

**DEPARTMENT  
OF PHYSICS**

## 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
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14PH2008	Electricity and Magnetism	3:0:0
14PH2009	Optics	3:0:0
14PH2010	Vacuum and Thin film Technology	3:0:0
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14PH2012	Spectroscopy	3:0:0
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14PH2015	Principles of medical diagnostic techniques	3:0:0
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14PH2020	Nuclear Energy for Sustainable development	3:0:0
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14PH2022	Nanophysics Lab	0:0:2
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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<sub>2</sub> 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, Cengage 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.Aruldas - Engineering Physics, PHI 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-Hill Publishing Company Pvt. Ltd. 2008
2. Millman. 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, poiseuille'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. Murugesan. 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 quadrupole 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, 5<sup>th</sup> edition. 2000
2. D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, 6<sup>th</sup> 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 radiotherapy.
- 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, 20<sup>th</sup> 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, 22<sup>nd</sup> 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, 6<sup>th</sup> 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, poiseuille's equation of flow of liquids, stokes method ,surface tension, definition, angle of contact, rise of liquid in capillary tube.

### Reference Books:

1. Murugesan. 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, Shyamal 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, 5<sup>th</sup> Edition. 2000.
2. D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, 6<sup>th</sup> 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, 8<sup>th</sup> 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, 3<sup>rd</sup> 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, 2<sup>nd</sup> 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<sup>th</sup> 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 2<sup>nd</sup> 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 simulators 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 ,20<sup>th</sup> 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, 2<sup>nd</sup> Edition 2001
6. Kwok Kwok Ng, Complete guide to semiconductor devices, 2<sup>nd</sup> 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, Environmental 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 21<sup>st</sup> 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, 2<sup>nd</sup> 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, Eigenvalues and Eigenfunctions, Dirac's Bra and Ket notations, Theory of angular momentum, Clebch – Gordon Coefficients, 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. Aruldas, 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, 3<sup>rd</sup> 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

## LIST OF SUBJECTS

<b>Sub. Code</b>	<b>Subject name</b>	<b>Credits</b>
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, PHI 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 force, 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 theorem,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, 3<sup>rd</sup> edition, 2006
2. Mathematical Physics – B.S.Rajput – PragatiPrakashan – Meerut, 17<sup>th</sup> 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.Arflen – 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 ( $\mu$ P) 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-Hill Publishing 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. Aruldas, 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, Kirchoff'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.Arffen – 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, 5<sup>th</sup> Edn. Tata McGraw-Hill Pub. Company Ltd. 2013
2. J.M.Hollas, Modern Spectroscopy; 4<sup>th</sup> Edition; John Wiley & Sons Ltd, 2004
3. G.Aruldas, 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, 2<sup>nd</sup> 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, 3<sup>rd</sup> Edition, John & Wiley Sons, Inc. 2014.
2. David J. Griffiths. Introduction to Electrodynamics, 3<sup>rd</sup> Edition, Prentice-Hall, 2012.
3. Ashok Das Lectures on Electromagnetism, 2<sup>nd</sup> Edition, World Scientific, 2013.
4. Mathew N.O. Sadiku, Principles of Electromagnetics, 4<sup>th</sup> Edition, Oxford University Press, 2010.
5. William Hayt and John A Buck, Engineering Electromagnetics, 8<sup>th</sup> Edition, Mc-Graw Hill, 2006.
6. Jordon and Balmain Electromagnetic waves and radiating systems, 2<sup>nd</sup> Edition, Prentice Hall, 2001.
7. David K Cheng, Fundamental of electromagnetic, 2<sup>nd</sup> 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 Aruldas, 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-empirical mass formula, Nuclear stability, Nuclear Models, Nuclear Forces, Ground state of Deuteron, 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 – Addison-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, Addison-wesley (1998)
5. S N Ghoshal, Nuclear Physics 1<sup>st</sup> Edition, S.Chand Publishing, 1994.
6. Irving Kaplan, Nuclear Physics 2<sup>nd</sup> Edition, Narosa Publishing House, 2002.
7. Kenneth S.Krane, Introductory Nuclear Physics 1<sup>st</sup> 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<sup>rd</sup> Edition, PHI Learning Pvt. Ltd- New Delhi, 2013.
10. Samuel S. M. Wong, Introductory Nuclear Physics 1<sup>st</sup> 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  $C_{2v}$ , and  $C_{3v}$ . 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, 5<sup>th</sup> Edn. Tata McGraw-Hill Pub. Company Ltd. 2013
2. Molecular Structure and Spectroscopy; G.Aruldas, 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; 3<sup>rd</sup> 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, Clausius-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. Haug, 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 Seshan William 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, Talyor 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, Thermoluminescent 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, Gaussian quadrature, solution of simultaneous equation, Gauss Jordan elimination method, Eigenvalue and eigenvectors by matrix diagonalization (Jacobian method), Application of numerical and statistical methods using C++ programming; Solving quadratic equations, solution of equation by Newton Raphson method, matrix diagonalization (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, Photoluminescence, light matter interaction, instrumentation, Electroluminescence, instrumentation, Applications, Thermogravimetric analysis (TGA), 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) Addison 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', Butterworths, 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 Tsoufanidis, 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 Structures, Structure - 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. Grzegorzczuk, 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-Haus effect; Gordon-Haus 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, Hertzsprung 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