ABDUL WALI KHAN UNIVERSITY MARDAN
DEPARTMENT OF PHYSICS
SCHEME OF STUDIES FOR BS 4-YEARS PROGRAM

FIRST YEAR

FIRST SEMESTER

Course Code	Course Title	Credit hours
Phy-301	Mechanics – I	3(2-1)
Phy-302	Waves and Oscillation	3(3-0)
Eng - 301	Functional English	3(3-0)
IS - 301	Islamic Studies	2(2-0)
Math - 321	Algebra	3(3-0)
PE-301	Foundation of Physical Education and Sports	3(3-0)
Total		**17**

Course Code	Course Title	Credit Hours
Phy-301	**MECHANICS-I**	3(2-1)

Objectives:

1. To give concept of vector and their various properties.
2. To give basic understanding of laws of motion and their applications is daily life.
3. To give mathematical concept and expressions of various physical parameters used in mechanics.

Vector Analysis:

Review of Vector in 3 dimensions and fundamental Operations, Direction, Cosines, Spherical polar coordinates, Cylindrical Coordinaties. Vector and scalar triple products, gradient of a scalar, Divergence and curl of a vector, Physical significance of each type, Divergence of a vector, flux, curl and line integral (mutual relation). Vector identities, Divergence Theorem, Stoke's Theorem, their derivation, physical importance and applications to specific cases

Particle Dynamics:

Dynamics of uniform, circular motion, the banked curve, Equations of motion, Deriving kinetic equations for x(t), v(t) via integration, Constant and variable forces, normal forces and contact forces, special examples, Time dependent forces, Obtaining x(t), v(t) for this case using integration method, Effect of drag forces on motion, Applying Newton's Laws to obtain v(t) for the case of motion with time dependent (Integration approach) drag (viscous) forces, terminal velocity, Projectile motion with and without air resistance, Non inertial frames and Pseudo forces, Qualitative discussion to develop understanding, Calculation of pseudo forces for simple cases (linearly accelerated reference frames), Centrifugal force as an example of pseudo force, Coriolis force

Work, Power and Energy:

Work done by a constant force, work done by a variable force (1-2 dimension), (Essentially a review of grade-XII concepts via integration technique to calculate work done (e.g. in vibration of a spring obeying Hooke's Law), Obtaining general expression for work done (2-dimensional case) and applying to simple cases e.g. pulling a mass at the end of a fixed string against gravity, Work

energy theorem, General proof of work energy theorem: Qualitative review of work energy theorem, Derivation using integral calculus, Basic formulae and applications, Power, Energy changes with respect to observers in different inertial frames, Conservation of Energy in 1, 2, and 3 dimensional conservative systems, Conservative and non conservative forces: Conservation of energy in a system of particles, Law of conservation of total energy of an isolated system

Systems of Particles:

Two particle systems and generalization to many particle systems, Centre of mass, Position, velocity and equation of motion, Centre of mass of solid objects, Calculation of Centre of Mass of solid objects using integral calculus, Calculating C.M. of Uniform Rod, Cylinder and Sphere, Momentum Changes in a system of variable mass, Derivation of basic equation, application to motion of a rocket (determination of its mass as a function of time)

Collisions:

Elastic Collisions, Conservation of momentum during collision in one and two dimensions, Inelastic collision, Collisions in centre of Mass reference frame (One and two dimensions), Simple applications, obtaining velocities in C.M. frame.

Recommended Books:

1. Halliday, D. Resnick, Krane, Physics, Vol. I & II, John Wiley, 5^{th} ed. 1999
2. D. Kleppner and R. Kolenkow, An Introduction to Mechanics, McGraw Hill, 1978
3. M. R. Speigel, Vector Analysis and an Introduction to Tensor Analysis, Mc-Graw Hill, 1959.

Course Code	Course Title	Credit Hours
Phy-302	**WAVES AND OSCILLATIONS**	**3(3-0)**

1. To understand the basics of waves, mechanism of wave production, propagation and interaction with other waves
2. Use of basic concept of waves in their application in daily life

Harmonic Oscillations:

Simple harmonic motion (SHM), Obtaining and solving the basic equations of motion x(t), v(t), a(t), Longitudinal and transverse Oscillations, Energy considerations in SHM. Application of SHM, Torsional oscillator, Physical pendulum, simple pendulum, SHM and uniform circular motion, Combinations of harmonic motions, Lissajous patterns, Damped harmonic motion, Equation of damped harmonic motion, Quality factor, discussion of its solution, Forced oscillations and resonances, Equation of forced oscillation, Discussion of its solution, Natural frequency, Resonance, Examples of resonance.

Waves in Physical Media:

Mechanical waves, Travelling waves, Phase velocity of traveling waves, Sinusoidal waves, Group speed and dispersion, Waves speed, Mechanical analysis, Wave equation, Discussion of solution, Power and intensity in wave motion, Derivation & discussion, Principle of superposition (basic ideas), Interference of waves, Standing waves. Phase changes on reflection

Sound:

Beats Phenomenon, Analytical treatment

Light:

Nature of light, visible light (Physical characteristics) light as an electromagnetic wave, speed of light in matter, physical aspects, path difference, phase difference etc.

Recommended Books:

1. Halliday, D. Resnick, Krane, Physics, Vol. I & II, John Wiley, 5th ed. 1999.
2. N.K. Bajaj, The Physics of Waves & Oscillations, Tata McGraw- Hill Publishing company Limited, 1986.
3. H. J. Pain, The Physics of Vibrations and Waves, 5th Edition 1999.

Course Code	Course Title	Credit Hours

ENG-301 **FUNCTIONAL ENGLISH** 3(3-0)

- Parts of Speech
- Tenses
- Use of active and passive voice
- Types of sentence
- Punctuation and spelling
- Phrase, Clause, and Sentence
- Structure of Paragraph
- Format of different types of letter

Recommended Books:

1. Practical English Grammar by A.J Thomson and A.V Martinet
2. Collins Cobuild Students' Grammar.London: Longman
3. Eastwood,J.2004.Oxford Practice Grammar.New Ed,With tests and answers.
4. Murphy,Raymond,Grammar in Use
5. Liz & Soars,J.New Headway: English Course, Oxford
6. Wren and Matin,English Composition.

Course Code	Course Title	Credit Hours
IS-301	**ISLAMIC STUDIES**	2(2-0)

- Tauheed Eight verses to Taught
- Worships
- Amer Bel Maroof-o-Nahe Anel Munkar
- Unity of UMMAH
- Kasab-e-Halal (Lawful earning)
- Rights of Human beings
- Rights of Women
- Rights of Non Muslims
- The last sermon of the Holy Prophet
- The life of Holy Prophet

Course Code	Course Title	Credit Hours
Math-321	**ALGEBRA**	3(3-0)

Objectives:

To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines

Course Contents

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions. *Matrices:* Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

Sequences and Series: Arithmetic progression, geometric progression, harmonic progression. *Binomial Theorem:* Introduction to mathematical induction, binomial theorem with rational and irrational indices. *Trigonometry:* Fundamentals of trigonometry, trigonometric identities.

Recommended Books:

1. Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin,

2. Boston (suggested text) Kaufmann JE, College *Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston 100

3. Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6^{th} edition), 1986, PWS-Kent Company, Boston

Course Code	Course Title	Credit Hours
PE-301	**Foundation of Physical Education and Sports**	3(3-0)

Course Objectives

1. To know the basics of Physical Education
2. To know the skills and techniques of games

Unit#1 Definition & Meaning of Physical Education and Sports

Unit#2 Olympics

Unit#3 Skills and Techniques of Games

Unit#4 Track & Field

Unit#5 Health and Diet

Unit#6 Sports, Trauma and Rehabilitation

Unit#7 Sports, leisure & Recreation

Unit#8 Ethics, Values and Sportsmanship

SECOND SEMESTER

Course Code	Course Title	Credit hours
Phy -351	Mechanics – II	3(2-1)
Phy -352	Optics	3(3-0)
Eng -351	Communication Skills	3(3-0)
PS -351	Pakistan Studies	2(2-0)
CS -351	Introduction to Computer	3(2-1)
Soc-351	Principles of Sociology	3(3-0)
Total		**17**

Course Code	Course Title	Credit Hours
Phy-351	**Mechanics - II**	3(2-1)

Objectives:

1. To give concept of rotational dynamics and their various properties.
2. To give basic understanding of laws of angular momentum and gravitation and their applications is daily life.
3. To give mathematical concept and expressions of various physical parameters used in mechanics.

Rotational Dynamics:

Relationships between linear & angular variables, scalar and vector form. Kinetic energy of rotation, Moment of Inertia, Parallel axis and Perpendicular axis theorems, Proof and Illustration, application to simple cases, Determination of moment of inertia of various shapes i.e. for disc, bar and solid sphere, Rotational dynamics of rigid bodies, Equations of rotational motion and effects of application of torques, Combined rotational and translational motion, Rolling without slipping.

Angular Momentum:

Angular Velocity, Conservation of angular momentum, effects of Torque and its relation with angular momentum, Stability of spinning objects, Discussion with examples, The spinning Top, Effects of torque on the angular momentum, precessional motion.

Gravitation:

Gravitational effect of a spherical mass distribution, Its mathematical treatment, Gravitational Potential Energy (develop using integration techniques), calculation of escape velocity, Gravitational field & Potential, Universal Gravitational Law. Radial and transversal velocity and acceleration, Motion of Planets and Keplers' Laws (Derivation & explanation) Motion of Satellites, Energy considerations in planetary and satellite motion, Qualitative discussion on application of gravitational law to the Galaxy.

Bulk Properties of Matters.

Elastic Properties of Matter, Physical basis of elasticity, Tension, Compression & shearing, Elastic Modulus, Elastic limit. Poisson's ratio, Relation between three types of elasticity, Fluid Statics, Variation of Pressure in fluid at rest and with height in the atmosphere, Surface

Tension, Physical basis; role in formation of drops and bubbles, Viscosity, Physical basis, obtaining the Coefficient of viscosity, practical example of viscosity; fluid flow through a cylindrical pipe (Poiseulle's law)

Recommended Books:

1. Halliday, D. Resnick, Krane, Physics, Vol. I & II, John Wiley, 5^{th} ed. 1999

2. D. Kleppner and R. Kolenkow, An Introduction to Mechanics, McGraw Hill, 1978.

3. M. R. Speigel, Vector Analysis and an Introduction to Tensor Analysis, Mc-Graw Hill, 1959

Course Code	Course Title	Credit Hours
Phy-352	**Optics**	3(3-0)

Objectives

1. To understand the concept of reflections, refraction, interference, diffraction and polarization.
2. To develop understanding about the optical devices

Geometrical Optics

Geometrical optics and its laws, sign convention, Refraction at a spherical surface, lens formula, lens formula by deviation method, two lens systems, Aberrations, Review of topics related to chromatic aberration, Chromatic aberration, Eye pieces, Fibre optics.

Polarization

Plane elliptically and circularly polarized light, Production of each type and their uses, Malus law, Polarizing angle and Brewster law, Uni-axial crystals, Induced optical effects, Optical activity in liquids

Interference

Far field approximation, Analytical treatment of interference phenomenon, point source and extended source, Typical cases of interference phenomena, (thin films, Fabry Perot & Michelson interferometer, Fresnel's biprism), Holography.

Diffraction

Huygen's principle, Fraunhofer diffraction, Fresnel diffraction, Diffraction by a single slit, Diffraction pattern of a rectangular aperture, Diffraction pattern of a circular aperture, Resolving power of lenses, Double slit diffraction pattern, Diffraction grating, Dispersing properties of prism and grating, X-ray diffraction, neutron and electron diffraction. Study of Fourier theorem and its analysis, Application to grating, Diffraction applications.

Recommended Books:

1. E. Hecht, Optics, Addison – Wesley Publishing Company 1987.
2. D. Halliday, R. Resnick, K. S. Krane, *Physics*, John Willey & sons, Inc., 1992.

Course Code	Course Title	Credit Hours
Eng-351	**COMMUNICATION SKILLS**	3(3-0)

- What is Communication
- Level of Communication

Reading Skill

- Types of reading
- Skimming
- Scanning
- Extensive reading
- Intensive reading
- Active reading

- Listening Skills
- Importance of Listening
- Causes of Poor Listening
- How to Become a Better Listener.

Recommended Books

1.Hargie,O.(ed) Hand Book of Communication Skills

2. Writing.Upper-Intermediate by Rob Nolasco,Oxford Supplementary Skill

3. Reading Advanced.Brain Tomlinson and Rod Ellis.Oxford Supplementary Skill

4. Stephhen E. Lucas. The Art of Public speaking.Ed 8,Mc Graw Hill:1983.

5. Gilinson's Pronunciation of English, Revised by Alam Cruttenden,Ed 7, Hodder Education: 2008.

6. Writing and Grammar: Communication in Action Diamond Level, Prentice Hall

Course Code	Course Title	Credit Hours
PS-351	**Pak Studies**	2(2-0)

Historical Perspectives:

- Ideological rationale with special reference to Sir Syed Ahmad Khan, Allama Muhammad Iqbal and Quaid -e- Azam Muhammad Ali Jinnah
- Factors leading to Muslim separatism
- People and land
    1. Indus civilization
    2. Muslim advent
    3. Location and geophysical features

Government and Politics in Pakistan:

- 1947-1958
- 1958-1977
- 1977-1988
- 1988-1999
- 1999 onward

Contemporary Pakistan:

- Economic Institutions and Issues
- Society and social structure
- Ethnicity
- Foreign Policy of Pakistan and challenges
- Futuristic outlook of Pakistan

Books Recommended:

1. Burki, Shahid javed, State and society in Pakistan, The Mamillan Press Ltd, 1980
2. Akbar S Zaidi, Issues in pakistan's Economy, Karachi, Oxford University Press, 2000
3. SM Burke and Lawrence Ziring, Paksitan Foreign Plicy, An Historical Analysis, Karachi, Oxford University Press, 1993
4. Mehmood Safdar, Pakistan Political Roots and Development, Lahore, 1994
5. Wilcox Wayne, The emergency of Bangladesh: Washington: American Enterprise, Institute of Public Policy Research. 1972

Course Code	Course Title	Credit Hours

CS-351 **INTRODUTION TO COMPUTER** 3(2-1)

Objectives:

This course focuses on a breadth-first coverage of computer science discipline, introducing computing environments, general application software, basic computing hardware, operating systems, desktop publishing, Internet, software applications and tools and computer usage concepts; Introducing Software engineering and Information technology within the broader domain of computing, Social issues of computing.

Course Outline:

Number Systems, Binary numbers, Boolean logic, History computer system, basic machine organization, Von Neumann Architecture, Algorithm definition, design, and implementation, Programming paradigms and languages, Graphical programming, Overview of Software Engineering and Information Technology, Operating system, Compiler, Computer networks and internet, Computer graphics, AI, Social and legal issues.

Reference Material:

Computers: Information Technology in Perspective, 9/e by Larry Long and Nancy Long, Prentice Hall, 2002/ISBN: 0130929891. An Invitation to Computer Science, Schneider and Gersting, Brooks/Cole Thomson Learning, 2000 Computer Science: An overview of Computer Science, Sherer.

Course Code	Course Title	Credit Hours
Soc-4351	**PRINCIPLES OF SOCIOLOGY**	3(3-0)

Course Aim and Objective:

The course is designed to introduce the students with sociological concepts and the discipline. The focus of the course shall be on major concepts like social systems and structures, socio-economic changes and social process. The course will provide due foundation for further studies in the field of sociology.

1. **Introduction**

- Definition ,Scope,and Subject Matter
- Historical background of Sociology
- Sociological Perspective in Sociology
- Structural, Functionalist prespective
- Conflict prespective
- Symbolic Interactionist prespective

2. **Culture and related Concepts**
   - Definition, aspects and characteristic of Culture
   - Material and non-material culture/culture and civilization
   - Ideal and real culture
   - Elements of culture
   - Nom and social sanctions
   - Cultural Relativism
   - Sub Cultures
   - Ethnocentrism and Xenocentrism
   - Cultural change and related concepts
3. **Socialization & Personality**
   - Socialization,Agencies of Socialization
   - Self
   - Personality,Factor in Personality Formation
   - Theories of socialization and personality development
   - Role & Status
4. **Social Processes**
   - Social interaction and form social interaction
   - Cooperation
   - Competition
   - Conflict
   - Assimilation and acculturation
   - Accommodation
5. **Social Groups**
   - Definition
   - Types of social groups
   - In and out groups
   - Primary and Secondary group
   - Reference groups

- Bureaucracy
- Pressure groups

6. Social Inequality and Social Stratification

- Social Class
- Caste
- Gender
- Race
- Social Mobility and types of Social mobility
- Income inequality

7. Soical Change

- Introduction and Definition of Social Change
- Responsible factors for social change
- Barriers towards social change
- Theories of Social change.

Recommended Books:

1. Ballantine,Jeanne H.and Roberts,Keith A.(Condensed Version)2010.Our Social World. California:Pine Forge Press/Sage Publication.

2 .Brown,Ken 2004.Sociology,United Kingdom:Polity Press.

3. Brym,RobertJ.and Lie,John ,Sociology:Your compass for new world (Brief Edition)2007. Belmot:Thomson Wads worth.

4. Colander, David C. and Hunt.Elign F.(Thirteenth Edition)(2010)Social Science:An introduction to the study of Society, India :Pearson Education/Dorling Dindersely

5. Gidden,Anthony 2002.Intrdouction to Sociology, UK: Polity Press

6. Rao, C. N.Shankar (2008), Socialogy: Principle of sociology with an introduction to social thoughts, New Dehli. S Chand and Co.

7. James M. Henslin, (2004), Sociology: A Down to earth approach. Toronto: Allen and Bacon.

8. Macionis, John J. (2006). 10th Edition Sociology: New Jersey: Prentice-Hall

9. Montuschi, Eleonora (2006). The objects of social sciences New York: Continuum.

10. Hortun, Paul B. and Hunt, Chester L. (1984) Sociology. New York: McGraw-Hill

SECOND YEAR

THIRD SEMESTER

Course Code	Course Title	Credit hours
Phy -401	Electricity and Magnetism – I	4(3-1)
Phy -402	Heat and Thermodynamics	3(3-0)
Eng -401	Technical Writing	3(3-0)
Math -411	Calculus	3(3-0)
Chem -402	Physical Chemistry	4(3-1)
Total		**17**

Course Code	Course Title	Credit Hours
Phy-401	**ELECTRICITY ANAD MAGNETISM-I**	4(3-1)

Objectives

1. To give the concept of electric field, electrical potential and dielectrics
2. To understand the DC circuits
3. To know the effect of magnetic field and basic magnetic

Electric Field:

Field due to a point charge: due to several point charges. Electric dipole. Electric field of continuous charge distribution e.g Ring of charge, disc of charge, infinite line of charge. Point charge in an electric field. Dipole in an electric field, Torque and energy of a dipole in uniform field, Electric flux: Gauss's law; (Integral and differential forms) and its application. Charge in isolated conductors, conductor with a cavity, field near a charged conducting sheet, Field of infinite line of charge, field of infinite sheet of charge, field of spherical shell and field of spherical charge distribution

Electric Potential:

Potential due to point charge, potential due to collection of point charges, potential due to dipole. Electric potential of continuous charge distribution, Poisson’s and Laplace equation without solution, Field as the gradient or derivative of potential, Potential and field inside and outside an isolated conductor

Capacitors and dielectrics:

Capacitance, calculating the electric field in a capacitor. Capacitors of various shapes, cylindrical, spherical etc. and calculation of their capacitance. Energy stored in an electric field. Energy per unit volume. Capacitor with dielectric, Electric field of dielectric. An atomic view. Application of Gauss's Law to capacitor with dielectric

D C Circuits:

Electric Current, current density J, resistance, resistivity, ρ, and conductivity, σ, Ohm's Law, energy transfer in an electric circuit. Equation of continuity. Calculating the current in a single loop, multiple loops, voltages at various elements of a loop. Use of Kirchhoff's Ist & 2^{nd} law, Thevenin theorem, Norton theorem and Superposition theorem, Growth and Decay of current in an RC circuit and their analytical treatment

Magnetic Field Effects and Magnetic Properties of Matter:

Magnetic force on a charged particle, magnetic force on a current, Recall the previous results. Do not derive. Torque on a current loop, Magnetic dipole: Energy of magnetic dipole in field, Discuss quantitatively, Lorentz Force with its applications in CRO. Biot-Savart Law: Analytical treatment and applications to a current loop, force on two parallel current changing conductors. Ampere's Law, Integral and differential forms, applications to solenoids and toroids, (Integral form), Gauss's Law for Magnetism: Discuss and develop the concepts of conservation of magnetic flux, Differential form of Gauss's Law. Origin of Atomic and Nuclear magnetism, Basic ideas.Bohr Magneton, Magnetization, Defining M, B, μ. Magnetic Materials, Paramagnetism, Diamagnetism, Ferromagnetism - Discussion. Hysteresis in Ferromagnetic materials

Recommended Books:

1. F. J. Keller, W. E. Gettys, M. J. Skove *Physics Classical and Modern (2nd edition)*, McGraw-Hill, Inc., 1993.
2. A. F. Kip *Fundamentals of Electricity and Magnetism (2nd Ed.)*, McGraw-Hill Book Co., 1969.
3. Halliday, Resnick, Krane *Physics (Vol-II)*,John Willey & sons, Inc., 1992.
4. D. N. Vasudeva *Magnetism and Electricity*, S. Chand & Co., 1959.
5. J. A. Edminister *Schaum's Outline Series; Theory and Problems of Electromagnetism*, McGraw-Hill Book Co., 1986.

Course Code	Course Title	Credit Hours
Phy-402	**HEAT AND THERMODYNAMICS**	3(3-0)

Objectives

1. To give the concept of heat and temperature
2. To give the concept of classical distribution function
3. To understand the laws of thermodynamics and their application

Statistical Mechanics:

Statistical distribution and mean values, Mean free path and microscopic calculations of mean free path. Distribution of molecular speeds, Distribution of energies, Maxwell distribution, Maxwell-Boltzmann energy distribution, Internal energy of an ideal gas. Brownian motion, Qualitative description. Diffusion, Conduction and viscosity

Heat and Temperature:

Temperature, Kinetic theory of the ideal gas, Work done on an ideal gas,Review of previous concepts. Internal energy of an ideal gas: Equipartition of energy. Intermolecular forces. Qualitative discussion, Van der Waals equation of state

Thermodynamics:

Review of previous concepts. First law of thermo-dynamics and its applications to adiabatic, isothermal, cyclic and free expansion. Reversible and irreversible processes, Second Law of thermodynamics, Carnot theorem, Carnot engines. Heat engine. Refrigerators. Calculation of efficiency of heat engines. Thermodynamic temperature scale: Absolute zero: Entropy, Entropy in reversible process, Entropy in irreversible process. Entropy & second law. Entropy & probability. Thermodynamic functions: Thermodynamic functions (Internal energy, Enthalpy, Gibb's functions, Entropy, Helmholtz functions) Maxwell's relations, TdS equations, Energy equations and their applications. Low Temperature Physics, Liquification of gases, Joule-Thomson effect and its equations. Thermoelectricity,Thermocouple, Seabeck's effect,
Peltier's effect, Thomson effect

Recommended Books:

1. J. F. Lee and F. W. Sears, Thermodynamics, Addison-Wesley 1954.

2. A. J. Pointon, Introduction to Statistical Physics, Longman 1967.

3. M. W. Zemansky, Heat and Thermodynamics, 3rd Edition, McGraw Hill, 1951.

4. Reif, Statistical Physics, Berkley Physics series, McGraw Hill 1965.

5. M. M. Abbott, Schaum's Outline of Thermodynamics, McGraw-Hill Professional Book Group, 1995.

Course Code	Course Title	Credit Hours
Eng-401	**TECHNICAL WRITTING**	3(3-0)

TECHNICAL WRITING SKILLS

1. Introduction to Technical Writing
2. Why is good report writing important?
3. Objective of Technical Writing
4. Technical Writing Style
5. Writing Process
6. Anylysis: Technique of Anylsis
7. Description: The Role of Description in Technical Writing
8. Proposal Writing
9. Letters Writing :Types of Business letters
10. Memos Writing
11. Email writing

Recommended Books:

1. Marshal Gersen,Technical Writing:The Process and Product
2. Michael H.2nd Edition,Technical writing:situation and strategies St.Martine's Press New York 1988
3. Technical writing :process and Product 5th Ed Sharon J. Gersen

Course Code	Course Title	Credit Hours
Math-411	**CALCULUS**	3(3-0)

Objectives:

To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities. *Limits and Continuity:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

Integration and Definite Integrals: Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

Recommended Books:

Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York

Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)

Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston

Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

Course Code	Course Title	Credit Hours
Chem-402	**PHYSICAL CHEMISTRY**	4(3-1)

Objectives:

1. This course aims to enable the students to learn fundamentals of most branches of physical chemistry such as physical states of matter, chemical thermodynamics , chemical kinetics, solution, surface and electrochemistry.
2. The course will also help to apply their theoretical concepts to some basic practical in the laboratory.

Physical States of Matter

Ideal and real gases, equations of state, critical phenomenon and critical constants. Molecules in motion: collision diameter and mean free path. Physical properties of liquids: surface tension, viscosity, refractive index etc. and their applications. Brief account of interactions among the molecules in liquids. Packing of atoms in solids. Unit cells and crystal systems. Method of crystal structure analysis. Brief account of polymers and composite materials with special emphasis on superconductors, semi-conductors etc. Introduction to plasma.

Chemical Thermodynamics

Laws of thermodynamics and their applications. Thermodynamic functions: internal energy, enthalpy, entropy and free energy. Relation between thermodynamic functions. van't Hoff's equation. Heat capacities, concept of entropy and probability.

Chemical Kinetics

Rate of reaction. Rate law, order and molecularity of the reactions. Zero, first and second order reactions. Determination of reaction order and its rate constant. Effect of temperature on the reaction rate. Concepts of chemical equilibrium. Le-Chatelier's principle and its applications. Elementary concepts underlying complex and fast reactions.

Solution Chemistry

Ideal and non-ideal solutions. Raoult's and Henery's laws and their applications. Molecular interactions in solutions. Colligative properties. Distillation and concept of azeotropic mixture.

Surface Chemistry

Concept of interfaces. Adsorption and adsorption isotherms: Freundlich and Langmuir adsorption isotherms. Catalysis, colloids emulsion and their industrial applications.

Electrochemistry

Basic concepts of electrochemistry. Ions in solution. Measurement of conductance and Kohlrausch's law. Debye-Hueckel theory and activity coefficient. Application of conductance measurement. Electrode potential. Electrochemical cell. Application of electrode potential

Books Recommended (Theory)

1. Alberty R. "Physical Chemistry" 17th ed., John Wiley and Sons (1987).

2. Atkins, P.W. "Physical Chemistry" 6th ed., W.H. Freeman and Co. New York (1998).

3. Laidler K.J. "The World of Physical Chemistry" 1st ed., Oxford University Press (1993).

4. Laidler K.J., John H.M. and Bryan C.S. "Physical Chemistry" 4th ed., Houghton Mifflin Publishing Company Inc.(2003).

5. Peter P.A. "Chemical Thermodynamics" Oxford University Press (1983).

6. Brain S.E. "Basic Chemical Thermodynamics" 4th ed., E.L.B.S. Publishers (1990).

7. Barrow G.M. "Physical Chemistry" 5th ed., McGraw Hill (1992).

Books Recommended (Practicals)

1. Jaffar M. "Experimental Physical Chemistry" University Grants Commission (1989).

2. Levitt B.P. "Findlay's Practical Physical Chemistry" 9th ed., Longman Group Limited (1978).

3. Shoemaker D. "Experiments in Physical Chemistry" 5th ed., McGraw Hill Publishing Company Limited (1989).

FOURTH SEMESTER

Course Code	Course Title	Credit hours
Phy-451	Electricity and Magnetism-II	4(3-1)
Phy -452	Modern Physics	3(3-0)
Math-465	Mathematics for Physics	3(3-0)
TH-	Civilization	3(3-0)
CS-451	Introduction to Programming	3(3-0)
Total		**16**

Course Code	Course Title	Credit Hours
Phy-451	**ELECTRICITY AND MAGNETISM-II**	4(3-1)

Objectives

1. To give the concept of inductance
2. To give the concept of alternating current circuits
3. To understand the uses of Gauss's law, Faraday Law, Ampere's La and their application

Inductance:

Faraday's Law of Electromagnetic Induction, Review of emf, Faraday Law and Lenz's Law, Induced electric fields, Calculation and application using differential and integral form, Inductance, "Basic definition". Inductance of a Solenoid; Toroid. LR Circuits, Growth and Decay of current, analytical treatment. Energy stored in a magnetic field, Derive. Energy density and the magnetic field. Electromagnetic Oscillation, Qualitative discussion. Quantitative analysis using differential equatins. Forced electromagnetic oscillations and resonance

Alternating Current Circuits:

Alternating current, AC current in resistive, inductive and capacitative elements. Single loop RLC circuit, Series and parallel circuits i.e. acceptor and rejector, Analytical expression for time dependent solution. Graphical analysis, phase angles. Power in A.C circuits: phase angles, RMS values, power factor

Electro-Magnetic Waves (Maxwell's Equations):

Summarizing the electro- magnetic equations, (Gauss's law for electromagnetism, Faraday Law, Ampere's Law). Induced magnetic fields & displacement current. Development of concepts, applications. Maxwell's equations, (Integral & Differential forms) Discussion and implications. Generating an electro- magnetic wave. Travelling waves and Maxwell's equations. Analytical treatment; obtaining differential form of Maxwell's equations, obtaining the velocity of light from Maxwell's equations. Energy transport and the Poynting Vector. Analytical treatment and discussion of physical concepts

Recommended Books:

1. F. J. Keller, W. E. Gettys, M. J. Skove *Physics Classical and Modern (2nd edition)*, McGraw-Hill, Inc., 1993.

2. A. F. Kip *Fundamentals of Electricity and Magnetism (2nd Ed.)*, McGraw-Hill Book Co., 1969.

3. D. Halliday, R. Resnick, K. S. Krane *Physics (Vol-II)*, John Willey & sons, Inc., 1992.

4. D. N. Vasudeva *Magnetism and Electricity*, S. Chand & Co., 1959.

5. J. A. Edminister *Schaum's Outline Series; Theory and Problems of Electromagnetism*, McGraw-Hill Book Co., 1986.

Course Code	Course Title	Credit Hours
Phy-452	**MODERN PHYSICS**	3(3-0)

Objectives:

To give the concept of modern physics

X-Rays:

Production of X-rays, Measurement of the intensity of X-rays, Diffraction of X-rays and Bragg's law, single crystal X-ray spectrometer, X-ray spectrum (continuous and discrete) Moseley's law, X-ray energy level diagram, radiation less trasitions, Auger effect, related problems

Origin of Quantum Theory:

The failure of classical Physics to describe atomic phenomena, the emission and absorption of thermal radiation, the classical theory of thermal radiation,the failure of the classical theory of thermal radiation, Planck's quantum theory of thermal radiation, Quantum theory and thermal radiation, Photoelectric and Compton effect, related problems

Wave Nature of Matter:

Wave behaviour of particle (wave function etc.) its definition and relation to probability of particle, d'Broglie hypothesis and its testing, Davisson- Germer Experiment and J.P. Thomson Experiment, Wave packets and particles, localizing a wave in space and time

Special Theory of Relativity:

Inertial and non inertial frame, Postulates of Relativity, The Lorentz Transformation, Derivation, Assumptions on which inverse transformation is derived, Consequences of Lorentz transformation, Relativity of time, Relativity of length, Relativity of mass, Transformation
of velocity, variation of mass with velocity, mass energy relation and its importance, relativistic momentum and Relativistic energy, (Lorentz invariants) $E^2= p^2c^2+m_o^2\ c^4$

Recommended Books:

1. Robert M Eisberg, Fundamentals of Modern Physics, John Wiley & Sons 1961
2. Sanjiv Puri, Modern Physics, Narosa Publishing House, 2004.

3. Paul A. Tipler and Ralph A. Llewellyn, Modern Physics 3rd edition, W H Freeman and Company 2000.

4. Arthur Beiser, Concepts of Modern Physics (fifth edition) McGraw-Hill 1995

5. Robert M. Eisberg and Robert Resnick, Quantum Physics of Atoms, molecules, Solids, Nuclei and Particles, 2nd edition, John Wiley & Sons, 2002.

6. D. Halliday, R. Resnick, K. S. Krane, *Physics*, John Willey & sons, Inc., 1992.

7. D. Halliday, R. Resnick, K. S. Krane, *Physics*, John Willey & sons, Inc., 1992.

8. A.P. Malvino, 'Electronic Principles', Tata McGraw Hill, New Delhi (1988).

9. B.L.Theraja ‘Electronics”

Course Code	Course Title	Credit Hours
Math-465	**MATHEMATICS FOR PHYSICS**	3(3-0)

Contents

2. Complex numbers and hyperbolic functions

- The need for complex numbers
- Manipulation of complex numbers

  Additions and subtraction; modulus and argument; multiplication; complex conjugate; division
- Polar representation of complex numbers

  Multiplication and division in polar form
- de Moivre's theorem

  Trigonometrical identities; finding the nth roots of unity; solving polynomial equations
- Complex logarithms and complex powers
- Applications to differentiation and integration
- Hyperbolic functions

Definitions; hyperbolic-trigonometric analogies; identities of hyperbolic functions; solving hyperbolic equations; inverses of hyperbolic functions; calculus of hyperbolic functions

3. Series and limits

- Convergence of infinite series

  Absolute and conditional convergence; convergence of a series containing only real positive terms; alternating series test
- Operations with series
- Power series

Convergence of power series; operations with power series

- Taylor series

  Taylor's theorem; approximation errors in Taylor series; standard Maclaurin series

Evaluation of limits

Partial differentiation

- Definition of the partial derivative
- The total differential and total derivative
- Exact and inexact differentials
- Useful theorems of partial differentiation

• The chain rule
• Change of variables
• Taylor's theorem for many-variable functions
• Stationary values of many-variable functions
• Stationary values under constraints

5. Multiple integrals

• Double integrals
• Triple integrals
• Applications of multiple integrals

Areas and volumes; masses, centers of mass and centroids; Pappus' theorems; moments of inertia; mean values of functions

• Change of variables in multiple integrals

Change of variables in double integrals;

Recommended Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig
2. Calculus with Analytical Geometry by Dr. S. M. Yousuf / Prof Zia-ul-Haq
3. Mathematical Techniques by Dr. Karamat

Course Code	Course Title	Credit Hours
TH-465	**CIVILIZATION**	3(3+0)

1 What is culture, Civilization, Community, Societey and association
2 Main nature and man plan in nature
3 Globoagentrs and 21st Century
4 History of Human devolepment, Life and achievement of man
5 Ideologies. Capitalism, communism and Islam
6 Word major civilizations

- IVC Indus valley civilization
- Person civilization

- Gandhara civilization
- Merop Civilization

7 Religions and then Rah

- Islam, Chemonisaity, Judaism, Buddhism, Hinduism

Course Code	Course Title	Credit Hours
CS-451	**INTRODUCTION TO PROGRAMMING**	3(3+0)

THIRD YEAR

FIFTH SEMESTER

Course Code	Course Title	Credit hours
Phy -501	Mathematical Methods of Physics- I	3(3-0)
Phy -502	Electrodynamics-I	3(3-0)
Phy -503	Classical Mechanics	3(3-0)
Phy -504	Quantum Mechanics -I	3(3-0)
Phy -505	Electronics	3(3-0)
Phy -506	Lab - V (Electronics)	2(0-2)
Total		**17**

Course Code	Course Title	Credit Hours
Phy-501	**MATHEMATICAL METHODS OF PHYSICS-I**	3(3-0)

Objectives

1. To develop the mathematical background of student in vectors, tensors, matrices and some of their uses in the world of Physics
2. To give basic understanding of group theory and complex variables used in physics

Vector Analysis & Tensor Analysis

Review of vectors Algebra, Vector differentiation and gradient, Divergence and Gauss's theorem, Vector integration, Green's theorem in the plane, Curl and Stoke's theorem. Tensor, Tensor algebra, Quotient rule. Covariant and contravariant tensors,

Curvilinear Coordinates:

Curvilinear coordinate system, Gradient, Divergence and Curl in the curvilinear coordinates system, Cartesian, Spherical and Cylinderical coordinate system,

Matrices:

Linear vector spaces, Determinants, Matrices, Eigenvalues and eigenvectors of matrices, Orthogonal matrices, Hermitian matrices, Similarity transformations, Diagonalization of matrices.

Complex Variables:

Functions of a complex variable, Cauchy Riemann conditions and analytic functions, Cauchy integral theorem and integral formula, Taylor and Laurent series, Calculus of residue, Complex integration.

Recommended Books:

1. G. Arfken, Mathematical Physics, 2nd ed, Academic Press, 1970.

2. E. Butkov, Mathematical Physics, Addison-Wesley 1968.

3. Pipes and Harvill, Applied Mathematics for Engineers and Physicists, McGraw Hill, 1971.

M. L. Boas, Mathematical Methods in Physical Sciences, John Wiley & Sons, New York (1989)

4. M. R. Speigel, Complex Variables Schaum's Outline Series, McGraw Hill 1979.

Course Code	Course Title	Credit Hours
Phy-502	**ELECTRODYNAMICS-I**	3(3-0)

Objectives:

1. To give the basic understanding in static electromagnetic fields and time dependent electromagnetic fields
2. To develop knowledge of propagation, reflection and refraction of electromagnetic waves
3. To develop the understanding of skin effect and wave guides

Fundamental Concepts:

Recapitulation of the fundamental concepts, Induction B, Addition of Laplace equation and methods of images, Electric dipole, Quadruple, Magnetic intensity H, Maxwell's equations in differential and integral forms, Poynting theorem and energy conservation

Static Electromagnetic Fields:

Electrostatic fields in several dielectric media, Magneto static fields of magnetized matter, Magneto static field of stationary current, Magnetization current

Reflection and Refraction of Electromagnetic Waves:

Laws of reflection and refraction, Fresnel's formula, Total reflection, Refraction in conducting media, Reflection from a conducting surface

Books Recommended:

1. D. Grifftns, An introduction to Dynamics, Prentice Hall, 1984 Jackson, Classical Electrodynamics, John Wiley, 1975
2. P.C. Lorrain & D.R. Corson, 'Electromagnetic Fields and Waves', W.H. Freeman & Co., New York (1978).
3. Ritze Millfadad Chiristy, Foundation of Electromagnetic Theory
4. H.C. Ohanion, 'Classical Electrodynamics', Allyn & bacon Inc., Massachusetts (1988).
5. A.M. Portis, 'Electromagnetic Fields', John Wiley & Sons, New York (1978).
6. Y.K. Lim, 'Introduction to Classical Elecrodynamics, World Scientific Publishing Co. Pt., Singapore (1986).

Course Code	Course Title	Credit Hours
Phy-503	**CLASSICAL MECHANICS**	3(3+0)

Objectives:

1. To develop the basic knowledge of classical world using the laws of Physics
2. To develop the understanding of two bodies central force problems
3. To give understanding of kinematics and dynamics of rigid bodies
4. Development of Hamiltonian equation and use of canonical transformation in classical physics

Elementary Principles:

Brief Survey of Newtonian mechanics of a system of particles, constraints, Alembert's principle, Lagrange's equation and its applications, Virtual work

Variational Principles:

Calculus of variation and Hamilton's principle, Derivation of Lagrange's equation from Hamilton's principle

Two Body Central Force Problem:

Low and least action, two body problem and its reduction to one body problem, Equation of motion and solution for one body problem, Kepler's Laws Laboratory and centre of mass systems, Rutherford scattering

Kinematics of Rigid Body Motion:

Orthogonal transformations, Eulerian angles, Euler's theorem, The coriolis force

Rigid Body Equation of Motion:

Angular momentum, Tensors and dyadics, Moment of inertia, Rigid body problems and Euler's equations

Hamilton Equation of Motion:

Legendre transformation and Hamilton equations of motion, Conservation theorems

Canonical Transformations:

Examples of canoical transformations, Lagrange and Poison brackets, Liouville's theorem

Books Recommended:

1. H. Goldstein, 'Classical Mechanics', 2nd. Edn., Addison Wesley, Reading, Massachusetts (1980).
2. Dr. S. L. Gupta Pragati Prakshan ,Classical Mechanics, Educational Publisher 240, Western Meerut-250001
3. V.I. Arnold, Mathematical Methods of Classical Mechanics Springer verlag, New York (1980).
4. S.N. Rasband, 'Dynamics', John Wiley & Sons, New York (1983).
5. R.A. Matzner & L.C. Shepley, 'Classical Mechanics', Prentice Hall Inc., London (1991).

6. N.M.J. Woodhouse, 'Introduction to Analytical Dynamics', Oxford Science Publications, Oxford (1987).

Course Code	Course Title	Credit Hours
Phy-504	**QUANTUM MECHANICS-I**	3(3+0)

Objectives

1. Understanding the behaviour of quantum mechanical particle and development of Schrodinger equation in one and three dimensions
2. introduction to Quantum mechanical operators and determination of angular momentum of a quantum mechanical particle

Quantum Mechanics of One dimensional Problems:

Review of concepts of classical mechanics, Particle Aspect of Radiation, Wave Aspect of Particles, particles versus waves, the wave function and its interpretation,State of a system, Functions and expectation values.

Formalism of Quantum Mechanics:

The state of a system, Dynamical variables and operators, commuting and non-commuting operators,Hermitian adjoint, Projection operators, Eigen values and Eigenvectors of an operator,Dirac Notation,Heisenberg uncertainty relations,

Angular Momentum:

Basic properties and Cartesian components, Orbital angular momentum, The eigenvalues and eigen functions of L_2 and L_z, Matrix representation of angular momentum operators, Addition of angular momenta.

Schrodinger Equation in Three Dimensions:

Separation of Schrödinger equation in Cartesian coordinates, The free particle, Potential, Three dimensional square well potential, The hydrogen atom, Three dimensional isotropic oscillator.

Books Recommended:

1. Introduction to Quantum Mechanics, David J. Griffiths, Prentice Hall, Int., Inc.
1. Introduction to Quantum Mechanics, B. H. Bransden&C. J. Joachain, Longman Scientific & Technical London, 1990.
2. Quantum Mechanics, Concepts and Application, NouredineZettli, John wiley& Son, 2001.
3. Quantum Mechanics, Lugen Merzbacher, John Wiley and Sons, 1997.
4. Quantum Mechanics, L LSchif, McGraw-Hill, 1968.
5. Introductory Quantum Mechanics, R.L Liboff Addition Wesley, 1992.

Course Code	Course Title	Credit Hours
Phy-505	**ELECTRONICS**	3(3+0)

Objectives:

1. To develop the understanding of different electronic circuit elements and devices like diode, transistors, amplifiers,
oscillators and voltage regulators used in daily life alliances
2. To understand the day to day electronic devices.

Electronics:

Basic crystal structure, free electron model, energy band in solid and energy gaps, p-type, n-type semiconductor materials, p-n junction diode, its structure. characteristics and application as rectifiers. Transistor, its basic structure and operation, transistor biasing for amplifiers, characteristics of common base, common emitter, common collector, load line, operating point, hybrid parameters (common emitter), Transistor as an amplifier (common emitter mode), Positive & negative feed back R.C. Oscillators, Monostable multi- vibrator (basic), Logic gates OR, AND, NOT, NAND, NOR and their basic applications.

Special Diodes:

Zener diodes, Zener regulators, Varactor diodes, Schottky diodes, Light emitting diodes, Photodiodes, Tunnel diodes, Varistors and their applications

Transistor Circuits:

Bipolar transistors; parameters and ratings, Ebers-Moll, Hybrid-p and h, z and y-parameter models, Switching circuits, Biasing and stability, Common emitter, Common base and common collector amplifiers, Frequency response, Power class A, B, and C amplifiers, Field Effect.

FET:

Transistors; Junction FET, MOSFET, Operation and construction, Biasing, Common source and common drain amplifiers, Frequency response, Multistage Amplifiers; RC coupled and direct coupled stages, The differential amplifiers, Negative feedback, Tuned RF Voltage amplifiers, I-F Amplifiers and automatic gain control.

Operational Amplifiers:

Ideal op-amps, Simple op-amp arrangements, its data and sheet parameters, Non inverting and inverting circuits, Feedback and stability, Op-amp applications; Comparators, Summing, Active filters, Integrator and Differentiator, Instrumentation amplifier.

Oscillators:

Armstrong, Hartley, CMOSS, Colpit's Phase shift and 555 timer oscillators

Books Recommended:

1. Basic Electronics by B. L. Theraja
2. J. Millman & C.C. Halkias, 'Integrated Electronics', McGraw Hill Book Company, Singapore (Latest Edition).
3. T.L. Floyd, 'Electronic Devices', Merril Publishing Company Columbus (1988).
4. A.P. Malvino, 'Electronic Principles', Tata McGraw Hill, New Delhi (1988).
5. D.B. Bell, 'Electronic devices & Circuits', Reston Publishing Company Inc., Virginia (1980).
6. C.J. Savant Jr. M.S. Roden, G.L. Carpenter, 'Electronic Design Circuit &

Systems', The Bengamin/Cummings Publishing Co., California (1991).

SIXTH SEMESTER

Course Code	Course Title	Credit hours
Phy -551	Mathematical Methods of Physics- II	3(3-0)
Phy -552	Electrodynamics-II	3(3-0)
Phy -553	Atomic & Molecular Physics	3(3-0)
Phy -554	Quantum Mechanics -II	3(3-0)
Phy -555	Solid State Physics -I	3(3-0)
Phy -556	Lab -VI (Spectroscopy/Modern Physics)	2(0-2)
Total		**17**

Course Code	Course Title	Credit Hours
Phy-551	**MATHEMATICAL METHODS OF PHYSICS-II**	3(3-0)

Objectives:

1) To give the understanding of Differential equations and their uses in Physics
2) Introduction to special functions, Fourier Series, Fourier Transforms
3) Solution of Boundary value problems and their uses

Differential Equations in Physics:

First and second order linear differential equations, Partial differential equations of theoretical physics, Separation of variables, Homogeneous differential equations, Frobenius series solution of differential equations, Second solution, Nonhomogenous differential equations. Applications of partial differential equations.

Special Functions:

Bessel functions and Hankel functions, Spherical Bessel functions, Legendre polynomials, Associated Legendre polynomials, Spherical harmonics Laguerre polynomials, Hermite polynomials, Gamma function, Sequence and Series.

Fourier Series:

Definition and general properties, Fourier series of various physical functions, Uses and application of Fourier series

Integral Transforms: Integral transform, Fourier transform, Convolution theorem, Elementary Laplace transform and its application

Books Recommended:

1. G. Arfken, Mathematical Physics, 2nd ed Academic Press, 1970.

2. R. Bronson,Differential Equations Schaums Outline Series, McGraw Hill, New York.

3. M.L. Boas, 'Mathematical Methods in Physical Sciences', John Wiley & Sons, New York (1989).

4. E. Butkov, „Mathematical Physics Addison-Weseley London .

5 C.W. Wong, 'Introduction to Mathematical Physics', Oxford University, Press, New York (1991).

6. Hassani, 'Foundations of Mathematical Physics', Prentice Hall International Inc., Singapore (1991).

7. Chattopadhyay, 'Mathematical Physics', Wiley Eastern Limited, New Delhi, (1990).

Course Code	Course Title	Credit Hours
Phy-552	**ELECTRODYNAMICS-II**	3(3-0)

Objectives:

1. To give the basic understanding in static electromagnetic fields and time dependent electromagnetic fields
2. To develop knowledge of propagation, reflection and refraction of electromagnetic waves
3. To develop the understanding of skin effect and wave guides

Time Dependent ElectromagneticFields:

Maxwell's equations for quasi stationery fields, Potentials of a rapidly varying field, Fields of uniformly moving and accelerated charges, Radiation from an accelerated charge, Field of oscillating expansion of electromagnetic field, Multiple fields. Expansion of emf

Propagation of Plane Electromagnetic Waves:

Monochromatic waves and plane waves, Forced oscillation of an electronic oscillator, Scattering by a bound electron, Dispersion in dilute medium and dense media, Dispersion in metallic conductor, Group velocity. Loren z, grange and Coulomb grange

Skin Effect and Wave Guides:

High frequency current in a semi- infinite conductor, Internal impedance at high frequencies, Waves guided by parallel plane conductor, Transmission by a rectangular. Wave Guidance, Power transfer and attenuation, Wave guides as cavity resonators, Q of a cavity resonator, Waves guided by dielectrics.

Books Recommended:

1. D. J. Griffths, An introduction to Electrodynamics, Prentice Hall, 1984
2. J. D. Jackson, Classical Electrodynamics, John Wiley, 1975

3. H.C. Ohanion, 'Classical Electrodynamics', Allyn & bacon Inc., Massachusetts (1988).
4. Y.K. Lim, 'Introduction to Classical Electrodynamics, World Scientific Publishing Co. Pt., Singapore (1986).
5. P.C. Lorrain & D.R. Corson, 'Electromagnetic Fields and Waves', W.H. Freeman & Co., New York (1978).
6. C.R. Paul & S.A. Nasar, 'Introduction to Electromagnetic Fields,McGraw Hill Book Company, Singapore (1987).
7. A.M. Portis, 'Electromagnetic Fields', John Wiley & Sons, New York (1978).

Course Code	Course Title	Credit Hours
Phy-553	**ATOMIC AND MOLECULAR PHYSICS**	3(3+0)

Rutherford Scattering, Review of Bohr's theory, Sommerfeld model, correspondence principal, Frank Hertz experiment and approximation methods. Energy levels, Nuclear motion and reduced mass, Quantum numbers, Radiative transitions, Selection rules, normal Zeeman effect, Pachen Back Effect, Many body atom, Pauli exclusion principle, Stern and Gerlach experiment, Spin orbit coupling, LS coupling, jj coupling, X-ray Spectra.

Molecular Spectra: Ionic and covalent bonding, Diatomic molecules-rotational, vibrational, and electronic spectra, Polyatomic molecules (brief introduction), Black body radiation, Einstein coefficient and stimulated emission, pumping schemes, characteristic of laser beam, resonators, different types of lasers.

Recommended Books:

1. Anne P. Thorn, Spectrophysics, second edition, Chapman and Hall, 1988.
2. B. H. Bransden and C.J. Joachain, Physics of atomic and Molecules, Longmans, London 1983,
3. R. Eisberg, and R. Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei an Particles, second edition, John Wiley and sons 1985.
4. B.B. Laud, Lasers and Nonlinear Optics, 2nd ed. Wiley Eastern Limited, New Delhi, 1991.
5. Koichi Shimoda, Introduction to Laser Physics, Springer Verlag, 1983.
6. S. N. Goshal, Atomic Physics (Modern Physics)

7. Semat, Introduction to Atomic and Nuclear Physics
8. P. Raja Gopal, Modern Physics, Prentice Hall of India Pvt Ltd New Delhi

Course Code	Course Title	Credit Hours
Phy-554	**QUANTUM MECHANICS-II**	3(3-0)

Objectives:

1. To understand the use of approximation in Quantum mechanics
2. To understand the theory of scattering and interaction of quantum systems with radiation
3. To understand the basics of relativistic quantum mechanics

The Hydrogen Atom:

The Radial Equation, Centrifugal Term, Spherical Bessel function, Spherical Neumann function, The Radial Wave function, Bohr formula, Bohr Radius, Binding energy, Ground State, Associated Laguerre Polynomial.

Perturbation Theory:

Time-Independent, Non-degenerate Perturbation Theory, Smallness of the Perturbation, the Perturbation Expansion, First-Order Corrections, Second-Order Corrections, Time-Independent Degenerate Perturbation Theory, First-Order Energies, Two-Dimensional Harmonic Oscillator, The WKB Approximation.

Time Dependent-Perturbation Theory:

Time-Dependent Perturbation Theory, Harmonic Perturbation, Stimulated Emission, Golden Rule.

Scattering in Three Dimensions:

Scattering Cross-section, The scattering Amplitude, Partial Wave Phase Shift, The Born Approximation, Determination of Scattering Amplitude using Born Approximation.

Books Recommended:

1. Introduction to Quantum Mechanics, David J. Griffiths, Prentice Hall, Int., Inc.
1. Introductory Quantum Mechanics, R.L Liboff Addition Wesley, 1992.

2. Introduction to Quantum Mechanics, B. H. Bransden&C. J. Joachain, Longman Scientific & Technical London, 1990.
3. Quantum Mechanics, Concepts and Application, NouredineZettli, John wiley& Son, 2001.
4. Quantum Mechanics, Lugen Merzbacher, John Wiley and Sons, 1997.
5. Quantum Mechanics, L LSchif, McGraw-Hill, 1968

Course Code	Course Title	Credit Hours
Phy-555	**SOLID STATE PHYSICS-I**	3(3-0)

Objectives:

1. To develop a basic knowledge of crystallography
2. To understand the x-ray diffraction in crystal investigation
3. To understand the binding forces in crystalline material
4. To develop the understanding of lattice dynamics and its uses in derivation of theories of specific heat
5. To understand the behaviour of free electrons in metals and Fermi Energy.

Structure of Solids

Lattices and basis, Symmetry operations, Fundamental types of lattice, Position and orientation of planes in crystals, Simple crystal structures, Atomic potential, space groups and binding forces.

Crystal diffraction and reciprocal lattice:

Diffraction of X-rays, Neutrons and electrons from crystals, Bragg's law, Reciprocal lattice, Reciprocal lattice to sc, bcc, fcc, orthorhombic and hexagonal crystals, Laue method, rotating crystal method, Powder methods, Scattered wave amplitude, Ewald construction and Brillouin zone, Miller Indices, Fourier analysis of the basis.

Phonons and Lattice Vibrations:

Lattice heat capacity, classical model, Einstein model, Enumeration of normal models, Density of state in one, two and three dimensions, Debye model of heat capacity, Comparison with experimental results, Thermal conductivity and resistivity, Umklapp processes.

Free Electron Theory of Solid;

Drude model, Electrical conductivity , Hall effect, Thermal conductivity , The Sommerfeld theory of electrons , Ground-state energy of electron gas , Thermal properties of electron gas

Recommended Books:

1. C. Kittle, Introduction to Solid State Physics, 7th Ed. By, Kohn Wiley, 1996.
2. N. M. W. Ashcroft and N. D. Mermin, Solid State Physics, 1976,
3. S. R. Elliott, The Physics and Chemistry of Solids, Wiley, 1998.

4. M. A. Omar, Elementary Solid State Physics, Pearson Education 2000.

6. M.A. Wahab, Solid State Physics, Narosa Publishing House, 1999.

7. G. Burns, High Temperature Superconductivity, An Introduction, Academic Press 1992.

8. Solid State Physics by R. K. Puri, S. Chand & Co. Ltd, Ram Nagar, New Delhi-110055

FOURTH YEAR

SEVENTH SEMESTER

Course Code	Course Title	Credit hours
Phy -601	Nuclear Physics	3(3-0)
Phy -602	Solid State Physics-II	3(3-0)
Phy -603	Thermal & Statistical Physics	3(3-0)
Phy -604	Elective-I	3(3-0)
Phy -605	Elective-II	3(3-0)
Phy -606	Lab-VII (Nuclear Physics)	2(0-2)
Total		**17**

Course Code	Course Title	Credit Hours
Phy-601	**NUCLEAR PHYSICS**	3(3+0)

History:

Starting from Bacqurel's discovery of radioactivity to Chedwick's neutron

Basic Properties of Nucleus*:* Nuclear size, mass, binding energy, nuclear spin, magnetic dipole and electric quadrupole moment, parity and statistics

Nuclear Forces: Yukawa's theory of nuclear forces. Nucleon scattering, charge independence and spin dependence of nuclear force, isotopic spin

Nuclear Models*:* Liquid drop model; Fermi gas model, Shell model; Collective model

Theories of Radioactive Decay:

Theory of Alpha decay and explanation of observed phenomena, measurement of Beta ray energies, the magnetic lens spectrometer, Fermi theory of Beta decay, Neutrino hypothesis, theory of Gamma decay, nuclear isomerism

Nuclear Reactions:

Conservation laws of nuclear reactions, Q-value and threshold energy of nuclear reaction, energy level and level width, cross sections for nuclear reactions, compound nucleolus theory of nuclear reaction and its limitations, direct reaction, resonance reactions

Neutron Physics:

Neutron Sources, slow neutron detectors, fast neutron detectors.

Books Recommended:

1. Segre, Nuclei and Practicles, Bejamin, 1977.
2. Kaplan, Nuclear Physics, Addison-Wisely, 1980.
3. Green, Nuclear Physics, McGraw Hill, 1995.
4. Kenneth S. Krane, Introducing Nuclear Physics, 1995.
5. B. Povh, K. Rith, C. Scholtz, F. Zetsche, Particle and Nuclei, 1999.
6. Glenn, F. Knoll, Radiation Detection and Measurement, John Wiley, 1989.
7. S. N. Goshal Nuclear Physics

8. Semat Introduction to Atomic and Nuclear Physics
9. S. R. Patel, An Introduction to Nuclear Physics, Wiley Eastern Ltd, New Delhi

Course Code	Course Title	Credit Hours
Phy-602	**Solid State Physics-II**	3(3-0)

Objectives:

1. To understand the transport properties in solids
2. To understand the crystal defects and their importance
3. To understand the dielectric and magnetic properties of materials
4. To give basic understanding of superconductivity.

Band Theory of Solids;

General theory of electrons in a periodic potential, Bloch's theorem, Crystal momentum, Density of states , Electrons in a weak periodic potential, Formation of energy gap, Three schemes to describe energy bands, Fermi surface.

Transport Properties of Solids:

Motion of electron in bands, Effective mass, Electrical conductivity of metals, electrical Conductivity of localized electrons, Boltzmann equation

Defects in Crystals:

Crystal imperfections, Thermodynamics of Point defects, Schottky and Frenkel defects, color centres, Dislocations in Solids, edge dislocation, Screw dislocation Slip and plastic deformation, Stacking faults and grain Boundaries, Strength of Crystals

Dielectrics and Ferroelectrics:

Maxwell Equations, Polarization, Dielectric Constant and Dielectric Polarizability, Susceptibility, Electronic Polarizablity, Clausius-Mossotti Relation, Structural Phase Transitions, Ferroelectric crystals, Classification of Ferroelectric Crystals, Theory of Ferroelectric Displacive Transitions, Thermodynamic theory of Ferroelectric transition, Ferroelectric Domains, Piezoelectricity,

Diamagnetism and Paramagnetism:

Atomic theory of magnetism, Diamagnetism, Paramagnetism, The quantum numbers, Orbital and spin magnetic moments of electrons, Langevin theory of Dia and Paramagnetism, Ferromagnetism, Domain theory, Weiss theory of Ferromagnetism, Magnetic relaxation and resonance phenomena

Semiconductors and Superconductivity:

Intrinsic Semiconductors, Extrinsic semiconductors, Band structure, Energy Gap, Donor and acceptor Level, Hall Effect, Superconductivity-an introduction, zero resistivity and Meissner effect, Diamagnetism, susceptibility, Critical field, temperature and current, Type-I and type-II superconductors, BCS theory, electron-phonon-electron interaction via lattice deformation, ground state of superconductors, Cooper pairs, Coherence length, the origin of energy gap, London equations (electrodynamics),London penetration depth, thermodynamics of superconductors, entropy and the Gibbs free energy, Josephson Effect.

Books Recommended:

1. C. Kittle, Introduction to Solid State Physics, 7th edition 1996, John Wiley.
2. S.O.Pillai, Solid State Physics, New Age International Pub. 2003.
3. W.T. Read Jr. Dislocations in crystals, McGraw Hill, 1991.
4. C.M. Kachaava, Solid State Physics, Tata McGraw Hill, Co. New Delhi, 1989
5. J.R. Christman, Solid State Physics, John Wiley & Sons, New York, 1988
6. H.E. Hall, Solid State Physics, John Wiley & Sons, New York, 1982.
7. A. Guinier & R. Jullien, The Solid State, Oxford University Press, Oxford, 1989.

Course Code	Course Title	Credit Hours
Phy-603	**THERMAL AND STATISTICAL PHYSICS**	3(3+0)

Equilibrium Thermodynamics:

Basic postulates, fundamental equations and equations of state, response functions Maxwell's relation, reduction of derivatives

Elements of Probability Theory:

Probabilities, distribution functions, statistical interpretation of entropy, Boltzmann H-theorem

Formulation of Statistical Methods:

Ensembles, counting of states (in classical and quantum mechanical systems, examples) partition function, Boltzmann distribution. Formation of Microcononical, canonical and grand canonical partion function

Partition Function:

Relations of partition function with thermodynamic variables, examples (collection of simple harmonic oscillators, Pauli and Van Vleck paramagnetics, Theorem of equipartition of energy

Statistical Systems:

Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac statistical systems, Examples of thermodynamics of these systems; Black body radiations, Gas of electrons in solids

Statistical Mechanics of Interacting Systems:

Lattice vibrations in solids; Van der Waals Gas: mean field calculation; Ferromagnets in Mean Field Approximation

Advanced Topics:

Fluctuations, Bose-Einstein Condensation, Introduction to density matrix approach

Books Recommended:

1. F. Mandl, Statistical Physics, ELBS/John Willey, 2nd Ed. 1988.
2. F. Reif, Fundamentals of Statistical and Thermal Physics, McGraw Hill, 1965.
3. A.J. Pointon, Introduction to Statistical Physics, Longman 1967.
4. C. Kittel, Elements of Statistical Physics, John Wiley 1958.

EIGHTH SEMESTER

Course Code	Course Title	Credit hours
Phy -651 Phy -652	Computational Physics OR Particle Physics	3(3-0)
Phy -653	Elective-III	3(3-0)
Phy -654	Elective-IV	3(3-0)
Phy -655	Elective-V	3(3-0)
Phy -656	Elective-V/Project/General Viva/Optional Paper	3(3-0)
Total		**15**

Course Code Course Title Credit Hours

PHY-651 **COMPUTATIONAL PHYSICS** 3(3+0)

Computer Languages:

A brief introduction of the computer languages like Basic, C. Pascal etc and known software packages of computation

Numerical Methods:

Numerical Solutions of equations, Regression and interpolation, Numerical integration and differentiation, Error analysis and technique for elimination of systematic and random errors

Modeling & Simulations:

Conceptual models, The mathematical models, Random numbers and random walk, Doing Physics with random numbers, Computer simulation, Relationship of modeling and simulation. Some systems of interest for physicists such as Motion of Falling objects, Kepler's problems, Oscillatory motion, Many particle systems, Dynamic systems, Wave phenomena, Field of static charges and current, Diffusion, Populations genetics etc

Books Recommended:

1. M. L. De Jong, 'Introduction to Computational Physics', Addison Wesley Publishing Company Inc., Massachusetts (1991)
2. S.T. Koonini, Computational Physics', The Benjamin/Coming Publishing Inc., California (1986).
3. P.K. Macheown & D.J. Merman, Computational Techniques in Physics' Adm Hilger, Bristol (1987).
4. H. Gould & J. Tobochnik, 'An Introduction to Computer Simulation Methods', Addison Wesley Publishing Company, Rading Massachusetts(1988).
5. S.C. Chapra & R.P. Chanle, 'Numerical Methods for Engineers with Personal Computer Applications, McGraw Hill Book Company, New York (1965)

Course Code	Course Title	Credit Hours
PHY--651	**PARTICLE PHYSICS**	3(3-0)

Objectives

1. To know the particles and their classification.
2. To learn about the interaction of these particles.
3. To learn about the Quark models.

Ingredients of the Standard Model, Quarks and leptons, Mesons and baryons, Exchange of virtual particles, Strong, electromagnetic and weak interactions, Relativistic kinematics, Invariant mass, thresholds and decays, Conservation laws, Angular momentum, Baryon number, lepton number, Strangeness, Isospin, Parity, charge conjugation and CP, The quark model, Super multiplets, Resonances, formation, production and decay, Heavy quarks, charm, bottom and top, Experimental evidence for quarks, Color, confinement and experimental value, Weak interactions, Parity violation, Helicity, CP violation, K^0 and B^0 systems, The Standard Model and beyond, Quark-lepton generations, Neutrino oscillations, The Higgs boson, Grand Unified Theories, Supersymmetry.

Recommended Books:

1. Martin, B. R. & Shaw, G. Particle Physics John Wiley & Sons Inc., 1997.
2. Perkins, D.H. Introduction to High Energy Physics Cambridge University Press, 2000.
3. Introduction to Elementary Particles by Griffiths, D., John-Wiley and Sons, (1987)

DETAIL OF ELECTIVE COURSES

Group-I

Introduction to Plasma Physics

Objectives:

1. To learn about the importance and application of the plasma physics with some basic understanding of plasma.
2. Plasma medium for wave propagation.

Introduction, Occurrance of plasma, Concept of temperature, Debye shielding, The plasma ammeter, Criteria for plasma. Applications of plasma physics, Single-particle motion in electromegnatic field. Uniform and non-uniform E and B fields, Time-variant E and B fields, Fluid description of plasma, Wave propagation in plasma, Derivation of dispersion relations for simple electrostatic and electromagnetic modes, Introduction to Controlled Fusion, Basic nuclear fusion reactions. Reaction rates and power density, radiation losses from plasma.

Books Recommended:

1. F. F. Chen, *Introduction to plasma Physics and Controlled Fusion*, 2nd ed. (Plenum, 1973).
2. D. H. Nicholson, *Introduction to plasma theory*,(John Wily and sons 19983).
3. G. K. Parks, *Physics of space plasma an Introduction*, 2nd ed. (Westview press 2004).
4. S. Glasstone and R. H. Lovberg, *Controlled Thermonuclear Reactions*, (D. Van Nestrand 1960).

SURFACE PHYSICS

Objectives:

1. To know aout the surface physics and its applications
2. Learn about the interaction of surface with the ions, electrons etc.

An Introduction to Surfaces:

What is a surface? The energetics and thermodynmics of creating a surface. An introduction to surface Physics. Surface energies and the Wulff Theorem.

Studying Surfaces:

What is UHV? Do we need UHV to study surfaces? The kinetic theory of gases, concept of vacuum and standard vacuum hardware components, Comparison of different types of pumps with measurement of vacuum pressure, Preparing a clean surface

Surface Structures and Reconstructions:

Lattice concept, 3 D crystal structures, 2D surface structures. Specific types of surface, fcc, hcp, bcc and stepped surfaces and a discussion of their relative energies. More complex ceconstruction, stability, growth mechanisms, adsorption, Desorption and experimental probes of surface structure such a LEED and RHEED. The structure of semi-conductor surfaces. The surface structures of very small metal particles.

Electron-Surface Interactions:

Electron diffraction and quasi – elastic scattering, comparison of particle scattering techniques, Electron spectroscopes, Discussion of the merits of different types of electron energy analysers and electron deterctors, Signal processing and spectral analysis. Theory and practice of Auger electron spectroscopy, Quantification of Auger spectra, Auger depth, Profiling

Atom/ion surface interactions:

Comparison of particle scattering techniques, An Introduciton to the theory and practice of SIMS, SIMS imaging and depth profiling, Auger depth profiling, theory and practice of Rutherford. Back scattering.

Books Recommended 1. John A. Venables, Introduction to Surface and Thin Film Processes Cambridge University Press (2000).

FLUID DYNAMICS

Objectives

1. To know the fundamentals of Fluid Mechanice and its applications
2. To learn about the computational aspect for solving diffusion equation.

Basic Fluid Mechanics:

Fundamentals of Continuum mechanics, Kinematics of the flow field, the continuity equation, governing equations of fluid motion, Incompressible flows, Compressible flows, Thin aerofoil.

Boundary Layer Theory:

Laminar Boundary layer, Turbulent Boundary layer Reynold‟s number

Computational Fluid dynamics-I:

Introduction to numerical computation, Introduction to numerical solution of Ordinary Differential equation‟s using multi-step methods, Boundary value problems, Introduction to solution of Partial Differential Equiation‟s using finite difference methods Advanced Techniques.

Computational Fluid Dynamics-II:

Governing equations in integral and differential form, Reduced forms of governing equations, The finite volume method, Incompressible and compressible flow & their methods, Discrete methods for the steady state and time dependent advection diffusion equation, The pressure correction method on staggered and unstaggered grids, Time marching schemes, Incorporation of turbulence models, Schemes for solving large algebraic systems, Use of a commercial code for the predication off complex flows.

Experimental Methods:

Introduction to laboratory techniques, Laboratory sessions (preceded by lectures): water waves, air flow past a cylinder aero foils, hydraulic jumps, vortex shedding and vibrations, turbulent jets and plumes.

Books Recommended:

1. H. Lamb, Hydrodynamics, Doer, 6th edition 1993.
2. White, F.M. Viscous flud flow (second Edition), Mcgraw Hill,1991.
3. P.J. Roache, “Computational Fluid Dynamics”, Albuquerque, N.M., Hemosa Publishers.
4. Patankar, S.V., Numerical Heat Transfer and Fluid Flow,Hemisphere, 1980.
5. K.A. Hoffmann and S.T. Chiang. Computational Fluid Dynamics for Engineers, Vol.1 & 11, 1993.

METHODS OF EXPERIMENTAL PHYSICS

Objectives:

1. To learn about the vacuum techniques
2. To learn the detection techniques about radiation, temperature.

3. To learn about the measuring techniques along with data analysis.

Vacuum Techniques:

Gas Transport: Throughout, Pumping Speed, Pump down Time Ultimate pressure. Fore-Vacuum Pumps: Rotary Oil pumps; sorption pumps. Diffusion pumps, sorption pumps (High Vacuum). Production of ultrahigh vacuum; Fundamental concepts; guttering pumps; Ion pumps; Cryogenic pumps; Turbo molecular pumps, Measurement of total pressure in Vacuums Systems; Units pressure ranges; Manometers; Perini gauges; The McLoad gauges; Mass spectrometer for partial measurement of pressure. Design of high Vacuum system; Surface to Volume ratio; Pump Choice; pumping system design Vacuum Components; Vacuum valves; vacuum Flanges; Liquid Nitrogen trap; Mechanical feed throughs & Electrical feed throughs Leak detection: Basic consideration; leak detection equipment; Special Techniques and problems; Repair Techniques.

Radiation Detection and Measurement: GM tubes, scintillation detector, channeltron, photo multipliers, neutron detectors, alpha/beta detectors, x-rays/gamma detectors, cosmic rays detectors, Spectrographs and Interferometers.

Sensor Technology:

Sensors for temperature, pressure displacement, rotation, flow, level, speed, rotation position, phase, current voltage, power magnetic field, tilt, metal, explosive and heat.

Electronics and Electronic Instruments:

Operational amplifiers, summing amplifiers, difference amplifiers, Differentiators, Integrators, Logarithmic amplifiers, current to voltage converter, Spectroscopy amplifiers, charge sensitive pre-amplifiers, Coincidence circuits, Isolators, Ramp Generators, and single channel analyzer. Power supplies, Signal Generators, Counters, Multichannel analyzer, Lock in Amplifiers, Boxcar averages.

Computer Introduction:

Introduction to computers, GPIB Interface, RS 232. Interfacing, DA/AD conversion, Visual c/visual Basic.

Data Analysis:

Evaluation of measurement: Systematic Errors, Accuracy; Accidental Errors, Precision, Statistical Methods; Mean Value and Variance; Statistical Control of Measurements; Errors of Direct measurements, Rejection of data; Significance of results; Propagation of errors; preliminary Estimation; Errors of Computation. Least squares fit to a polynomial. Nonlinear

functions. Data manipulation, smoothing, interpolation and extrapolation, linear and parabolic interpolation

Books Recommended:

1. H.D.Young, Statistical Treatment of Methods of Experimental Physics, Academic Press, Inc. New York & London Vol.1.
2. J. Yarwood, High Vacuum Techniques, Chapman Hall
3. P. Bevington, Data Reduction and Error Analysis for Physical Science, McGraw Hill.
4. J.B.Toping, Errors of Observations, IOP, 1962.

ENVIRONMENTAL PHYSICS

Objective:

1. To become familiar with the essentials of environment and Global climate
2. To learn to use spectroscopy for environments.

Introduction to the Essentials of Environmental Physics:

The economic system, living in green house, enjoying the sun, Transport of matter, Energy and momentum, the social and political context

Basic Environmental Spectroscopy:

Black body radiation, The emission spectrum of sun, The transition electric dipole moment, The Einstein Coefficients, Lambert – Beer‟s law, The spectroscopy of bi-molecules, Solar UV and life, The ozone filter.

The Global Climate:

The energy Balance, (Zero-dimensional Greenhouse Model), elements of weather and climate, climate variations and modeling

Transport of Pollutants:

Diffusion, flow in reverse, ground water. Flow equations of fluid Dynamics, Turbulence, Turbulence Diffusion, Gaussian plumes in air, Turbulent jets and planes.

Noise: Basic Acoustics, Human Perceptions and noise criteria, reducing the transmission of sound, active control of sound.

Radiation: General laws of Radiation, Natural radiation, interaction of electromagnetic radiation and plants, utilization of photo synthetically active radiation

Atmosphere and Climate:

Structure of the atmosphere, vertical profiles in the lower layers of the atmosphere, Lateral movement in the atmosphere, Atmospheric Circulation, cloud and Precipitation, The atmospheric greenhouse effect

Topo Climates and Micro Climates: Effects of surface elements in flat and widely unduling areas, Dynamic action of seliq. Thermal action of selief

Climatology and Measurements of Climate Factor: Data collection and organization, statistical analysis of climatic data, climatic indices, General characteristics of measuring equipments. Measurement of temperature, air humidity, surface wind velocity, Radiation balance, precipitation, Atmospheric Pressure, automaticweather stations.

Books Recommended:

1. Egbert Booker and Rienk Van Gron Belle, Environmental Physics, 2 nd ed. J. W. and sons. 1999.

2. Physics of Environmental and Climate, Guyot Praxis Publication. 1998.

INTRODUCTION TO QUANTUM COMPUTING

Objectives

1. To be familiar with the quantum computing
2. To learn about the Quantum circuits, and cryptography

Computer technology and historical background; Basic principles and postulates of quantum mechanics: Quantum states, evolution, quantum measurement, superposition, quantization from bits to qubits, operator function, density matrix, Schrodinger equation, Schmidt decomposition, EPR and Bell‟s inequality; Quantum Computation: Quantum Circuits,

Single qubit operation, Controlled operations, Measurement, Universal quantum gates, Single qubit and CNOT gates; Breaking unbreakable codes: Code making, Trapdoor function, One time pad, RSA cryptography, Code breaking on classical and quantum computers, Schor‟s algorithm; Quantum Cryptography: Uncertainty principle, Polarization and Spin basis, BB84, BB90, and Ekert protocols, Quantum cryptography with and without eavesdropping, Experimental realization; Quantum Search Algorithm.

Books Recommended:

1. Quantum Computation and Quantum Information by M. A. Nielson and I. L. Chuang, Cambridge University Press, Cambridge 2000.
2. Exploration in Quantum Computation by C.P. Williams and S. H. Clearwater, Springer Verlag (1997).
3. The Physics of Quantum Information: Quantum Cryptography, Quantum Teleportation, Quantum Computation by P. Bouwmester, A.Ekert, and A. Zeilinger, Springer Verlag, Berlin, Heidelberg (2000).
4. Mathematics of Quantum Computation by A.K.Brylinsky and G. Chen, Chapman & Hall/CRC (2002).

EXPERIMENTAL NUCLEAR PHYSICS

Objectives

1. To learn the nuclear detection system and techniques fr their measurements
2. To learn about the charged particles accelerator and nuclear reactor
3. To develop understanding of neutrons physics

Nuclear Radiation Detection and Measurements:

Interaction of nuclear radiation with matter; photographic emulsions; Gas-filled detectors; Scintillation counters and solid-state detectors; Cloud chambers; Bubble chambers.

Charged Particle Accelerators:

Linear and orbital accelerators Van de Graaff, Cyclotron; Betatron; Synchrocyclotron; Electron-Synchrotrons; Proton-synchrotron; Alternating-gradient Synchrotron.

Neutron Physics:

Neutron Sources, Radioactive sources, Photo neutron sources Charged particle sources, Reactor as a neutron source, slow neutron detectors, fast neutron detectors, Measurement of neutron

cross-sections as a function of energy, slowing down of neutrons, Nuclear fission, Description of fission reaction, Mass distribution of fission energy, Average number of neutrons released, Theory of fission and spontaneous fission, Nuclear chain reaction and applications.

Elementary Reactor Physics:

Controlled fission reactions, Types of nuclear reactors (Power and Research), Detailed study of PWR and CANDU type reactors.

Books Recommended:

1. Glenn, F. Knoll, Radiation Detection and Measurement, John Wiley, 1989.
2. William, R. Leo, Techniques for Nuclear and Particle Physics, Spinger, 1994.
3. Philips Berington and D. Keith, Data Detection and Error analysis for physical sciences, 2002.
4. Segre, Nuclei and Practicles, Bejamin, 1977.
5. Kenneth S. Krane, Introducing Nuclear Physics, 1995.
6. B. Povh, K. Rith, C. Scholtz, F. Zetsche, Particle and Nuclei, 1999.

LASERS

Objectives

1. Develop fundamental concepts about lasers
2. Learn the principles of spectroscopy of molecules and semi-conductos
3. Understand the optical resonators and laser system.
4. Applications of lasers

Introductory Concepts:

Spontaneous Emission, Absorption, Stimulated Emission, Pumping Schemes, Absorption and Stimulated Emission Rates, Absorption and Gain Coefficients, Resonance Energy Transfers. Properties of Laser Beam: Monochromaticity, Coherence, Directionality, Brightness, Laser Applications

Spectroscopy of Molecule and Semiconductors:

Electronic Energy Levels, Molecular Energy Levels, Level Occupation at Thermal Equilibrium, Stimulated Transition, Selection Rules, Radiative and Nonradiative Decay, Semiconductor.

Pumping Processes:

Optical pumping: Flash lamp and Laser, Threshold Pump Power, pumping efficiency, Electrical Pumping: Longitudinal Configuration and Transverse Configuration, Gas Dynamics Pumping, Chemical Pumping.

Lasers ystems:

Solid State Lasers: Ruby Laser, Nd: YAG & Nd: Glass Lasers and Semiconductor Lasers: Homojunction Lasers Double-Heterostructure lasers, *Gas lasers:* Helium Neon laser, CO2 laser, Nitrogen Laser and Excimer Lasers, *Free-Electron and X-Ray Lasers*

Books Recommended

1. O. Svelto, Principles of Lasers, Plenum Press New York & London (1992).

2. J. Eberly and P. Milonni, Lasers, Wiley, New York, (Latest Edition) Scully and Zubairy, Quantum Optics, Cambridge University Press (1997)

3. A.E. Siegman, Laser, University, Science Books Mill Valley, C.A. (1986)

4. H. Haken, Laser Theory, Springer, Berlin (Latest Edition)

5. W. T. Silfvast, Laser Fundamentals, latest edition.

COSMOLOGY

Objectives

1. To learn about the Special theory of relativity
2. To learn the basics of relativistic mechanics and develop understanding about the General theory.

Special Relativity:

Galilean relativity, concept of ether, Michelson-Morley experiment, Einstein‟s postulates of special relativity, Lorentz transformations, structure of space-time, Minkowski space time tensors, the light-cone, line element, four-vectors, relativity of simultaneity, time dilation, proper time, length contraction, time paradox, velocity transformation and velocity addition.

Relativistic Mechanics:

Force equation in relativity, rest mass, kinetic and total energy, conservation of energy and momentum.

Elements of Tensor Calculus: Manifolds and coordinates, curves and surfaces, tensor fields, Lie derivative, geodesics, Riemann tensor, metric tensor.

Introduction to general relativity:

Cosmology: Newtonian cosmology, cosmological red-shift, Hubble‟s law, microwave background, the Big Bang expansion rate, matter and radiation domination, history of the universe.

Books Recommended:

1. W.D.McComb, Dynamics and Relativity, Oxford University Press, 1999.
2. J.V.Narlikar, Introduction to Cosmology, Cambridge University Press, 1989.
3. R.D.D‟Inverno, Introducing Einstein‟s Relativity, Oxford University Press, 1992.

Introduction to Nanophysics and Nanotechnology

Objectives:

- To understand the basic principles of nanophysics and nanotechnology
- To deal with the measurement techniques for the properties of nanoscale materials and devices
- To deal with the fabrication, properties and applications of semiconductor nanostructure and carbon nanomaterial.

Introduction to nanophysics and nanotechnology, scaling laws and limits to smallness, quantum nature of nanoworld, nano fabrication, nanoscopy, electron microscopy, atomic force microscopy, scanning tunneling microscopy, properties and application of semiconductor nanostructures, fabrication of semiconductor nanowires and quantum dots, electronic and optical properties, optical spectroscopy of semiconductor nanostructures, carbon nanostructures, nanomagnets.

Recommended Books:

1. Introduction to Nanotechnology, Charles Poole Jr., F. J. Owens, John Wiley & Sons, Inc., 2003.
2. Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Edward L. Wolf, Wiley-VCH 2006.
3. Nanotechnology Applications to Telecommunications and Networking, Daniel Minoli, John Wiley & Sons, Inc., 2006.

4. Nano, The Essentials: Understanding Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw-Hill Publishing Company Limited, 2007.
5. Carbon Nanotubes: Basic Concepts and Physical Properties, S. Reich, C. Thornsen, J. Maultzsch, Wiley-VCH Verlag GMBH &Co. KGaA, 2004.
6. Nanoscale Science and Technology, Eds. R. W. Kelsall, I. W. Hamley and M. Geoghegan, John Wiley & Sons, 2005.

Dielectric and Optical Properties

Objectives:

1. To understand the dielectric properties in solids
2. To understand the interaction of electromagnetic waves with matter
3. To understand the response of materials in electric and magnetic fields
4. To understand basics of micro-structure changes that affect the physical properties of a material.

Matter polarization and relative permittivity, electronic polarization, covalent solids, various polarization mechanisms, frequency dependence of relative permittivity, dielectric loss, dielectric strength and insulation breakdown, capacitor dielectric materials, piezoelectricity, ferroelectricity, pyroelectricity, refractive index and light absorption, refractive index wavelength behavior, group velocity and group index, lattice absorption, band-to-band absorption, light scattering in materials, attenuation in optical fibers, optical anisotropy, uniaxial crystals and Fresnel's optical indicatrix, birefringence of calcite, dichroism, optical activity and circular birefringence, electro-optic effects.

Recommended Books:

1. Dielectric Materials and Applications, Arthur R. Von Hippel, Artech House; 1995.
2. Optical Properties of Dielectric Films, Norman N Axelrod, Electrochemical Society, 1968.
3. Dielectric Materials: Introduction, Research and Applications, R. N. P. Choudhary, S. K. Patri, Nova Science Publishers Inc. 2009.

Quantum Field Theory

Objectives:

1. To understand the application of QFT

2. To understand the quantization of electromagnetic field

Preliminaries, Classical Lagrangian Dynamics, Lagrangian Field Theory, Global and Local Symmetries, Noether's Theorem, Canonical Quantization, From Classical to Quantum Mechanics, Quantum Fields and Causality, Canonical Quantization of Scalar Field Theory, Complex Fields and Anti-Particles, The S-Matrix in Quantum Field Theory, Time Evolution of Quantum States and the S-Matrix, Feynman Propagator and Wick's Theorem, Transition Amplitudes and Feynman Rules, Particle Decays and Cross Sections, Unitarity and the Optical Theorem, Quantum Electrodynamics, Weyl and Dirac Spinors, Quantization of the Fermion Field, Gauge Symmetry, Quantization of the Electromagnetic Field, the Photon Propagator and Gauge Fixing, Becchi-Rouet-Stora Transformations, Feynman Rules for Quantum Electrodynamics,·Renormalization, Renormalizability, Dimensional Regularization, Renormalization of a Scalar Theory, Displacement Operator Formalism of Renormalization to All Orders, Renormalization Group Equation, Anomalous magnetic moment and the Lamb shift.

Recommended Books:

1. F. Mandl and G. Shaw, Quantum Field Theory, Wiley, 1992.
2. M. E. Peskin and D. V. Schroeder, Quantum Field Theory, Perseus Books Group, 1995.
3. T. P. Cheng and L. F. Li, Gauge Theory of Elementary Particle Physics, Oxford University Press, 1984.
4. S. Pokorski, Gauge Field Theories, Cambridge University Press, 2000.
5.

Relativistic Quantum Mechanics

Objectives:

1. To understand the basics of relativistic quantum mechanics
2. To understand its application in high energy Physics

Relativistic Quantum Mechanics of Spin ½ particles, Probability conservation in relativistic quantum mechanics, The Dirac equation, simple solutions, no relativistic approximations, plane waves, covariant perturbation theory, Natural units and dimensions, S-matrix expansion in the interaction representation, first-order processes, Mott scattering and hyperons decay, Two-photon annihilation and Compton scattering, the electron propagator, Mass and charge renormalization radioactive corrections, Greens functions and field theory (fermions), pictures, Green’s functions, Wicks’s theorem, diagrammatic analysis of perturbation theory. Fermi systems, HartreeFock

approximation, imperfect Fermi gas, Degenerate electron gas, Linear response and collective modes, General theory of linear response to an external perturbation, Boss systems, Green's functions, perturbation theory and feyman rules, Weakly interacting Boss gas, Finite temperature formalism, Field theory at finite temperature, physical systems at finite temperature, HartreeFock approximation, imperfect Bose gas near Tc, specific heat of an imperfect Fermi gas at low temperature, Electron gas, Real-time Green's functions and linear response.

Recommended Books:

1. Advanced Quantum Mechanics, J. J. Sakurai Addison-Wesley 1980.
2. Quantum Theory of Many-Particle Systems, A L Fetter. J D Walecka, McGraw Hill 1978.
3. Relativistic Quantum Mechanics, J D Bjorken and S D Drell McGraw Hill 1984.
4. Introduction to Quantum Mechanics R H Dicke Addison Wesley 1980.

Superconductivity

Objectives:

1. To give basic understanding of superconductivity
2. To understand the transport mechanism in a material at low temperature inside a magnetic field
3. To understand quantum theory of conductivity
4. To understand different transitions in material phases under enormous conduction

Phenomenon of superconductivity, the thermodynamics transition, the MeissnerOchsenfeld effect, the critical field, the energy gap, Coulomb interaction between electron, the Bose-Einstein gas model, the quasi-chemical equilibrium theory, the concept of electron pairs as quasi molecules, thermodynamic of chemical equilibrium, treatment of the ground state, the BCS and Bogoliubov theories at zero temperature, thermodynamics in the quasi-equilibrium theory, the Meissner effect, persistent currents, quantumtheory of normal conductivity.

Recommended Books:

1 Theory of Superconductivity, John M. Blatt, Academic Press New York, 1984.

2 Theory of Superconductivity, Lane M. Von, Academic Press New York, 1994.

3 Superconductivity Electronics, Kohara, Prentice Hall, 1987.

4 High Temperature Superconductivity, Ten years after its discovery, K. B. Grag& S. M. Bose, Narosa Publishing London, 1998.

Semiconductor Devices

Objectives

1. To develop the understanding of different electronic circuit elements and devices like diode, transistors, amplifiers, oscillators and voltage regulators used in daily life alliances
2. To understand the day to day electronic devices
3. To understand the basics of conduction in semiconductors

Semiconductor principles, survey of semiconductor chemistry, semiconductor crystal growth, control of composition in semiconductor, defect interactions in semiconductors, diffusion processes in Germanium and Silicon, the chemistry of some compound semiconductors, group-iv semiconductors, properties of some covalent semiconductors, infrared absorption of semiconductors, recombination and trapping effect of imperfections on Germanium and Silicon, semiconductor electrodes.

Recommended Books:

5. Semiconductor Physics and Devices,Basic Principles, Donald A. Neamen, McGraw Hill, 2003.
6. Semiconductors, N. B. Hannay, Reinhold Publishing Corporation, 1989.
7. Electron and Holes in Semiconductors, W. Shockley, Princeton, D. Van, 1988.

Electron Microscopy-I

Objectives:

- To understand the Basic optics and image formation of scanning and transmission electron microscopes.
- To develop a thorough understanding of all operating modes of an electron microscope.
- To have a practical knowledge concerning the applicability of electron microscopy to materials science

Basic opticsand operation of scanning and transmission electron microscopes.Image formation, modes ofcontrastand resolution in SEM and TEM.Electron diffraction. Images of perfect crystals and defects in two-beam diffraction contrast, Analytical microscopy of specimen preparation and insitu microscopy.

Recommended Books:

1. Practicalscanning Electron Microscopy Goldstein, J.I. Yokowitz, H Plenum Press, New York 1977.
2. Electron Microscopy in the study of Materials, Grundy, P.J. and Jones, G A, Edward Annold, Limited 1976.
3. Transmission Electron Microscopy Thomas, G and Goringe, M. J Jones Wiley & Sons, New York 1979.
4. Practical Analytical Electron Microscopy in Material Science: WilliamD B Philips Electronics Instruments 1983.

Electron Microscopy-II

Objectives:

- To understand the Basic optics and image formation of scanning and transmission electron microscopes.
- To develop a thorough understanding of all operating modes of an electron microscope.
- To have a practical knowledge concerning the applicability of electron microscopy to materials science

Students will be instructed in the proper use of a scanning and a transmission electron microscope, allstages from initial alignment of the instrument to presentation of the result will be covered. Three or four projects will be completed, including obtaining atomic lattice fringeimages and x-ray microanalysis.

Recommended Books:

1. Practicalscanning Electron Microscopy Goldstein, J.I. Yokowitz, H Plenum Press, New York 1977.
2. Electron Microscopy in the study of Materials, Grundy, P.J. and Jones, G A, Edward Annold, Limited 1976.

3. Transmission Electron Microscopy Thomas, G and Goringe, M. J Jones Wiley & Sons, New York 1979.
4. Practical Analytical Electron Microscopy in Material Science: WilliamD B Philips Electronics Instruments 1983.

Magnetic Resonance Imaging (MRI)

Objectives:

- To understand the basic principles of magnetic resonance imaging.
- To utilize appropriate MR pulse sequences in MR imaging.
- To describe techniques in manipulating MR parameters to optimize image quality.
- To explain proper selection and usage of MR coils to optimize image quality.

A Preview, Nuclear Magnetization, and the Bloch Equation, The Quantum Mechanical Basis of Precession and Excitation, The Quantum Mechanical Basis of Thermal Equilibrium and Longitudinal Relaxation, Signal Detection Concepts, Introductory Signal Acquisition Methods, Free Induction Decay, Spin Echoes, Inversion Recovery and Spectroscopy, One Dimensional Fourier Imaging, k Space and Gradient Echoes, Multi-Dimensional Fourier Imaging and Slice Excitation, NMR Signal, Continuous and Discrete Fourier Transforms, Sampling and Aliasing in Image Reconstruction, Filtering and Resolution in Fourier Transform Image Reconstruction, Projection Reconstruction of Images, Signal, Contrast and Noise, Fast Imaging in the Steady State, Spin Density, T-1 and T-2 Quantification Methods in MR Imaging, Introduction to MRI Coils and Magnets.

Recommended Books:

1. Magnetic Resonance Imaging: Physical Principles and Sequence Design, E. Mark, Robert W. Brown, Michael R. Thompson, Ramesh. V. Willy, 1999.
2. Functional Magnetic Resonance Imaging, Second Ed., S. A. Huettel, A. W. Song, G. McCarthy, Sinauer Associates Inc., 2008.
3. Handbook of MRI Pulse Sequences, 1st ed., Bernstein, K. F. King, X. J. Zhoa, Academic press, 2004.

Metal Nanoparticles Diffusion in Solids

1. To understand fundamentals of diffusion in solids
2. To understand different laws of diffusion and Nernst-Plank molar flux equation
3. To understand different types of diffusion and their relevant modifications in the structure of a material

Fundamentals of Diffusion, Continuum Theory of Diffusion, Fick's Laws in Isotropic Media, Fick's First Law, Equation of Continuity, Fick's Second Law, Solutions of the Diffusion Equation, Steady-State Diffusion, Random Walk Theory and Atomic Jump Process, Atomic JumpProcess, Point Defects in Crystals, Diffusion Mechanisms, Interstitial Mechanism, Collective Mechanisms, Vacancy Mechanism, Divacancy Mechanism, Interstitially Mechanism, Interstitial-substitutional Exchange Mechanisms, Correlation in Solid-State Diffusion, Interstitial Mechanism, Vacancy Mechanism of Self-diffusion, Vacancy-mediated Solute Diffusion, Dependence of Diffusion on Temperature and Pressure, Activation Volumes of Self-diffusion, Activation Volumes of Ionic Crystals, Interdiffusion and Kirkendall Effect,Diffusion and External Driving Forces, Fick's Equations with Drift, Nernst-Einstein Relation.

Recommended Books:

1. Fundamentals, Methods, Materials, Diffusion-Controlled Processes, Mehrer, Helmut, Springer Series in Solid-State Sciences, Vol. 155, 2007.
2. Introduction to glass science and technology, J. E. Shelby, Royal Society of Chemistry, 2005.

Radiation Detection & Measurement

Objectives

1. To learn basics of radiation interaction with matter.
2. To learn the various detection techniques about radiation.
3. To learn the basics of nuclear electronics.

Particle Detection, Review of atomic and nuclear physics, Natural and Man-made sources of radiations, Radioactive decays, characteristic and bremsstrahlung X-rays, Interactions of photons

with matter, Interaction of neutrons with matter- Elastic and inelastic scattering and cascade reactions, Interactions of charged particles with matter- Elastic, inelastic, Semi-classical derivation of Bethe's formula of stopping power, Energy loss for electrons and heavy ions, Ionization, Recombination effects, Principle and operating characteristics of ionization chambers, Proportional and Geiger Mueller Counters, Scintillation mechanism in organic and inorganic detectors, Principle and operating characteristics of various types of scintillation detectors, Gamma Spectroscopy, Uses and operational characteristics of surface-barrier semiconductor detectors and Lithium-drifted &Hyper-pure Germanium (HPGe) detectors, Slow and fast neutron detection methods and spectroscopy, Thermoluminiscence (TL) dosimetery, Nuclear Electronics, Nature of information provided by the detectors, pulse shapes and times, preamplifiers and their functions, Main amplifiers, Pulse-shaping networks, integration and differentiation circuits, pole zero cancellation, Signal to noise ratio, Coincidence units, Analogue to digital converter (ADC), Multi-channel analyzers.

Recommended Books:

1. Radiation Detection and Measurements, 3rd Ed., Glen F Knoll, John Wiley & Sons, Inc. 1999.
2. Nuclear Radiation Detection, 2nd Ed., W. J. Price, McGraw Hill,1964.
3. Atoms, Radiation, and Radiation Protection, James E. Turner, John Wiley & Sons, Inc. 1995.

Radiation Physics

Objectives:

1. To understand the mechanism of formation of radiation sources
2. To understand interaction of radiation with matter
3. To know the energy loss mechanism of these radiations in matter

Review of atomic physics, Review of nuclear physics, Types of radiation and their characteristics, Penetrating power of radiations, Natural and Man-made sources of radiations, Transition probabilities. Radioactive decays and radiations, Electron capture, conversion electron, decay constant, characteristic and bremsstrahlung x-rays, Auger electrons, Interactions of photons with matter - Photoelectric absorption, Compton Scattering, pair production, Rayleigh, Thomson, and Raman scatterings, and photonuclear interactions. Interaction of neutrons with matter- Elastic and inelastic scattering and cascade reactions, radiative capture, charged-particle emission, Effect of target structure and atomic motion. Interactions of charged particles with matter- Elastic, inelastic:

excitation, ionization, and bremsstrahlung. Semi-classical derivation of Bethe's formula of stopping power. Radiation effects on matter.

Recommended Books:

1. Introduction to Radiological Physics and Radiation Dosimetry, Attix, F.H., Wiley, New York 1986.
2. Radiation Dosimetry, Attix, F.H., Roesch, W.C., Tochilin, E., Academic Press, New York 1968.
3. The Atomic Nucleus, Evans, R.D., McGraw-Hill, New York 1955.
4. The Fundamentals of Radiological Science, Hale, J., Thomas, Springfield, IL 1974.
5. The Physics of Radiology, Johns, H.E., Cunningham, J.R., Thomas, Springfield, IL 1984.
6. The Dosimetry of Ionizing Radiation, Kase, K.R., Bjarngard, B.E., Attix, F.H. Eds, Academic Press, San Diego, CA 1985.
7. The Physics of Radiation Therapy, Khan, F., 3rded, Lippincott, Williams and Wilkins, Baltimore, MD 2003.
8. Modern Physics from A to Z, Rohlf, J.W., Wiley, New York 1994.
9. Clinical Radiotherapy Physics, Jayaraman, S., Lanzl, L.H., CRC Press, Boca Raton, FL 1996.
10. Atoms, Radiation, and Radiation Protection,James E. Turner 3rd Ed., Wiley-VCH Verlag GmbH &Co.KGaA, 2000.
11. Nuclear Reactor Theory, J. R. LamarshAddison-Wesley, Reading, 1966.
12. The Elements of Neutron Interaction Theory,A. Foderaro, MitPrSeptember 15, 1971.
13. A primer in Applied Radiation Physics, F.A. Smith, World Scientific Co. Pte. Ltd 2000.
14. Nuclear Radiation Physics, Howard Lucius Andrews, Prentice Hall, 4thRevised ed.ed.Dec 1972.
15. Elementary Radiation Physics, G.S. Turner & J E Hurst,Wiley, New York 1970.

Heavy Ion Physics

Objectives:

1. To understand the kinematics of heavy ion collisions
2. To learn the reaction cross section nucleon-nucleon and nucleus-nucleus interaction.

Kinematics of Ion-Ion Collisions, Strong Absorption Models of Heavy Ion Scattering, Light Scattering System, Elastic Scattering and Reaction Cross sections, Possible reactions in heavy ion collisions like distant, grazing and close collision, reaction cross section, classical theory of elastic scattering, gross properties of heavy ion collisions e.g. channels, Q-values, heavy ion interaction potential, compound nucleus formation between two heavy ions.

Recommended Books:

1. Nuclear Reactions with Heavy Ion Physics, R. Bass, Springer, 1st Ed.ed.2010.
2. Treatise on Heavy Ion Science, Ed. D.A. Bromley, Mishawaka, IN, U.S.A. 1984.

Heavy Ion Collisions, Ed. R. B

Luminescence of Solid Materials

Objectives:

1. To understand the basics of luminescence in solid materials.
2. Different mechanisms involved in the luminescence process in different materials.
3. To know the experimental techniques for the measurements of luminescence.

Theory of luminescence, Characteristics of Luminescence, Fundamentals of the Quantum theory of radiation, Theoretical model and mechanism of luminescence, Experimental techniques of luminescence measurements , Absorption and luminescence spectroscopy, Spectroscopic components, Time-resolved spectroscopy, Hole-burning, Fluorescence line-narrowing and Photon echo, Quantum efficiency and non-radiative processes, New developments, Photoluminescence, Classification of photoluminescence in solids, Band to band luminescence, Wannier exciton luminescence, Characteristics of localized center luminescence, Extrinsic luminescence of unlocalized type, Extrinsic luminescence of localized type, Thermoluminescence, Thermoluminescence model, Thermoluminescence mechanism, Methods of analysis, Applications.

Recommended Books:

1. Luminescence of Solids, D. R. Vij, Plenum Press New York, 1998.
2. Luminescence, From Theory to Applications, R. Ronda (WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, 2008.
3. Luminescence Materials, G. Blasse, B. C. Grabmaier, (Springer-Verlag, 1994.

Inorganic Scintillations for Detector Systems

Objectives:

1. To know the scintillation mechanism involved in scintillation materials.
2. To understand the interaction of radiation with scintillation materials
3. To know the requirement of scintillation materials in different applications.

Basic Principles and Processes, Physical mechanism of scintillation, Creation of electron hole pairs, Excitation and emission of luminescence centers, Scintillation Materials, Halides, Oxides and Oxides systems, Interaction of Ionization radiation with scintillators, High energy photons, Charged particles, Neutral particles, General characteristics of inorganic scintillators, Light yield, Duration of scintillation pulse, Afterglow, Temperature response, Optical properties, Radiation hardness, Density, Cost considerations, Conversion of Electronic Excitations in Solids, Charge carriers behavior, Energy losses, Scintillation yield spectra, Intrinsic Luminescence of Inorganic Scintillators, Excitonic luminescence, Core to valance transition, Defect Formation by Ionizing Radiation, Mechanism of defect formation, Efficiency of defect production, Formation time of F-H pairs.

Recommended Books:

1. Physical Process in Inorganic Scintillators, Piotr, A. Rodnyi, CRC Press, Boca Raton New York 1997.
2. Inorganic Scintillators for Detector Systems, Springer-Verlag Berlin Heidelberg 2006.
3. Inorganic Scintillators for Modern and Traditional Applications, M. Globus, B. Grinyov, J. K. Kim, Institute for single crystals Ukrain-Kharkiv, 2005.

Introduction to renewable energies

Objectives:

1. To learn about the fossil fuel energy and renewable energy
2. To understand the basics about the solar energy

Background, Renewable energy, Terawatt challenge, introduction to some renewable energy sources, Hydrogen as a fuel of the future, Solar energy and the hydrogen economy ,Water splitting, Photosynthesis, Fuel fells, Basic properties of the sun , The Spectral distribution of the sun as a radiation source, The Earth's atmosphere as a filter , Spectral response of materials, Electrolysis of water, Alkaline electrolyzer, Proton exchange membrane electrolyzer, Direct conversion of

concentrated sunlight to electricity, Theory of direct solar thermal hydrogen generation, Direct solar thermal hydrogen processes, Indirect solar thermal hydrogen processes, Theory of hybrid solar hydrogen generation, Hydrogen evolution catalysts. Photocatalytic activity.

Books Recommended:

1. Solar Hydrogen Generation: Toward a Renewable Energy Future, Krishnan Rajeshwar, Robert McConnell, Stuart Licht, 2008.
2. On Solar Hydrogen & Nanotechnology, Lionel Vayssieres, 2009.
3. Light, Water, Hydrogen: The Solar Generation of Hydrogen by Water Photoelectrolysis, Craig A. Grimes, Oomman K. Varghese, Sudhir Ranjan, 2007.
4. Photocatalysis: Science and Technology, Masao Kaneko, Ichiro Okura, 2002.