Scheme of Study

MSC Physics

Department of Physics (ULM)

University of LakkiMarwat, LakkiMarwat, KPK.

Scheme of Studies MSc Physics

Year	Semester	Course Code	Course Title	(CrH)
1st Year	1st	PHY-351	Mathematical Methods of Physics-I	(3)
		PHY-321	Electrodynamics-I	(3)
		PHY-311	Classical Mechanics	(3)
		PHY-391	Introductory Electronics	(3)
		EW-	English Study Skills	(3)
		PHY-311L	Lab-I	(1)
		Total Credit Hours Per Semester		**16**
	2nd	PHY-352	Mathematical Methods of Physics-II	(3)
		PHY-322	Electrodynamics-II	(3)
		PHY-331	Quantum Mechanics-I	(3)
		PHY-241	Heat and Thermodynamics	(3)
		EW-	Communication skills	(3)
		PHY-391L	Lab-II	(1)
		Total Credit Hours Per Semester		**16**
2nd	3rd	PHY-393	Nuclear Physics-I	(3)
		PHY-441	Solid State Physics-I	(3)
		PHY-372	Statistical Mechanics	(3)
		PHY-432	Quantum Mechanics-II	(3)
		PHY-231	Computational Physics	(3)
		PHY-393L	Lab-III	(1)
		Total Credit Hours Per Semester		**16**
	4th	PHY-433	Atomic and Molecular Physics	(3)
		PHY-442	Solid State Physics-II	(3)
		PHY-493	Nuclear Physics-II	(3)
		PHY-XXX	Elective-I	(3)
		PHY-XXX	Elective-II	(3)

		Project	(3)
	PHY-433L	Lab IV	(1)
	Total Credit Hours Per Semester		**16**

Total Credit Hrs: 64

MSC Physics Course Outline

PHY-311　　　　　　**ClassicalMechanics**　　　　　　**CreditHrs: 03**

Course Contents

Review of Newtonian Mechanics: Frame of reference, orthogonal transformations, angular velocity and angular acceleration, Newton's laws of motion, Galilean transformation, conservationlaws,systemsofparticles,motionunderaconstantforce,motionsundervariable force, time-varying mass system.

The Lagrange Formulation of Mechanics and Hamilton Dynamics: Generalized co-ordinates and constraints, D-Alembert's principle and Lagrange's Equations, Hamilton's principle, integrals of motion, non-conservative system and generalized potential, Lagrange's multiplier method, the Hamiltonian of a dynamical system, canonical equations, canonical transformations, Poisson brackets, phase space and Liouville's theorem.

CentralForceMotion: Thetwo-bodyproblem,effectivepotentialandclassificationoforbits, Kepler'slaws,stabilityofcircularorbits,hyperbolicorbitsandRutherfordscattering,centerof mass co-ordinate system, scatteringcross-sections.

Motion in Non- inertial Systems: Accelerated translational co -ordinate system, dynamics in rotating co-ordinate system, motion of a particle near the surface of the earth.

The Motion of Rigid Bodies: The Euler angles, rotational kinetic energy and angular momentum, the inertia tensor, Euler equations of motion, motion of a torque-freesymmetrical top, stability of rotationalmotion.

Recommended Books:
1. T. L. Chow, "Classical Mechanics", John Wiley, 1995.
2. T. Kibble and F. Berkshire, "Classical Mechanics", World Scientific, 5th ed. 2004.C
3. Classical Mechanics, H. Goldstein, 3rd Ed., Addison Wesley Reading, Massachusetts, 2006
4. Classical Dynamics of Particles and System, Jerry B. Marian, Stephen T. Thornton, 4th Ed., Harcourt Brace & Company, 1995.
5. Classical Mechanics, A. Douglas Davis, Academics Press, 1986HEME

PHY- 351　　　　**Mathematical Methods ofPhysics-I**　　　**CreditHrs:03**

Objective(s)

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

Course Contents:

Vector Analysis

Review of vectors Algebra, Vector operations, Physical significance of DEL operator, Line integrals, Surface and Volume Integrals, Gradient of a scalar, Divergence of a vector , Directional derivatives and gradients, Curl of a vector , Gauss's divergence theorem, Green's theorem, Vector differentiation and gradient, Vector integration, , Stokes's Curl theorem, , Cartesian coordinates systems, Polar coordinates systems, Spherical polar and Cylindrical coordinates systems.

Matrices:

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

Complex Variables:

Complex numbers , Functions of a complex variable, analytic functions of complex variables, De Moivre's theorem, Taylor and Laurent series, Cauchy Riemann conditions and analytic functions, Cauchy integral theorem, Cauchy integral formula, Euler's formula, harmonic functions, complex integration, Contour integrals, singularities and residues, residue theorem.

Recommended Books:
6. G. Arfken, Mathematical Physics, 2nd ed, Academic Press, 1970.
7. Dass H.K, R. Verma, 2011, 6th Edition, Mathematical Physics, S. Chand& Company Ltd. New Delhi.
8. E. Butkov, Mathematical Physics, Addison-Wesley 1968.
9. Pipes and Harvill, Applied Mathematics for Engineers and Physicists, McGraw Hill, 1971.
10. M. L. Boas, Mathematical Methods in Physical Sciences, John Wiley & Sons, New York (1989)
11. M. R. Speigel, Complex Variables Schaum's Outline Series, McGraw Hill 1979

PHY-321   Electrodynamics-I   CreditHrs: 03

Course Contents:

ReviewofCalculus:vectoralgebraandcalculus,Cartesiancoordinatessphericalcoordinates.

TheDiracDeltaFunction: Reviewofvectorcalculususingexampleof DiracDeltafunction, the divergence of r/r^2, the one -dimensional and the three-dimensional Dirac delta functions. The theory of vector fields: the Helmoholtz theorem,potentials.

Electrostatics: The electric field: introduction, Coulomb's law, the electric field, continuous charge distributions. Divergence and curl of electrostatic fields: field lines, flux and Gauss's law, the divergence of Electric field, applications of Gauss's law, the curl of Electric field. Electric potential: introduction to potential, comments on potential, Poisson's equation and Laplace's equation, the potential of a localized charge distribution, summary, electrostatics boundary conditions, Work and energy in electrostatics: the work done to move a charge, the energyofapointchargedistribution,theenergyofacontinuouschargedistribution,comments on electrostatic energy. Conductors: basic properties, induced charges, surface charge and the force on a conductor,capacitors.

Special Techniques: Laplace's equation: introduction, Laplace's equation in one, two and three dimensions, boundary conditions and uniqueness theorems.

TheMethodofImages: Theclassicimageproblem,inducedsurfacecharge,forceandenergy, other imageproblems.

Multi-poleExpansion: Approximatepotentialatlarge,themonopoleanddipoleterms,origin of coordinates in multi-pole, expansions, the electric field of adipole.

Electric Fields in Matter: Polarization: dielectrics, induced dipoles, alignment of polar molecules, polarization. The field of a polarized object: bound charges, physicalinterpretation of bound charges, and the field inside a dielectric. The electric displacement: Gauss's law in the presence of dielectrics, a deceptive parallel, boundary conditions. Linear Dielectrics: susceptibility, permittivity, dielectric constant, boundary value problems with linear dielectrics, energy in dielectric systems, forces ondielectrics.

Recommended Books:
12. D. J. Griffiths, "Introduction to Electrodynamics", Prentice Hall, 3rd ed. 1999.
13. P.C. Lorrain & D.R. Corson, 'Electromagnetic Fields and Waves', W.H. Freeman & Co., New York.
14. Ritze, Millford&Chiristy, Foundation of Electromagnetic Theory.4th edition
15. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 5th ed. 2009.
16. F. Melia, "Electrodynamics", University of Chicago Press, 2001.
17. Hearld J and W. Muller-Kristen, "Electrodynamics", World Scientific Publishing, 2nd ed. 2011.CHEME

PHY-391   **Introductory Electronics**   **Credit Hrs: 03**

Course Contents:

TheSemiconductorDiode: Metals,insulatorsandsemiconductors,ConductioninSiliconand Germanium,Theforbiddenenergygap,nandptypesemiconductors,thejunctiondiode,diode voltage-currentequation,Zenerdiodes,lightemittingdiodes,photodiodes,capacitanceeffects   in the pnjunction.

The Diode as Rectifier and Switch: The ideal diode model, the half wave rectifier, the full wave rectifier, the bridge rectifier, measurement of ripple factor in the rectifier circuit, the capacitorfilter,the∏filter,the∏-Rfilter,thevoltagedoublingrectifiercircuit,rectifyingAC voltmeters, diode wave clippers, diodeclampers.

Circuit Theory and Analysis: Superposition theorem, Thevenin's Theorem, Norton's Theorem, Model for circuit, one port and two-port network, Hybrid parameter equivalent circuit, Power in decibels.

The Junction Transistor as an Amplifier: Transistor voltage and current designations, the junctiontransistors,thevolt-amperecurveofatransistor,thecurrentamplificationfactors,the   load line and Q point, the basic transistor amplifiers, the common emitter amplifier, the trans-conductancegm,performanceofaCEamplifier,relationbetweenAiandAv,theCBamplifier,   the CC amplifier, comparison of amplifierperformance.

DC Bias for the Transistor: Choice of Q point, variation of Q point, fixed transistor bias,the four resistor bias circuit, design of a voltage feedback bias circuit, Common emitter, common collector, common base biasing.

Operational Amplifiers: The integrated amplifier, the differential amplifier, common mode rejection ratio, the operational amplifier, summing operation, integration operation, comparator, milli-voltmeter.

Recommended Books:
18. Imillman&c.Chalkaias , 'integrated Electronic ' ,McGraw hill Block Company, Singapore (Latest Edition)
19. T.L.Floyd , "electronic device", Merril Publishing company Columbus (1988)
20. A.P .Malvino , "electronic principle" , TATA McGraw Hill ,New Delhi (1980)
21. D.B.Bell , "Electronics devices &Circuits" ,Reston Publishing Company Inc, Virginia (1980)
22. C.J.SavantJr.M.S .Roden, G.L.Carpenter, "Electronic Design Circuits & Systems", The BEngamin /Cummings Publishing Co, California (1991).
23. Larry D Jons, Principles and applications of Digital Electronics, Mic-Millian Publishingcompany, 1993.
24. Digital system design and microprocessor J.C. Bortie (NBF).
25. Mic-Millian, Micro electron, Megraw Hill.
26. Digital Logic and computer Design Morris Mono, 1995 Prentic Hall.
27. Tochim, Digital Electronics (1999).
28. Barrey B. Bery, Intel UPS architecture, Programming and interfacing, Printic Hall (1998).

PHY-311L   LAB-I (Mechanics)   Credit Hrs: 01

Experiments with pendulums, stop watches, one-dimensional motion and verification of Newton's laws of motion, measurement of forces, speed, acceleration and linear momentum, collisions and conservation of momentum, impacts, free fall and acceleration due to gravity, gyroscopes,rotationalmotion,conservationofangularmomentum,friction,staticanddynamic equilibrium, compound pendulum, rolling motion along inclined planes, simple harmonic motion, masses attached to springs and Hooke's law, damped motion and the regimes of damping (overdamped, underdamped and critically damped), pressure in fluids, experiments demonstrating continuity, Bernoulli's principle, buoyancy and Archimedes' principle,Atwood machine, fluid viscosity, surfacetension.

Recommended Books:
29. Saeeduddin, Ahmad Dar and Sarfaraz Hussain Ansari, 'Pakistan Study as a Discipline', in S.H. Hashmi (ed.), The State of Social Science in Pakistan (Islamabad: Quaid-i-Azam University, 1989)
30. Faruqi, Dr. Burhan Ahmad. "Shaikh Ahmad Sarhindi" in The Muslim Luminaries-Leaders of Religious, Intellectual and Political Revival in South Asia (Islamabad: National Hijra Council, 1988)
31. Hafiz Malik, Muslim Nationalism in India and Pakistan.
32. Maududi, S. AbulA'la. A Short History of the Revivalist Movement in Islam 2nd.ed., trans. Al-Ash'ri (Lahore: Islamic Publications Ltd., 1972), pp. 99-115.
33. Ahmad, Aziz. Islamic Modernism in India and Pakistan 91857-1964) (Karachi: Oxford University Press, 1967), pp. 31-56; Hafiz Malik, Muslim Nationalism in India and Pakistan.
34. Aziz, K.K., "Some Thoughts on the Khilafat Movement", Journal of Research Society of Pakistan University of the Punjab, Vol.III, No. 4, 1966.
35. Iqbal, Justice Dr. Javid. "Muhammad Iqbal" in The Muslim Luminaries-Leaders of Religious, Intellectual and Political Revival in South Asia (Islamabad: National Hijra Council, 1988).

EW-   English Study Skills   Credit Hrs: 03

Course Outlines:

Study Habits, Study Place, Study Time (Time Management), Concentration, Motivation, Note- Taking & Note Making Techniques, Techniques: Symbols, abbreviations, mind maps etc., Reading Notes, Lecture Notes, Using Library, The Card Catalog,

- ➢ Using the Card Catalog Efficiently, The Call Slip
  - Reference Works
  - Encyclopedias
  - Yearbooks
  - Dictionaries
  - Atlases

- Bibliographies
- Some Common Reference Works
- Periodicals
- The Readers Guide

➢ Using Dictionary
- How to find a word
- Word Grammar
- Pronunciation
- Idioms
- Common Spelling Problems

➢ Reading Skills
- Intensive Reading
- Extensive Reading
- Reading Surveys
- Sub Skills in Reading
  - ■ Vocabulary
  - ■ Inference
  - ■ Coherence
  - ■ Cohesion
  - ■ Close exercises
  - ■ Skimming
  - ■ Scanning
  - ■ Predicting
  - ■ Organization

➢ Writing Skill
- Writing paragraph: Topic Sentence, Support and Conclusion.
- Types of paragraph: Paragraph of Analysis, Paragraph of Description, Paragraph of Comparison and Contrast, Paragraph of analogy, Paragraph of Definition.
- Punctuation Marks

- Discourse Markers
- Essay: Definition & Types

➢ Writing an Outline
➢ Learning the Vocabulary of English

- Word Formation
- Changing Parts of Speech
- Present and Past Participles as Adjectives
- Word Stems
- Guessing Meanings from Context
- Recording the Meanings of Words
- Fixing the Meanings of Words

➢ Preparing for Examination

- How to prepare for Examinations
- Physical Preparation
- Emotional Preparation
- Review Preparation
- How to take an Examination
- Types of Examinations
- Objective Examinations
- Subjective (or Essay-Type) Examinations

Recommended Books:
36. Buzan, T. (1982)   Use Your Head (Rev .Ed.)
37. Grellete, F. (1981)   Developing Reading Skills, Cambridge.
38. Jordon. R.R   Academic Writing Course, London: Collins.
39. Nuttal. (1981)   Teaching Reading Skills in a FL. London.
40. Pineas, A (1982)   Writing in English, New York: Macmillan.
41. Wallace, M.J. (1980) Study Skills in English. Cambridge: Cup
42. Yorkey, R.C. (1970) Study Skills for Students of English as a Second Language

PHY-391LLAB-II (Mechanics, Electrical and Electronics)   Credit Hrs: 01

Course Outlines:

1. Kinematics predicting acceleration, verification of Newtons 2nd law

2. Conservation laws (conservation of momentum and energy in collisions), conservation of momentum in explosion cart apparatus.

3. Motion on inclined plane, coefficient of frictions.
4. a. Simple harmonic motion mass on spring pendulum and oscillation on an incline, spring constants.

b. Hooks law

5. Projectile motion study and determination of related parameters.
6. Photo-gate pendulum (relation between period and mass, period and amplitude, period and length).
7. Rectification half and full wave.
8. PNP transistors characteristics
9. Logic gates with digital trainer.
10. Circuit rules current and voltage divider, Kirchoffs, Thevenin and Norton,
11. Conservation of energy (potential to electrical by energy transfer generator).
12. Electrical power generation by hand crank generator.
13. Function of AC and DC synchronous motors, DC and AC Power generation.
14. Study of fields produced by different charge configurations (dipoles, parallel plate capacitors, cylindrical capacitors).

PHYS-441   SOLID STATE PHYSICS-I   Credit Hrs: 03

Course Outlines:

Crystal structure in 2D and 3D, fundamental types of lattices, index system for crystal planes, simple crystal structures, X-ray diffraction, Braggs law, reciprocal lattice, Diffraction of waves by crystals, scattered wave amplitude, Brillouin zones, crystal binding and elastic constants, Classification of Solids, ionic crystals, covalent crystals, Ionic Radii, II-VI and III-V compounds, Molecular crystals, metals, Cohesive energy, The Lenard Jones Potential, Density, Cohesive energy and Bulk Modulus of crystalline solids, The Madelung constant, Cohesion in Covalent crystals, elastic waves in cubic crystals. Vibration of crystals with monatomic basis, two atoms per primitive basis, quantization of elastic waves, normal vibration modes and phonon, phonon momentum, inelastic scattering by phonons, Phonon heat capacity, lattice heat capacity, Einstein and Debye models, Somerfield model of free electron theory, Energy levels in one dimension, free electron gas in three dimensions, DC and AC electrical conductivity of metals

Recommended Books:

15. 1. C. Kittle, "Introduction to Solid State Physics", John Wiley & Sons, Inc. 7th ed. (2005).
16. 2. N.W. Ashecroft, N. David Mermin "Solid state physics", CBS Publishing Asia Ltd. (2003).
17. 3. J.S. Blakemroe, "Solid State Physics", Cambridge University Press (1991).
18. 4. M.A. Omar "Elementary solid state physics",(2003).
19. 5. N.G.Szwachi and T.Szwacka "Basic elements of crystallography", (2010)
20. 6. R.K.Puri and V.K.BabbarSolid State Physics and electronics", (2007)

PHY-352   Mathematical Methods of Physics-II   Credit Hrs: 03

Course Outlines:

Differential Equations in Physics: First and second order linear differential equations, partial differential equations in theoretical physics, separation of variables, homogeneous differential equations, Frobenius series solution of differential equations, second solution, non-homogeneous differential equations Special Functions: Bessel functions and Hankel functions, Spherical Bessel functions, Legendre polynomials, associated Legnedre polynomials, spherical harmonics, Laugerre polynomials, Hermite polynomials Fourier Series: Definition and general properties, Fourier series of various physical functions, Uses and application of Fourier series. Integral Transforms: The integral transforms, Fourier transform, Convolution theorem, Parseval's theorem, elementary La place transform and its applications Boundary Value Problems and Green's Functions: Boundary3 value problems in Physics, Non-homogeneous boundary value problems and Green's functions, Green's functions for one-dimensional problems, Eigenfunction expansion of Green's function, construction of Green's functions in higher dimensions.

Recommended Texts:
43. M.L. Boas, 'Mathematical Methods in Physica Sciences', Jhon Wiley & Sons, New York (1989).
44. C. Wa Wong, 'Introduction to Mathematical Physics', OxfordUniversity Press, New York (1991).
45. Hassani, 'Foundations of Mathematical Physics', Prentice Hall International Inc., Singapore.
46. Chattopadhyay, 'Mathematical Physical', Wiley Eastern Limited, New Delhi, (1990).
47. H. Cohen, 'Mathematics for Scientists & Engineers' Prentice Hall International Inc., New Jewrsey (1992)
48. Essential mathematical methods for Physicists, Webber and Arfken

PHY-322   Electrodynamics-II   Credit Hrs:03

Course Outlines:

The Lorentz force law, Magnetic fields and Magnetic forces, Current, Biot-Savart law, The divergence and curl of B, Ampares Law and its application, Vector potential, Magnetostatic boundary condition, Multipole expansion of the vector potential, Dimagetic, Feromegetics, Magnetization, Bound currents and its physical interpretation, Magnetic field inside a matter, Auxiliary field inside matter, Amperes law in Magnetized material, Ohms law, Electromotive force and motional emf, Faradays law, Inductance, Electrodynamics before Maxwell, How Maxwell fixed Amperes Law, Maxwells equation, Boundary condition . Maxwell's Equations in matter, Boundry Conditions, The Wave Equation, Sinusoidal Waves, Boundary Conditions (Reflection and Transmission), Polarization, The Wave Equation for E and B, Monochromatic

Plane Waves, Energy and Momentum in Electromagnetic Waves, Propagation in Linear Media, and Transmission at Normal Incidence, Reflection and Transmission at Oblique Incidence, Electromagnetic Waves in Conductors, Reflection at a Conducting Surface , The Frequency Dependence of Permittivity, Wave Guide, The Waves in a Rectangular Wave Guide, The Coaxial Transmission Line, Einstein Postulates of Special Theory of Relativity, The Geometry of Relativity, The Lorentz Transformations, The Structure of Space-time.

Recommended Books:
1.   By David J. Griffiths, third edition "Introduction to Electrodynamics"
2.   Reitz & Milford; 200: Foundation of Electromagnetic Theory Addison Wesley Ohanion, H. C.; 1988: Classical Electrodynamics. Allyn & bacon Inc., Massachusetts
3.   Jackson, Classical Electrodynamics, John Wiely, 1975
4.   Y.K. Lim; 1986: Introduction to Classical Electrodynamics, World Scientific Publishing Co. Lt., Singapore.

PHY-331   Quantum Mechanics-I   Credit Hrs:03

Course Outlines:

Energy the Hamiltonian and angular momentum, The state of a system, Properties of the one dimensional positional function. The works of Planck Black body radiation, The work of Einstein The photo electric effect, The work of Bohr. A Quantum theory of atomic states, Waves versus particles, The De Broglie hypothesis and the Davison-Gamer Experiment, The work of Heisenberg, The work of Born. Probability waves, Observable and operators, Measurement in Quantum Mechanics, The State Function and Expectation values, Time Development of the state function, Particle in a box, The Bohr correspondence principle, Dirac Notation, Hilbert space, Hermitian Operators, Properties of Hermitian operators. The superposition principal, Commutator relations and the uncertainty principal, Schrodinger wave equation, Time department and time independent, One dimensional positional step problem, The rectangular barrier (tunneling), The finite positional well.

Recommended Books:
1.   Richard L. Liboff, 4th Edition, Person Education Introductory Quantum Mechanics.
2.   NouredineZettli, John Wiley & Son, 2001Quantum Mechanics, Concepts and Application, B.H. Bransden& C.J. Joachain: Introduction to Quantum Mechanics Longman Scientific & Technical London (1990).
3.   J. S. Townsedn, 'A Modern Approach to Quantum Mechanics,McGraw Hill Book Company, Singapore (1992).
4.   W. Greiner, 'Quantum Mechanics: An Introduction', Addison Wesley PublishingCompany, Reading Massachausetts (1980).
5.   R.L. Liboff, 'Introductory Quantum Mechanics', Addison Wesley Publishing Company, Reading Massachusetts (1980).
6.   Bialynicki-Birula, M. Cieplak& J. Kaminski, Theory of Quantua', Oxford University Press, New York (1992).
7.   W. Greiner, 'Relativistic Quantum Mechanics', Springer Verlag. Berlin (1990).
8.   F. Schwable, 'Quantum Mechanics', Narosa Publishing House, New Delhi (1992)
9.   David J. Griffths, Introduction to Quantum Mechanics. Prentice-Hall S. Gasiorowiz,

10. Quantum Physics. John Wiley and Sons Inc. Singapore

PHY-241   Heat and Thermodynamics   Credit Hrs: 03

Course Outlines:

Temperature and Zeroth Law of Thermodynamics: Macroscopic and microscopic point of view, Scope of Thermodynamics, Thermal Equilibrium and Zeroth Law, Thermometer and temperature, Comparison of Thermometer, Platinum Resistance Thermometry, Radiation Thermometry, Radiation Thermometry, Thermocouple.

Simple Thermodynamics System: Thermodynamic equilibrium, Equation of state, Hydrostatic, Mathematical Theorem Stretched wire, Surfaces Electrochemical Cell, Dielectric Slab, and Paramagnetic.

Work. Quasi-static process, Work in changing volume of hydrodynamic system, PV diagram, and Hydrostatics work depends on path, Work in changing length of wire, Work in moving charge in electrochemical cell, Work in changing the total magnetization of paramagnetic solid, generalized work, composite system.

Heat and first law of Thermodynamics: Work and heat, Adiabatic work, Internal energy ftn., Mathematical formulation of First Law, Concept of Heat, Differential form of First Law, Heat Capacity and its measurement, Specific heat of water, Quasi-static flow of heat, Heat conduction, Thermal conductivity, Heat convection, Kirchoff's Law, Black body, SteafenBoltzman Law.

Ideal Gas: Equation of state of a gas an ideal gas, Ideal gas, Quasistatic Adiabatic p[process, Ruchaardt's method of measuring, Kinetic theory of Ideal gas.

The second Law of Thermodynamics: Conversion of work into heat and vice versa, Different types of engines, Kelvin- Planck statement of 2nd law, Clauses statement of second law, reversibility and irreversibility

Entropy: Principle of Carathedory, entropy of ideal gas, TS diagram, Reversibility and irreversibility, Principle of increase of entropy. Entropy and disorder.

Recommended Books:
1. Heat and Thermodynamics Mark W. Zemansky, Richard H. Dittman.
2. Thermodynamics, Kinetic Theory and statistical Thermodynamics, Third edition, Sears, Salinger.

EW-   Communication Skills   Credit Hrs: 03

Course Outlines:

- ➢ The Communication Process

- Definition of Communication
- Components of Communication (Context, Sender, Message, Medium, Receiver, Feedback)
- Intercultural Communication

➢ Barriers to Communication
- Psychological Barriers
- Semantic Barriers
- Physical Barriers

➢ Listening
- Faults in Listening
- Purposes for Listening
- Activities for Improving Listening Skills

➢ Speaking
- Steps for Preparing Effective Oral Presentations
- Ways of Delivering the Oral Message
- Activities for Improving Speaking Skills

➢ Reading
- Skimming, Scanning, Reading in chunks
- Guessing the Meaning of Unfamiliar words.
- Activities for Improving Reading Skills

➢ Writing
- Formal Letters
- Job Application
- Resume
- Activities for Improving Writing Skills

➢ Job Interview
- Successful Preparation for the Job Interview
- Prior to the Interview
- Chronology of the interview (Introduction, Company Information, Candidate Assessment, Conclusion)

- Activity During the Interview
- Answering or Asking Questions During the Interview.

➢ Non-Verbal Communication

- Effective Non-Verbal Delivery

Recommended Books:
1. Communicating Effectively by Saundra Hybels, Richard L. Weaver II Effective Business Communications by H.A. Murphy, H.W. Hilde brand Business Communications: Strategy and Skill by Mary Munter English Grammar and Composition by P.C. Wren and Martin.

PHYS-393   NUCLEAR PHYSICS-I   Credit Hrs: 03
Course Outlines:

Nuclear Physics: Basic properties of Nucleus: Size and mass of the nucleus. Nuclear spin, magnetic dipole moment, electric quadropole moment, parity and statistics, Detectors, Passage of charged particle through matter, ionization chamber, proportional counter, scintillation counter, semi-conductor detector, emulsion technique, bubble chamber, Particle Accelerators: Linear accelerator, Van de Graff, Betatron, synchrocyclotron, proton synchrotron, Nuclear Forces, Yukawa theory, proton-proton and neutron-proton scattering, charge independence of nuclear force, isotopic spin, Liquid drop model, shell model, collective model, Conservation laws of nuclear reaction, Q-value of nuclear reaction, threshold energy, transmutation by photons, proton, deuterons and alpha particles, excited states of nucleus, energy levels, level width, Cross section from nuclear reactions.

Recommended Books:
1.Krane, "Introductory Nuclear Physics", (2008).
2. Kaplan, "Nuclear Physics", Addison-Wisely, 1980.
3. A.E.S Green, "Nuclear Physics", McGraw Hill Book Co. (1995).
4. E. Serge, "Nuclei and particles", W. A. BanjaminInc (1977).
5. G. Chatwal, "Nuclear Physics" (Vol I and II), Dominant Publisher and Distribution, (2007).
7. B. Povh, K. Rith, C. Scholtz, F. Zetsche, "Particle and Nuclei", (1999).

PHYS-432   QUANTUM MECHANICS-II   Credit Hrs: 03
Course Outlines:

Addition of Angular Momenta: Total angular momentum in classical mechanics, total angular momentum in quantum mechanics, addition of two spin ½ angular momenta, addition of two arbitrary angular momenta, Clebsch-Gordon coefficients, addition of spherical harmonics, vector operators, Wigner-Eckart theorem, electric Multi-pole moments, Evolution of two angular

momenta J1 and J2 coupled by an interaction aJ1 . J2.Stationary Perturbation Theory: Description of the method, perturbation of non-degenerate level, perturbation of a degenerate level, one-dimensional harmonic oscillator subjected to a perturbing potential, interaction between the magnetic dipoles of two spin ½ particles, Van der Waals forces, volume effect and The influence of the spatial extension of the nucleus on the atomic levels, vibrational method, energy bands of electrons in solids, a simple example of the chemical bond: The ion Applications of Perturbation Theory to Atomic Systems: fine and hyperfine structure of atomic levels in hydrogen, Calculation of the mean values of the spin-orbit coupling in the 1s, 2s and 2p levels, hyperfine structure And the Zeeman effect for muonium and positronium, Stark effect Approximation Methods for Time-Dependent Problems: Statement of theproblem, approximate solution of the Schrodinger equation, An importantspecial case: Sinusoidal or constant perturbation, Interaction of an atom withelectromagnetic waves, linear and non-linear response of a two-level system subjected to a sinusoidal perturbation, Oscillations of a system between two discrete states under the effect of a resonant perturbation, Rabi flopping, decay of discrete state resonantly coupled to a continuum of final states, Fermi's golden rule Systems of Identical Particles: Identical particles, Permutation operators.

Recommended Books:

1. R.L. Liboff, "Introductory Quantum mechanics", Addison Wesley Publishing Company, Reading Mass. (1980).
2. N. Zettili, "QUANTUM MECHANICS: Concepts and Applications" JOHN WILEY & SONS (2001)
3. J.S. Townsend "A Modern Approach to Quantum Mechanics" McGraw Hill Book Company, Singapore (1992).
4. W. Greiner, "Quantum Mechanics: An Introduction", Addison Wesley Publishing Company, Reading Mass. (1980).
5. Bialynicki-Birula, M. Cieplak, J. Kaminski "Theory of Quantua", Oxford University Press, New York (1992).
6. W. Greiner, "Relativistic Quantum Mechanics", SpringerVerlag, Berlin (1990).
7. F.S. Narosa "Quantum Mechanics", Publishing House, New Delhi (1992).
8. Gasiorowicz, "Quantum Physics", John Wiley & Sons, Inc., Singapore, (2003).
9. D. J. Griffiths, "Introduction to Quantum Mechanics", PRENTICE Hall, Int., Inc, (2005).

PHYS-372   STATISTICAL MECHANICS   Credit Hrs: 03

Course Outlines:

Review of thermodynamics: Mathematical formulation of first and second law of thermodynamics, Maxwell's relation, Reduction of derivatives, General conditions of equilibrium. Partition Function: Partition Function, Relations of partition function with thermodynamical variables, examples (collection of simple harmonic oscillators, Half spin paramagnet. Basic Principles of statistical Mechanics: Microscopic and macroscopic states, Phase Space, Ensemles,Liouvillie theorem, Formation of Micro canonical, Canonical and Grand canonical partition function. Maxwell distribution of molecular speed: Probability of the particle

in quantum state, Density of states in k-space, single particle density of states in energy, Maxwell-Boltzman Distribution Function, Validity of Maxwell-Boltzman statistics, Evaluation of constants α and β, Maxwell Speed distribution function. Theory of ideal Fermi System: Fermi-Dirac Distribution Function, Examples of the Fermi system (free electron theory of metals, Electrons in stars, electrons in white dwarf stars). Theory of Bose System: Bos-Einstein Distribution Function, Black body radiation, the photon gas, ideal bose gas model of liquid helium, Einstein's model of vibration in solids, Debye's model of vibration in solids.

Advanced Topics: Fluctuations, Bose-Einstein Condensation, Introduction to density matrix approach

Recommended Books:
1. F. Reif, "Fundamentals of Statistical and Thermal Physics", Waveland PrInc, (2008).
2. W. Brewer, F. Schwabl, "Statistical Mechanics", Springer, 2nd ed. (2006).
3. T. L. Hill, "Statistical Mechanics", World Scientific Publishing Company,(2004).
4. K. Huang, "Statistical Mechanics", John Wiley, 2nd ed. (1987).

PHYS-231   COMPUTATIONAL PHYSICS   Credit Hrs: 03
Course Outlines:

Preparatory Concepts: A brief introduction of the computer languages C++ or FORTRAN (different data types, variables and constants, selection structures, repetition structures, arrays, built in functions, user defined functions etc.) and known software packages of computation Mathematica, MATLAB, MAPLE (only one), Numerical Techniques: Numerical Solutions of equations, Interpolation and Extrapolation, Numerical integration and differentiation and solution of differential equations. Modeling & Simulations: Basic concepts of modeling and simulation, relation between modeling and simulation. Case Study: 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 (only one).

Recommended Books:
1. M. L. De Jong, "Introduction to Computational Physics", Addison Wesley Publishing Company Inc., Massachusetts (1991).
2. H. Schildt, "C++: The Complete Reference" Osborne/McGraw-Hill, 4th ed. (2000).
3. A First Course in COMPUTATIONAL PHYSICS Paul L. DeVries, John Wiley and Sons, Inc. (1994).
4. Computational Physics by S.T. Koonini, The Benjamin/Coming Publishing Inc., California (1986).
5. Computational Techniques in Physics by P.K. Macheown& D.J. Merman, AdmHilger, Bristol (1987).
6. H. Gould & J. Tobochnik "An Introduction to Computer Simulation Methods" Addison Wesley Publishing Company, Rading Massachusetts (1988).
7. S.C. Chapra and R.P. Chanle"Numerical Methods for Engineers with Personal Computer Applications", McGraw Hill Book Company, New York (1965).
8. E. Don, "Schaum's Outlines of Mathematica", McGraw-Hill, 2nd ed. (2009).

PHY-451 Nuclear Physics-II   Credit Hrs: 03

Course Outlines:

Gamma decay: Energetic of gamma decay, Classical electromagnetic radiation, Transition to quantum mechanics, Angular momentum and parity selection rules, Internal conversion, Life time for a gamma emission, Gamma rays spectroscopy

Nuclear Reaction: Types of reaction and conservation law, Energetic of nuclear reaction, Nuclear reaction and the excited states of nuclei, The compound nucleus, Cross-section for nuclear reaction, Limitation of the compound nucleus theory, Direct reaction, Resonance reaction, Heavy ion reaction

Nuclear Fission: Why Nuclear Fission, Characteristics of nuclear fission, Energy in fission, Fission and nuclear structure, Controlled fission reaction, Fission reactors, Radioactive fission products.

Nuclear Fusion: Basic nuclear fusion process, Characteristic of fusion, Solar fusion, Controlled fusion reactor.

RcommendedBooks :
1. K.S. Krane 'Introductory Nuclear Physics' John-Wiley (1987).
2. .D. Evans 'The Atomic Nucleus' McGraw-Hill (1955).
3. W.E. Meyerhof 'Elements of Nuclear Physics' McGraw-Hill (1989).
4. B.L. Cohen 'Comcepts of Nuclear Physics' McGraw-Hill (1971).
5. L. Kaplan 'Nuclear Physics' Addison-Wesely (1979).
6. R. E. Lapp and H.L. Andrews 'Nuclear Radiation Physics' Prentice-Hall (1972).
7. H. A. Enge 'Introduction to Neclear Physics' Addison-Wesley (1969)

PHYS-393L   LAB-III (MODERN PHYSICS)   CreditHrs: 01

Course outline:

photoelectric effect, determination of Planck's constant (e.g. using a light bulb), verification of Moseley's law using X-ray fluorescence, Compton effect, Millikan's experiment for determination of charge of electron, properties of nuclear radiation, Geiger-Muller tubes, cloud chambers, energy spectroscopy of gamma rays, experiments on medical physics.