth quakes and Seismographs, Wave equation in three dimensions, spherical waves. Fundamental postulates of statistical mechanics and their basic laws, Universal law in statistical mechanics, application to one dimensional harmonic operator.

Reference Books:

1. Murugeshan. R., Properties of Matter , S. Chand & Co Pvt. Ltd., New Delhi. 2007.
2. Gulati H.R., Fundamentals of General Properties of Matter, R. Chand & Co., New Delhi, 1982.
3. Subrahmanyam N. & Brij Lal, Waves & Oscillations, Vikas Publishing House Pvt. Ltd., New Delhi, 1994..
4. P.K. Chakrabarthy, Mechanics and General Properties of Matter, Books & Allied (P) Ltd., 2001.
5. D. Halliday, R.Resnick and J.Walker, Fundamentals of Physics, 6th Edition, Wiley, NY, 2001.
6. Gour R.K. and Gupta S.L. – "Engineering Physics". Dhanpat Rai Publications, New Delhi, 2002.

14PH2003 PHYSICS FOR ELECTRICAL ENGINEERING SCIENCES

Credits : 3:0:0

Course Objective:

- To know about the Basic laws of Physics
- To learn about the principles of Electricity and magnetism

Course Outcome:

- Better understanding of theory of electricity and magnetism
- Able to select materials for different applications

- Demonstrate the properties of materials through working models

Course Description :
Electrostatic potential and field due to discrete and continuous charge distributions. Dipole and quadrapole moments. Energy density in an electric field. Dielectric polarization. Conductors and capacitors. Electric displacement vector, dielectric Susceptibility, Biot-Savart's law and Ampere's law in magnetostatics. Magnetic induction due to configurations of current-carrying conductors. Magnetization and surface currents. Energy density in a magnetic field. Magnetic permeability and susceptibility. Force on a charged particle in electric and magnetic fields. Time-varying fields. Faraday's law of electromagnetic induction. Self and mutual inductance. Resonance and oscillations in electrical circuits. Displacement current. Maxwell's equations in free space and in linear media. Scalar and vector potentials, gauges. Plane electromagnetic waves. Electromagnetic energy density, Poynting vector. Wave guides.

Reference Books
1. Raymond A. Serway and Robert J. Beichner's Physics: for Scientists and Engineers, 5th edition. 2000
2. D. Halliday, R.Resnick and J.Walker, Fundamentals of Physics, 6th Edition, by Wiley, NY, 2001
3. H.Young, A. Freedman, University Physics , Addison-Wesley, 2000
4. Brij Lal, N.Subramanyam , Electricity and Magnetism, S. Chand &. Co., 2005.
5. Randall D. Knight, Physics for Scientists and Engineers A Strategic Approach, Volume 4: Pearson/ Addison Wesley, 2004.
6. A.Marikani, Engineering Physics, PHI learning Private Limited, 2009

14PH2004 PHYSICS FOR BIOTECHNOLOGY

Credits : 3:0:0

Course Objective:
- To impart knowledge on crystal structure and lattice
- To learn the Physics principles in medical imaging techniques
- To learn the principles of fiber endoscopy and laser assisted surgery.

Course outcome:
- Able to gain knowledge about the crystal structures and radiotheraphy.
- Able to apply the techniques in treatments of tumours and medical imaging

Course Description:
Lattice , Basis, and crystal systems, Bravais lattices, Crystal planes and miller indices, Medical imaging techniques, Magnetic Resonance Imaging, Nuclear Magnetic Resonance image analysis, Ultrasound Theory, Echo sound and echo cardiograph, Theory of nuclear medicine and radiotherapy, Targeted delivery techniques, dosimetry and radiation safety measures, Optical microscope and electron microscope, fiber optic endoscopy, Laser medical applications, treatment of tumours, treatment of retina.

Reference Books
1. Mukherjee,K.L., Medical Laboratory Technology-A procedure manual for routine diagnostic tests Volume 1,2,3, Tata McGraw Hill Publishing Company Ltd.
2. Godkar,P B., Textbook of Medical Laboratory Technology, 2 Edition.,Bhalani Publishing House, 2006
3. John Bernard Henry,(2001), Clinical Diagnosis and Management by Laboratory Methods ,20th Edition.,Saunders.
4. M. A. Flower (Editor), Webb's Physics of Medical Imaging. CRC Press, Taylor & Francis Group, 2012. ISBN: 978-0-7503-0573-0
5. William R. Hendee, E. Russell Ritenour, Medical Imaging Physics, John Wiley & Sons, 2003
6. A.Marikani, Engineering Physics, PHI learning Private Limited, 2009

14PH2005 PHYSICS FOR MEDIA

Credits : 3:0:0

Course Objective:

- To gain knowledge on lens system and photometry
- To understand the concept colour theory and aberrations
- To gain knowledge on sound waves and its properties
- To understand the basic concepts of signal processing

Course Outcome:

- Demonstrate the knowledge on sound, light and signals

Course Description:

Basic lens system, Measurement of light, Photometry and colour theory, mixing of colours, Rayleigh's criterion of resolution, resolving power of grating, prism and telescope, microscope

Theory of Aberrations and types, Sound waves, Theory of vibration and experimental verification, Reflection of sound in open and closed organ pipe, principle of resonators, characteristics of musical sound, measurement of reverberation .acoustics of building and their remedies, sound engineering.

Reference Books:

1. N.Subrahmanyam and Brij lal, A Text book of Optics, S.Chand & Co.ltd., New Delhi, 22nd edition, 2000
2. R.K. Gaur and S.L. Gupta, Engineering Physics, Dhanpat Rai Publications, 2006
3. SN Sen Wiley, Acousics Waves and oscillations, Eastern Limited, 1990
4. Lonnie C Lumens, Fundamentals of digital signal processing, John Wiley and sons,1987
5. Avadhanulu, M.N., Kshirsagar, P.G., A Text Book of Engineering Physics, S.Chand & Co. Ltd., New Delhi, 6th edition, 2003.
6. Li Tan, Jean Jiang Fundamentals of: Analog and Digital Signal Processing Author House, 2007
7. R. G. Lyones, Understanding digital signal processing, Addison Wesley 1997

14PH2006 MECHANICS & PROPERTIES OF MATTER

Credits: 3:0:0

Course Objective:

- To know about the Basic laws of Physics
- To learn about the properties of matter in different conditions
- To understand elasticity and moment of inertia

Course Outcome:

- Better understanding of mechanics and properties of matter of materials
- Able to select materials for different applications
- Demonstrate the properties of materials through working models

Course Description:

Kepler's law, Newton's law, Experimental methods and applications, Earth quakes and Seismographs, Theory of Projectiles, Laws of impact, impulse, Coefficient of restitution Elastic and inelastic collision, , direct and oblique impact, velocity and kinetic energy on impact, Laws of kinetic energy, relative masses of colliding bodies, Theory of elasticity and experimental methods, Moment of inertia and its applications, Theory and applications of bending of beams, Torsional pendulum, cantilever, Flow of liquids, Coefficient of viscosity, Critical velocity, poiseuillie's equation of flow of liquids, stokes method ,surface tension, definition, angle of contact, rise of liquid in capillary tube.

Reference Books:

1. Murugeshan. R., Properties of Matter , S. Chand & Co Pvt. Ltd., New Delhi. 2007.

2. Gulati H.R., Fundamentals of General Properties of Matter, R. Chand & Co., New Delhi, 1982.
3. Subrahmanyam N. & Brij Lal, Waves & Oscillations, Vikas Publishing House Pvt. Ltd., New Delhi, 1994..
4. P.K. Chakrabarthy, Mechanics and General Properties of Matter, Books & Allied (P) Ltd., 2001.
5. D. Halliday, R.Resnick and J.Walker, Fundamentals of Physics, 6th Edition, Wiley, NY, 2001.
6. D. Halliday, R.Resnick and K.S. Krane, Physics, 4th Edition, VoIs. I, II & II Extended Wiley, NY, 1994.
7. Mathur D.S., Elements of Properties of Matter, Shyamlal Charitable Trust, New Delhi, 2008.
8. Brij Lal & Subramaniam. N, Properties of Matter, S.Chand & Co., New Delhi, 2005.

14PH2007 HEAT AND THERMODYNAMICS

Credits: 3:0:0

Course Objective:

- To learn about the different laws in thermodynamics
- To know the basic principles of statistical mechanics
- To learn the application of thermodynamics of a wide variety of physical systems

Course Outcome:

- Acquiring skills on the basic principles of thermodynamics & statistical mechanics
- Apply the principles of thermodynamics for real time systems
- Demonstrate the thermodynamic principles through experimental models

Course Description:

Laws of Thermodynamics**,** Entropy, change in entropy in adiabatic and reversible cycles Statistical basis of thermodynamics, probability and frequency, permutation and combination, macrostate and microstate, Fundamental postulates of statistical mechanics and their basic laws, Universal law in statistical mechanics, application to one dimensional harmonic operator, statistical ensemble, Basic theories of Phase transitions in statistical mechanics**,** Quantum statistics.

Reference Books:

1. B. K. Agarwal and M. Einsner, Statistical Mechanics, John Wiley & Sons,1988
2. John M. Seddon , Julian D. Gale, Thermodynamics and statistical mechanics, 2001
3. Federick Reif, Fundamentals of Statistical and Thermal Physics, McGraw- Hill,1985
4. Brijlal, N.Subramanyam, P.S.Hemne, Heat thermodynamics and statistical physics, S.Chand & Co. Ltd, 2007
5. M.C. Gupta, Statistical Thermodynamics, Wiley Eastern Ltd, 1990
6. J.B.Rajam and C.L.Arora, Heat and Thermodynamics, S. Chand & Co. Ltd, 1972

14PH2008 ELECTRICITY AND MAGNETISM

Credits: 3:0:0

Course Objective:

- To develop a basic understanding of electric and magnetic fields in free space using the integral forms of Maxwell's laws.
- To learn electrostatic properties of simple charge distributions using Coulomb's law, Gauss's law and electric potential.
- To understand the concepts of electric field , potential for stationary charges

Course Outcome:

- Able to demonstrate an understanding of the electric field and potential, and related concepts, for stationary charges.
- Demonstrate an understanding of the magnetic field for steady currents and moving charges.
- Apply the principles in developing Circuits for devices

Course Description:
Laws and fundamental theory of Charged Particles and Electric Fields, Electrostatic Fields and Gauss's Law, Electric Potential, Ohm's Law and Direct Current Circuits, Magnetostatics, Biot- savart's law, differential equation of magnetostatics and ampere's law, Magnetic moment, magnetic scalar potential, macroscopic magnetisation, Magnetic Forces and Fields, Theory of Magnetic Fields and Electromagnetic Induction, working principle of dynamo, theory of transformers and its types.

Reference Books :

1. Raymond A. Serway and Robert J. Beichner's Physics: for Scientists and Engineers, 5th Edition. 2000.
2. D. Halliday, R.Resnick and J.Walker, Fundamentals of Physics, 6th Edition, by Wiley, NY, 2001.
3. H.Young, A. Freedman, University Physics , Addison-Wesley, 2000.
4. Brij Lal, N.Subramanyam , Electricity and Magnetism, S. Chand &. Co., 2005.
5. Randall D. Knight, Physics for Scientists and Engineers: A Strategic Approach, Volume 4: Pearson/Addison Wesley, 2004.

14PH2009 OPTICS

Credits: 3:0:0

Course Objective:
- To impart basic knowledge pertaining to optics
- To learn the theoretical aspects of light
- To study the properties of waves and working principles of the optical instruments

Course Outcome:
Able to
- understand the basic properties of light wave and the principle optical instruments
- apply the knowledge on optics on designing various optical instruments.
- Demonstrate the optics principles in developing an optical device

Course Description:
Basic principles of Geometrical Optics, Superposition of waves, Theory of polarization, Brewster's law, Double refraction, Elliptically and circularly polarized light, Quarter wave plates and Half wave plates, Theory of Interference , Young's experiment, Phase difference and path difference, Newton's rings , principle and working of Michelson Interferometer, Theory of diffraction, diffraction due to a narrow slit, Fraunhofer diffraction, resolving power of microscope and telescope, Applications.

Reference books

1. M N Avadhanulu & P G Kshirsagar, A Text book of Engineering Physics, 8th edition, 2006
2. N. Subrahmanyam and Brijlal, Textbook of optics, chand publications ,1985
3. Eugene Hecht and A. R. Ganesan, Optics: Dorling Kindersely (India), 2008
4. A. K. Ghatak, Optics: Tata McGraw Hill, (2008)
5. Charles A. Bennett, Principles of Physical Optics, Wiley, 2008

14PH2010 VACUUM AND THIN FILM TECHNOLOGY

Credits: 3:0:0

Course Objective:
- To introduce students to the theory and use of high vacuum systems as well as thin film deposition process
- To study the physical behavior of gases and the technology of vacuum systems including system operation and design.
- To learn the Thin film deposition process, characterization techniques and applications

Course Outcome:

- Able to apply the knowledge of thin film coating techniques to prepare thin film devices.
- Able to understand the application of thin film technologies in fabricating optical coatings such as mirror, antireflective, and dielectric filter coatings
- Apply the characterization techniques in analyzing the material properties

Course Description:

The concept of vacuum, degrees of vacuum, Gas pressure, unit of measurements, Types of vacuum pumps, pumping mechanisms, direct pressure measurement, indirect pressure measurement, Thin film deposition mechanisms, Classification of thin film coating techniques and instrumentation, Thin film growth process, Evaporation, Deposition, Diffusion, Nucleation, Thin film characterization techniques. Structural, Optical, Electrical and morphology analysis of thin films. Application of thin films in electronic device fabrications.

Reference Books:

1. John F. O' Hanlon, An user's guide to Vacuum Technology, 3rd Edition., John Wiley & Sons Inc, 2003.
2. Austin Chambers, Chapman & Hall, Modern Vacuum Physics, CRC, Taylor and Francis, London, 2005, ISBN No: 0-8493-2438-6.
3. Krishna Seshan, Hand book of thin film deposition processes & technologies, Noyes publications/William Andrew publishing, 2nd Edition., 2002.
4. Milton Ohring, The materials Science of thin films, Academic Press, 1992, ISBN No: 0-12-524990-x.
5. L.B. Freund & S. Suresh, Thin film materials – stress, defect formation & surface evolution, Cambridge University Press, 2003, ISBN No: 0-521-822815.
6. K.L Chopra, Thin film Device Applications, Plenum Press, NY, 1983
7. L. N. Rozanov, Vacuum Technique, Taylor and Francis, London, 2002, ISBN No: 0-415-27351-x.
8. Donald L. Smith, Thin film deposition Principles & Practice, McGraw Hill, 1995, ISBN No: 0-07-058502-4.

14PH2011 SEMICONDUCTOR PHYSICS

Credits: 3:0:0

Course Objective:

- To introduce students to the theory of semiconductors and its characteristics.
- To study the physical behavior of semiconductors and the technology of integrated circuit fabrication.
- To learn the IC fabrication techniques for designing different electronic devices.

Course Outcome:

- Able to apply the knowledge of semiconductor physics to prepare electronic devices.
- Able to understand the application of semiconductor theory in fabricating integrated circuits.
- Apply the IC fabrication techniques for large scale applications

Course Description:

Electron arrangement in atoms, conduction in metals, semiconductors, energy band pictures, intrinsic and extrinsic semiconductors, semiconductor junction characteristics, forward and reverse bias, diode characteristics, Fermi energy, Hall effect, continuity equation, Fabrication of ICs, Basic monolithic integrated circuit technology, Epitaxial growth, photolithography, thin film resistors, transistors and capacitors, diodes, integrated field effect transistor, LSI, MSI and VLSI, MOS technology.

Reference Books:

1. Jacob Millman, Christos C Halkias, Millman's Electronics Devices and Circuits, Satyabrata , Tata McGraw-HillPublishing Company Pvt. Ltd. 2008
2. Millmaan. J. and Halkias C.C, Integrated Electronics, McGraw Hill, 2004
3. Allen Mottershead, Electronic Devices and Circuits, Prentice Hall of India, 2009
4. Malvino and Leach, Digital Principles and Applications, Tata McGraw Hill,Co. 2008.
5. V.K.Metha, Rohit Metha, Principles of Electronics, 2006

14PH2012 SPECTROSCOPY

Credits 3:0:0

Course Objective:

- To learn how these spectroscopic techniques are used in atomic and molecular structure determination
- To understand the principles and the theoretical framework of different Spectroscopic
- techniques
- To know the instrumental methods of different spectroscopic techniques

Course Outcome:

- Students can understand how spectroscopic studies in different regions of the spectrum probe different types of molecular transitions

Course Description:

Bragg's Law, X- ray diffraction , Zeeman, , Stark effect- Hyperfine structure -Photoelectron spectroscopy- UV-Visible spectrophotometer theory and instrumentation, analysis of absorption and transmission spectrum. Infra red spectroscopy, vibration spectrum of carbon monoxide, IR spectrophotometer, Instrumentation, FTIR and analysis of molecular interaction, Raman effect, polarization of light, Laser Ramam spectrophotometer, theory, instrumentation and applications.

Reference Books:

1. C. N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, Tata McGraw-Hill Publishing Company Ltd. 4^{th}Edition (2010)
2. J.M.Hollas, Modern Spectroscopy, John Wiley, (2004)
3. G. Aruldhas, Molecular Structure and Spectroscopy, Prentice - Hall of India Pvt. Ltd., New Delhi, (2008)
4. B. P Straughan and S.D Walker, Spectroscopy Vol I, II, III, Chapman and Hall, 1976
5. G. Herzberg Van Nostrand, Molecular Spectra and Molecular Structure, 1950
6. Harvey Elliot White, Introduction to Atomic Spectra, McGraw-Hill, 1934

14PH2013 ELECTROMAGNETIC THEORY

Credits 3:0:0

Course Objective:

- To learn the basics of electricity and magnetism and equations governing them.
- To acquire knowledge of fundamentals of magnetism
- To know the Maxwell's equations
- To learn about the electromagnetic waves.

Course outcome:

- Students apply the fundamental concept of electricity and magnetism in day to day life and solve problems in physics

Course Description:

Electric field, Gauss Law, Scalar potential , Poisson's equation, Green's Theorem, electrostatic potential energy and energy density, displacement vector, Biot and Savart law , Ampere's law, The magnetic vector and scalar potential, Macroscopic magnetization , Magnetic field, Electromagnetic induction – Faraday's law – Maxwell's equations , Displacement current, Vector and Scalar potentials , Gauge transformation, Lorentz gauge, Columb's gauge, Gauge invariance , Poynting's theorem, Radiation from an oscillating dipole , Radiation from a half wave antenna , Radiation damping , Thomson cross section , Lienard – Wiechert Potentials , The field of a uniformly moving point charge.

Reference Books

1. E. C. Jordan, K. G Balmain, Electromagnetic Waves and Radiating Systems, PHI Learning Pvt. Ltd., 2008

2. W. H. Hayt, J. A., Buck, Engineering Electromagnetics, Tata McGraw-Hill, 2011
3. J. D. Jackson, Classical Electrodynamics, John Wiley & Sons, 1998
4. John R. Reits, Fredrick J. Milford & Robert W. Christy. Foundations of Electro Magnetic Theory – Narosa Publishing House (1998)
5. B. B. Laud, Electromagnetics: New Age International 2nd Edition (2005)

14PH2014 SOLAR CELL AND ITS APPLICATIONS

Credits: 3:0:0

Course Objective:

- To impart knowledge of theory of photovoltaics
- To learn the history and development of solar cells
- To understand the Importance of carbon free energy sources

Course outcome:

- Able to learn mechanism of solar cells
- Able to understand the manufacturing process of thin film solar cell fabrication
- Able to apply thin film technique in solar cell fabrication.

Course description:

Solar cell fundamentals ,Classifications and manufacturing technologies, single- and multi-crystalline silicon, micromorph tandem cells, CdTe, CIGS, CPV, PVT), Next generation solar cells organics, biomimetic, organic/inorganic hybrid, and nanostructure-based solar cells. Solar cell performance, Efficiency of solar cells and solar simulatore Grid connected supply, cost, and the major hurdles in the technological, economic, and political — towards widespread substitution of fossil fuels.

Reference Books

1. Bube, R. H. *Photovoltaic Materials*. London, UK: Imperial College Press, 1998. ISBN: 9781860940651.
2. Green, M. A. *Solar Cells: Operating Principles, Technology and System Applications*. Upper Saddle River, NJ: Prentice Hall, 1981. ISBN: 9780138222703.
3. Wenham, S. R., M. A. Green, M. E. Watt, R. Corkish. *Applied Photovoltaics*. 2nd ed. New York, NY: Earthscan Publications Ltd., 2007. ISBN: 9781844074013.
4. Green, M. A. *Silicon Solar Cells: Advanced Principles and Practice*. Sydney, Australia: Centre for Photovoltaic Devices & Systems, 1995. ISBN: 9780733409943.
5. Aberle, A. G. *Crystalline Silicon Solar Cells - Advanced Surface Passivation & Analysis*. Sydney, Australia: University of New South Wales, 2004. ISBN: 9780733406454

14PH2015 PRINCIPLES OF MEDICAL DIAGNOSTIC TECHNIQUES

Credits: 3:0:0

Course Objective:

- To impart knowledge in Medical diagnostic techniques
- To learn the Physics principles in medical instrumentation
- To train the students to understand the principles of advanced equipments and the use of basic Medical diagnostic tools.

Course outcome:

- Able to Gain knowledge about the measurements and instrumentation techniques of some medical diagnostic techniques.
- Able to understand the Physics principles involved in diagnostic techniques and Instrumentation
- Able to apply the techniques in treatments like cancer and urology

Course Description:
Fundamentals and working principles of medical laboratory equipments, Medical imaging techniques, Medical Instrumentation analysis Magnetic Resonance Imaging, Theory of Digital signal Processing and its applications, Ultrasound, Theory Echo sound and echo cardiograph, X-ray Diffraction analysis and Instrumentation, Fundamental of Nuclear Radiation, Theory of nuclear medicine and radiotherapy, Targeted delivery techniques, dosimetry and radiation safety measures.

Reference Books

1. Mukherjee,K.L., Medical Laboratory Technology-A procedure manual for routine diagnostic tests Volume 1,2,3, Tata McGraw Hill Publishing Company ltd.
2. Godkar,P B.(2006), Textbook of Medical Laboratory Technology, ,2 Ed.,Bhalani Publishing House.
3. John Bernard Henry,(2001), Clinical Diagnosis and Management by Laboratory Methods ,20th Ed.,Saunders.
4. M. A. Flower (Editor), Webb's Physics of Medical Imaging. CRC Press, Taylor & Francis Group, 2012. ISBN: 978-0-7503-0573-0
5. William R. Hendee, E. Russell Ritenour, Medical Imaging Physics, John Wiley & Sons, 2003

14PH2016 THIN FILM TECHNOLOGY FOR ENGINEERS

Credits: 3:0:0

Course Objective:
- To gain knowledge on vacuum systems
- To learn about various coating techniques
- To learn about the various characterization techniques of thin films
- To gain knowledge on application of thin films

Course outcome:
- Able to apply the knowledge of thin film coating techniques to prepare thin film devices.
- Able to understand the application of thin film technologies in fabricating optical coatings such as mirror, antireflective, and dielectric filter coatings
- Apply the characterization techniques in analyzing the material properties

Course Description:
The concept of vacuum, degrees of vacuum, Gas pressure, unit of measurements, Types of vacuum pumps, pumping mechanisms, direct pressure measurement, indirect pressure measurement Thin film coating techniques, physical and chemical methods of thin film preparation, thin film growth process, growth monitoring and morphology, structural, optical and electrical studies on thin films and instrumentation, application of thin films in VLSI , Sensors, MEMS and NEMS.

Reference Books:

1. Alfred Wagendristel, Yuming, Yu-ming Wang, An Introduction to Physics and Technology of Thin Films, World Scientific, 1994
2. Krishna Seshan, Handbook of Thin-film Deposition Processes and Techniques: Principles, Methods Equipment and Applications, William Andrew Inc., 2002
3. L.I.Maissel and R.Glang, Handbook of thin film technology, McGraw Hill Book Company, New York, 1983.
4. Kasturi L. Chopra, R. E., Thin Film Phenomena, Krieger Pub. Co., 1979
5. Goswami, Thin Film Fundamentals, New Age International Ltd, 2003
6. Donald L. Smith, Thin-film deposition: principles and practice, McGraw-Hill Professional, 1995

14PH2017 ASTROPHYSICS

Credits: 3:0:0

Course Objective:

- To provide with a fundamental Understanding about the stars and their properties
- To give an overview of the giant scale structure of the universe such as galaxy and clusters of galaxies
- To know about the origin and fate of the universe

Course outcome:

- Able to have knowledge of the instruments used to explore the cosmos.
- Able to demonstrate the mechanisms of different telescopes.
- Able to apply the concepts of astrophysics in identifying new stars and comets.

Course Description:

Introduction to Solar systems and various models, Laws of planetary motions, the formation of stars and planets , the properties of stars, types and distant measurements, concept of black holes and supernovas, theory of telescope and detectors, new generation optical telescopes, The milkyway, galaxy, different types of galaxies, the cosmological distant scale, The Universe, Cosmological models,the standard Big bang theory, big bounce theory and the life in the universe.

Reference Books

1. Michael Zeilik, Stephen. A.Gregory, Introductory Astronomy and Astrophysics, Fourth Edition, Saunders College Pub., Michigan, U.S.A, 1998 ISBN 9780030062285
2. A. B. Bhattacharya, S. Joardar, R. Bhattacharya, Astronomy and Astrophysics, Jones and Barlett Publishers, U.S.A., (2010) ISBN 978-1-934015-05-6
3. Martin V. Zombeck, Book of astronomy and Astrophysics, Cambridge University Press, U.K. (2007) ISBN 978-0-521-78242-5
4. Thanu Padmanabhan, Theoretical Astrophysics (Vol. I, II, II): Cambridge University Press, U.S.A., (2002) ISBN 0 521 56242 2
5. Wolfgang Kundt, Astrophysics: A new approach, Second edition, Springer, 2006

14PH2018 RENEWABLE ENERGY SOURCES

Credits 3:0:0

Course Objective:

- To give an overview of the energy problem faced by the current generation
- To highlight the limitations of conventional energy sources that affect the climate
- To underline the importance of renewable energy sources
- To give a thorough knowledge about various renewable energy technology and to give a glimpse of cutting edge research technology that is happening place in the field of renewable energy sources.

Course Outcome :

- The students will understand the problems of conventional energy sources. They will
- realize the importance of renewable energy sources and try to find solutions to nonconventional
- energy sources by research.

Course Description:

Classification of Energy Sources, Fossil Fuels and Climate Change issues, Advantages and Limitations of Renewable Energy sources, Solar radiation at the Earth's Surface – Solar Radiation Measurements, Solar Cell, Solar Energy Collectors, Flat-plate Collectors, Concentrating Collector, Focusing Type, Solar Energy Storage, Applications of Solar Energy, Solar Water Heating, Solar Pumping, Solar Furnace, Solar Cooking , Wind Energy Technology, Aerodynamics , Wind Energy Conversion, Classification of WECS, Wind Energy Collectors, Wind Energy Storage, Applications of Wind Energy, Bio Fuels, Bio mass Resources, Classification of Bio-gas plants, Materials Used For Bio-gas generation, Ocean Thermal Energy Conversion , Fuel Cells and Batteries , Hydrogen Energy , Micro Hydel Powers.

Reference Books

1. G.D. Rai, Non-Conventional Energy Sources, Standard Publishers Distributors, ISBN 9788186308295 (2004)
2. B.H.Khan, Non-Conventional Energy Sources, Tata McGraw Hill (2006) ISBN 0- 07- 060654-4
3. Godfrey Boyle, Renewable Energy, Oxford University Press in association with the Open University, (2004), ISBN 9780199261789
4. Thomas B. Johansson, Laurie Burnham, Renewable energy: sources for fuels and electricity, Island Press, (1993), ISBN 9781559631389
5. Thomas Bührke, Renewable energy: sustainable energy concepts for the future, Roland Wengenmayr, Wiley-VCH, (2008), ISBN 9783527408047
6. Anne Maczulak, Renewable Energy: Sources and Methods, Infobase Publishing, (2009), ISBN 9780816072033

14PH2019 CONDENSED MATTER PHYSICS

Credits: 3:0:0

Course Objective:

- To gain knowledge on band theory of solids
- To understand theoretical aspects of dielectric, magnetic and optical properties of solids
- To gain knowledge on the principle of super conductivity

Course Outcome:

- Able to comprehend the properties of solid through the basic crystal theories.
- Able to Demonstrate Magnetic properties of different materials
- Able to Apply the Properties of solid in developing new materials

Course Description

Theory of Lattice vibrations, elastic vibration, localized vibration, , Phonon- Phonon interaction, band theory of solids, Different types of polarization and its theory, dielectric properties, ferroelectric theory and properties, Theory of para, ferro and anti-ferro magnetism, point defects in crystals, color centers, electronic transitions in photoconductors, Thermo luminescence , electroluminescence, theory of superconductivity, Meissner effect, B.C.S theory, A.C and D.C Josephson's effect, Applications.

Reference Books

1. S.O. Pillai, Solid State Physics, New Age Publications, 2002
2. M. Ali Omar, Elementary Solid State Physics, Pearson Education, 2004
3. Kittel, Introduction to Solid State Physics, John wiley, 8th edition,2004
4. S.M.Sze, Physics of semiconductor devices, 2007
5. Chihiro Hamaguchi, Basic Semiconductor Physics, 2nd Edition 2001
6. Kwok Kwok Ng, Complete guide to semiconductor devices, 2nd Edition 2002
7. Philip Philips, Advanced Solid State Physics, Cambridge University Press, 2012

14PH2020 NUCLEAR ENERGY FOR SUSTAINABLE DEVELOPMENT

Credits 3:0:0

Course Objective:

- To give an overview of the energy problem faced by the current generation
- To highlight the limitations of conventional energy sources that affect the climate
- To underline the importance of renewable energy sources

- To give a thorough knowledge about various renewable energy technology and to give a glimpse of cutting edge research technology that is happening place in the field of renewable energy sources.

Course Outcome :

- The students will understand the problems of conventional energy sources. They will realize the importance of renewable energy sources and try to find solutions to nonconventional energy sources by research.

Course Description:

Nuclear basics, Atoms, electrons, nuclei, Fundamental forces, Nuclear characteristics, Static properties, Dynamic properties , Energy scenario in the world and in India, Growth trends and future prospects, Limitations of various energy resources, Enviromental Impacts, Importance of nuclear energy in the current energy mix, Various types of nuclear reactors, Nuclear Fuel Cycle ,Three stage Indian nuclear power programme, Growth, challenges and opportunities, The future of Indian nuclear power programme, Nuclear energy for sustainable growth.

Reference Books

1. J. Suppes and Truman S. Storvick (Eds.), Sustainable Nuclear Power, Galen Elsevier Science (technical) (2006), ISBN: 978-0-12-370602-7
2. S N Ghoshal , Nuclear Physics, S.Chand Publishing (2013), ISBN 13 – 9788121904131
3. M V Ramana, The Power of Promise (Examining Nuclear Energy in India), Penguin Books Ltd (2012) ISBN: 9788184755596
4. Ian Hore-Lacy, Nuclear Energy in the 21st Century, Elsevier Science (2010), ISBN: 9780080497532
5. Raymond Murray, Keith E. Holbert, Raymond L. Murray, Nuclear Energy, Elsevier Science (2008), ISBN: 9780080919447

14PH2021 LASERS AND FIBER OPTICS

Credits: 3:0:0

Course Objective:

- To give a comprehensive overview of laser theory, laser engineering, types of laser and associated equipment, with an emphasis on practical system design.
- To learn techniques for characterisation, measurement and control of laser output.
- To illustrate the state of the art of laser technology via applications of lasers in industry and research

Course Outcome:

- Able to comprehend the laser principle and its applications.
- Able to understand the classification of lasers and its efficiency
- Able to demonstrate lasers in industrial applications

Course Description:

Power source for Continuous wave and pulsed lasers: Energy transfer in solid state laser systems, ion laser systems, molecular lasers, organic dyes and liquid dye lasers. Semiconductor lasers, Excimer lasers and metal vapour lasers, Optics for lasers, damage in optical components. Laser instrumentation and applications. Applications of Lasers in Medical field .Principle and theory of Holography, Construction and Reconstruction of Holograms, Theory and working principle of holographic interferometer. Classification of fibers, propagation of light through fiber, fiber losses, industrial applications of fibers, fibers in medical applications.

Reference Books:

1. Ready, J.F., Industrial Applications of Lasers, Academic Press, 2nd Edition, 2000.
2. Charschan, S.S.,Van Nostrand, Lasers in Industry, 2001.
3. C.Breck Hitz, J.J.Ewing, Jeff Hecht, Introduction to laser technology, John wiley & Sons, New Jersey, 2012
4. Colin Webb, Julian Jones, Handbook of Laser Technology & Applications, IOP publishing Limited, 2004
5. Lan Xinju, Laser Technology, Second Edition, CRC press, 2010.
6. K.Thyagarajan, D.Ajoy Ghatak, Lasers Fundamental and Applications, Second edition, Springer , New York, 2010

7. Anuradha D, Optical fibre laser: Principles and applications, New Age International, 2003.

14PH2022 NANO PHYSICS LAB

Credits: 0:0:2

Course Objective:

- To get practical skill on various deposition techniques to prepare thin films and grow Crystals having nanostructures
- To get practical training on some basic characterization techniques of nanostructure thin films and crystals
- To learn the process of preparing the nanomaterials through different techniques

Course Outcome:

- Able to understand and hands on training on different nanomaterial preparation techniques.
- Able to operate the sophisticated nanomaterial preparation equipments
- To apply the practical knowledge to fabricate novel nano devices to solve research problems

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14PH3001 NANOPHOTONICS

Credits: 3:0:0

Course Objective:

- To impart knowledge on the photonics in nanoscale structures
- To learn the properties of light in nano optics.
- To Study the Light –matter interactions

Course Outcome:

- Able to demonstrate the light interaction in different nanoscale systems.
- Can apply the concept in developing Nanooptical devices
- Able to demonstrate the Nonophotonics concepts in laser developments

Course Description

EM wave review, Review of Maxwell equations, Near fields and far fields, Concept of photons, and a brief review of other quantisation of energy, plasmons and phonons, Light generation by nanostructures, light propagation by nanostructures, Light-matter interaction, Surface effects, Surface EM wave, Surface polaritons, Size dependence Quantum wells, wires, and dots, Nanophotonics in microscopy, Nanophotonics in plasmonics, Dispersion engineering, Material dispersion, Waveguide dispersion (photonic crystals).

Reference Books :

1. P. N. Prasad, Nanophotonics, Wiley (2004).
2. M. Di Ventra et al., Introduction to Nanoscale Science and Technology, Springer (2004).
3. S. Kawata, Near-Field Optics and Surface Plasmon Polaritons, Springer (2001).
4. K. Sadoka, Optical Properties of Photonic Crystals, Springer-Verlag (2004)
5. John D. Joannopoulos, Steven G. Johnson, Joshua N. Winn & Robert D. Meade, Photonic Crystals: Molding the Flow of Light, Second Edition,
6. Lukas Novotny , "Principles of Nano-Optics" , Cambridge University Press, 2006
7. Mark L. Brongersma, Mark L. Brongersma, Pieter G. Kik, "Surface Plasmon Nanophotonics" Springer, 2010

14PH3002 QUANTUM MECHANICS

Credits: 3:0:0

Course Objective:

- To understand quantum theory and to learn about the formulation of quantum mechanics
- To learn about the solutions of Schrödinger equations in one dimensional problems
- To gain knowledge on the approximation methods used for solving stationary states problems

Course outcome:

- Able to execute the use of quantum theory to various problems in atomic Scale
- Able to Understand the behavior of micro systems with boundary conditions
- Able to apply the Quantum concepts in nano technology

Course Description:

Basic concepts of quantum theory, Matter waves- De Broglie wave theory–De Broglie wavelength of electrons. Experimental verification of matter waves- Davisson and Germer experiment, G.P.Thomson's experiment, Schrodinger wave equations, Applications of Schrodinger wave equations, Formulation of Quantum mechanics, Eigenvales and Eigenfunctions, Dirac's Bra and Ket notations, Theory of angular momentum, Clebch – Gordon Co-efficients, Perturbation theories (Time dependant and time Independent) and its applications.

Reference Books

1. P.M. Mathews and Venkatesan, A text book of Quantum Mechanics –Tata McGraw-hill, Ist edition (2005)
2. K. Ghatak and Lokanathan,Basic Quantum Mechanics, Mc Millan,2006
3. Gupta Kumar Sharma, Quantum mechanics, Jai Prakash Nath & Co -2007
4. G. Aruldhas, Quantum mechanics, PH Learning Pvt. Lmt. – 2008
5. Jolly. D, Advanced Quantum Theory and Fields, Sarup & Sons, New Delhi, 2006
6. Leonard I. Schiff, Quantum Mechanics, McGraw Hill Book Company, 1968
7. Stephen Gasiorowicz, Quantum Mechanics, 3rd Edition, Pushp, Print Services, New Delhi, 2005

14PH3003 SOLID STATE PHYSICS

Credits: 3:0:0

Course Objective:

- To gain knowledge on band theory of solids
- To understand theoretical aspects of dielectric, magnetic and optical properties of solids
- To gain knowledge on the principle of super conductivity

Course Outcome:

- Able to comprehend the properties of solid through the basic crystal theories.
- Able to Demonstrate Magnetic properties of different materials
- Able to Apply the Properties of solid in developing new materials

Course Description

Theory of Lattice vibrations, elastic vibration, localized vibration, , Phonon- Phonon interaction, band theory of solids, Different types of polarization and its theory, dielectric properties, ferroelectric theory and properties, Theory of para, ferro and anti-ferro magnetism, point defects in crystals, color centers, electronic transitions in photoconductors, Thermo luminescence , electroluminescence, theory of superconductivity, Meissner effect, B.C.S theory, A.C and D.C Josephson's effect, Applications.

Reference Books

1. S.O. Pillai, Solid State Physics, New Age Publications, 2002
2. M. Ali Omar, Elementary Solid State Physics, Pearson Education, 2004
3. Kittel, Introduction to Solid State Physics, John wiley, 8th edition,2004
4. S.M.Sze, Physics of semiconductor devices, 2007

5. Chihiro Hamaguchi, Basic Semiconductor Physics, 2nd Edition 2001
6. Kwok Kwok Ng, Complete guide to semiconductor devices, 2nd Edition 2002
7. Philip Philips, Advanced Solid State Physics, Cambridge University Press, 2012

14PH3004 LASER TECHNOLOGY

Credits: 3:0:0

Course Objective:

- To give a comprehensive overview of laser theory, laser engineering, types of laser and associated equipment, with an emphasis on practical system design.
- To learn techniques for characterisation, measurement and control of laser output.
- To illustrate the state of the art of laser technology via applications of lasers in industry and research

Course Outcome:

- Able to comprehend the laser principle and its applications.
- Able to understand the classification of lasers and its efficiency
- Able to demonstrate lasers in industrial applications

Course Description:

Power source for Continuous wave and pulsed lasers: Energy transfer in solid state laser systems, ion laser systems, molecular lasers, organic dyes and liquid dye lasers. Semiconductor lasers, Excimer lasers and metal vapour lasers, Optics for lasers, damage in optical components. Laser instrumentation and applications. Applications of Lasers in Medical field .Principle and theory of Holography, Construction and Reconstruction of Holograms, Theory and working principle of holographic interferometer.

Reference Books:

1. Ready, J.F., Industrial Applications of Lasers, Academic Press, 2nd Edition, 2000.
2. Charschan, S.S.,Van Nostrand, Lasers in Industry, 2001.
3. C.Breck Hitz, J.J.Ewing, Jeff Hecht, Introduction to laser technology, John wiley & Sons, New Jersey, 2012
4. Colin Webb, Julian Jones, Handbook of Laser Technology & Applications, IOP publishing Limited, 2004
5. Lan Xinju, Laser Technology, Second Edition, CRC press, 2010.
6. K.Thyagarajan, D.Ajoy Ghatak, Lasers Fundamental and Applications, Second edition, Springer , New York, 2010
7. Anuradha D, Optical fibre laser: Principles and applications, New Age International, 2003.

14PH3005 THIN FILM LAB

Credits: 0:0:2

Course Objective:

- To get practical skill on various deposition techniques to prepare thin films.
- To get practical training on some basic characterization techniques of nanostructure thin films
- To learn the process of preparing the nanomaterials through different techniques

Course Outcome:

- Able to prepare thin films for fabrication of devices like diodes, transistors and Solar cells.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14PH3006 THERMODYNAMICS AND QUANTUM MECHANICS FOR NANOSCALE SYSTEMS

Credits: 3:0:0

Course Objective:
- To learn and understand basic and advanced concepts of thermodynamics, statistical mechanics and quantum mechanics in the perspective nanoscale systems.

Course Outcome:
- The students should be able to understand the basic and advanced concepts to analyze the nanoscale systems

Course Description:
Laws of Thermodynamics , Thermodynamic potentials and the reciprocity relations , Maxwell's , Gibb's – Helmholtz relation, Thermodynamic equilibrium , Chemical potential, Statistical Description of Systems of Particles Statistical formulation of the state , Ensemble , Equation of motion and Liouville theorem, Statistical equilibrium ,Review of classical mechanics , de Broglie's hypothesis , Heisenberg uncertainty principle , Pauli exclusion principle , Schrödinger's equation, properties of the wave function , Application, Electrical and magnetic properties ,One dimensional systems, Metallic nanowires and quantum conductance , dependence on chirality , Quantum dots, Two dimensional systems , Quantum wells and modulation doping , Resonant tunnelling , Magnetic properties Transport in a magnetic field, Quantum Hall effect, Spin valves, Spin-tunnelling junctions , Domain pinning at constricted geometries , Magnetic vortices , Mechanical properties, Individual nanostructures , Bulk nanostructured materials, Ways of measuring, Optical properties, Two dimensional systems (quantum wells), Absorption spectra, Excitons , Coupled wells and superlattices, Quantum confined Stark effect.

Reference Books :

1. Federick Reif, Fundamentals of Statistical and Thermal Physics, Waveland press Inc, 2009
2. Bipin K. Agarwal and Melvin Eisner, Statistical Mechanics, New Age International (P) Ltd, 2005
3. M.C. Gupta, Statistical Thermodynamics, New Age International (P) Ltd, 2003
4. Charles P. Poole, Jr. and Frank J.Owens, Introduction to Nanotechnology, , Wiley, 2003
5. J.D. Plummer, M.D.Deal and P.B. Griffin, Silicon VLSI Technology, Prentice Hall, 2000
6. C.Kittel, Introduction to Solid State Physics, Wiley, 2004