Scheme of Study

MS PROGRAM

Department of Physics

Karakoram International University

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Faculty of Natural Sciences

Department of Physics

MS Scheme of Studies

Scheme of Studies for Spring Semester Year -I

S. No	Course Title	Course Code	Credit Hours
1.	Advanced Electrodynamics	Phys — 623	3(3-0)
2.	Advanced Quantum Mechanics	Phys — 634	3(3-0)
3.	Mathematical Methods of Physics	Phys — 653	3(3-0)
4.	Research Methodology & Statistical Applications	Phys — 625	3(3-0)
Total			12

Scheme of Studies for Fall Semester Year -I

S. No	Course Title	Course Code	Credit Hours
5.	Radiation Physics	Phys — 617	3(3-0)
6.	Classical Mechanics	Phys — 612	3(3-0)
7.	Material Science	Phys — 613	3(3-0)
8.	Statistical Mechanics	Phys — 662	3(3-0)
Total			12

Research (Thesis) Spring Semester Year-II

Research (Thesis) Fall Semester Year-II

Classical Mechanics

Course Code	Phys- 612	
Course Title & Credit Hours	Classical Mechanics (3 Cr Hrs)	
Name of Faculty (Name & Department)	Physics	
Program& Department (Course Offered in)	MS-2 years	
Prerequisites by Course(s) and Topics	Classical mechanics by Goldstine	
Assessment Instrument with Weights (Homework, Quizzes, Midterms, Final, Assignments, Presentations, Lab work, etc.)	Assignment+ Quizes 30% OHT-I + OHT-II 30% Final Term 40%	
Reference Material	1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers",Golden Sunburst Series, 8th ed. 2010. 2. R. A. Freedman, H. D. Young, and A. L. Ford (Sears and Zeemansky),"University Physics with Modern Physics", Addison-Wesley-Longman,13th International ed. 2010 3. F. J Keller, W. E. Gettys and M. J. Skove, "Physics: Classical and Modern, McGraw Hill. 2nd ed. 1992. 4. D. C. Giancoli, "Physics for Scientists and Engineers, with Modern Physics", Addison-Wesley, 4th ed. 2008. 5. D. Halliday, R. Resnick, K. S. Krane, Physics, John Willey and sons, Inc, 1992.	
Course Goals	1. To give concept of vector and them Various properties. 2. To give basic understanding of laws of motion and their applications in daily life. 3. To give mathematical concept and expression of various physical parameters Used in mechanics.	
Topics to be covered in the Course, with	**Week 1 (03 Lectures)**	Survey of the elementary principles, Variational principles and Lagranges's equations,

Classical Mechanics

Number of Lectures on Each Topic (Assume15-week instruction and one-hour lectures)	**Week 2 (03 Lectures)**	Oscillations, The classical mechanics of the special theory of relativity,
	Week 3 (03 Lectures)	Hamiltonian equations of motion,
	Week 4 (03 Lectures)	canonical transformations,
	Week 5 (03Lectures)	Hamilton-Jacobi theory and Action angle variable,
	Week 6 (03 Lectures)	Classical Chaos
	Week 7 (03 Lectures)	Canonical perturbation theory,
	Week 8 (03 Lectures)	Introduction to the Lagrangian
	Week 9 (03 Lectures)	Hamiltonian formulations for continuous systems and fields,
	Week 10 (03Lectures)	Lorentz invariance of Maxwell equations
	Week 11 (03Lectures)	Theory relativity
	Week 12 (03 Lectures)	Four vectors
	Week-13 (03 Lectures)	System of particles and frame of references
	Week-14 (03 Lectures)	Centre of mass and laboratory coordinate systems
	Week-15 (03 Lectures)	Problems related with Lagrangian and Hamiltonian
Assignments: Each student will be given a topic to prepare an assignment just like a research report and will be graded accordingly.		
Quizes: End of each chapter there will be quizes.		
Attendance: At least 75% attendance is compulsory to sit in the midterm and final term examination		

Electrodynamics

Karakoram International University, Gilgit – Baltistan

Department of Physics

Course name: Electrodynamics (Phys – 623)

Course code: 03 Credit Hours

Marks distribution:

Quizzes (**announced** and **surprise**)	**30 %**
OHT1+OHT2	**30 %**
Final Term Exam	**40 %**

Recommended Books:

1. Classical Electrodynamics by J. D. Jackson (3rd Edition), Wiley 1998
2. **Modern Electrodynamics by Andrew Zangwill Cambridge university press, first published 2012**

The Maxwell Equations Introduction (electric charge, electric current, Conservation of Charge) The Maxwell Equations in Vacuum (Electrostatics, The Field Concept, Magnetostatics, Faraday's Law, The Displacement Current, Maxwell Equations),	**1st week**
Microscopic vs. Macroscopic (Lorentz Averaging, The Macroscopic Surface, Matching Conditions), The Maxwell Equations in Matter (Macroscopic Sources and Fields, Microscopic Fields),	**2nd week**
Quantum Limits and New Physics (Quantized Matter, Vacuum Polarization, Quantum Fluctuations, New Physics, Magnetic Charge), SI Units, A Heuristic Derivation	**3rd week**
General Electromagnetic Fields Introduction, Symmetry (Discrete Symmetries, Dual Symmetry, Continuous Symmetries), Electromagnetic Potentials (Gauge Invariance, The Coulomb Gauge, The Lorenz Gauge),	**4th week**
Conservation of Energy (The Poynting Vector and Field Energy Density, Energy Flow in Resistive Wires, Non-Uniqueness of the Poynting Vector),	**5th week**
Conservation of Linear Momentum (The Mechanical Force on a Volume, Momentum Density and Momentum Current Density)	**6th week**
Conservation of Angular Momentum, The Center of Energy, Conservation Laws in Matter, The Force on Isolated Matter	**7th week**
Waves in Vacuum Introduction, The Wave Equation, Plane Waves, Polarization, Wave Packets,	**9th week**
The Helmholtz Equation, Beam-Like Waves, Spherical Waves2, Hertz Vectors, Forces on Particles in Free Fields	**10th week**
Waves in Simple Matter Introduction, Plane Waves, Reflection and Refraction, Radiation Pressure,	**11th week**
Layered Matter, Simple Conducting Matter, Anisotropic Matter	**12th week**
Waves in Dispersive Matter Introduction, Frequency Dispersion, Energy in Dispersive Matter, Transverse and Longitudinal Waves,	**13th week**
Classical Models for Frequency Dispersion, Wave Packets in Dispersive Matter, The Consequences of Causality, Spatial Dispersion	**14th week**
Final Term Exam	**15th week**

Materials Science

Course code	Physics-.613......
Course Title & Credit Hours	Materials Science
Name of Faculty **(Name & Department)**	
Program & Department (Course Offered in)	MS Physics
Prerequisites of the Course	solid state Physics.
Assessment Instruments with Weights (Homework, Quizzes, Midterms, Final, Assignments, Presentations, Lab work, etc.)	Quizzes+Assgnt+ppt 30% OHT1+OHT2 30% Final Term 40%

Textbook	1. Materials Science and Engineering an Introduction, by W. D. Callister, Jr., publisher John Wiley & Sons Inc (2007)	
Reference Material	1. The Physics and Chemistry of Materials, by J. I. Gersten and F. W. Smith, publisher John Wiley & Sons Inc (2001) 2. Fundamentals of Ceramics, by M. W. Barsoum, IOP Publishing Ltd (2003) 3. The Physics of Amorphous Solids, by Richard Zallen, publisher John Wiley & Sons Inc. (1998). 4. An Introduction to Polymer Physics, D. I. Bower, publisher Cambridge University Press, Cambridge (2002). 5. Materials Science of Thin Films, by M. Ohring, (2nd edition) publishers Academic Press (2002) 6. Soft Condensed Matter, R. A. L. Jones, publishers Oxford University Press (2002)	
Course Objectives	1. Introduce to the basic of the nanotechnology to applications with the synthesis and characterization of the nanomaterials.	
Topics to be covered in the Course, with Number of Lectures on Each Topic (Assume 15-week instruction	**Week 1** **(02 Lectures)**	• Materials Science and Engineering • Why Study Materials Science and Engineering? • Processing/Structure/Properties/Performance • Classification of Materials • Historical Perspective
	Week 2 **(02 Lectures)**	• Introduction • ATOMIC STRUCTURE • 2.2 Fundamental Concepts • 2.3 Electrons in Atoms • 2.4 The Periodic Table

and one-hour lectures)		• ATOMIC BONDING IN SOLIDS • 2.5 Bonding Forces and Energies • 2.6 Primary Interatomic Bonds • 2.7 Secondary Bonding or van der Waals Bonding • Materials of Importance—Water (Its Volume Expansion Upon Freezing) • 2.8 Molecules
	Week 3 (02 Lectures)	• Basic Structural and Symmetry Concepts, • Concept of Diffraction in a Periodic Lattice,
	Week 4 (02 Lectures)	• Structural Information from X-ray Diffraction • Other Diffraction Techniques. • Crystal Structures of Metals and Ceramic Materials.
	Week 5 (02 Lectures)	• Point Defects (vacancies, interstitials, impurities, F-centres) and their stability
	Week 6 (02 Lectures)	• Line and Extended Defects (Dislocations, Grain Boundaries, Stacking Faults, • Interfacial, Surface and Volumetric Defects). • Effect of Defects on the Properties of Materials.
	Week 7 (02 Lectures)	• Amorphous Materials/Glasses (Glass formation, Glass Transition and • Crystallization of Glasses, Various Glass Forming Systems).
	Week 8 (02 Lectures)	• Random Closed • Packing in Metallic Glasses, • Continuous Random Network in Covalent Glasses.
	Week 9 (02 Lectures)	• Basic Concepts, Equilibrium Phase Diagrams, Phase Transformations – • Basic Concepts, Kinetics, Metastable versus Stable Transformations, • Microstructure Development,
	Week 10 (02 Lectures)	• Precipitation and Dispersion Hardening, • Multi Component and Multi Phase Systems, Alloys, Equilibrium Structures, Phase Separation.

	Week 11 (02 Lectures)	• Geometry of Interfaces, Coherent and Commensurate Interfaces, • Stacking Period and Interplanar Spacing, Defects on Surfaces, Experimental • Determination and Creation of Surfaces,
	Week 12 (02 Lectures)	• Surface Characterization • Techniques (LEED, RHEED, MBE, STM and AFM) and Their Principles.
	Week-13 (02 Lectures)	• Introduction to Soft Matter, Colloidal Dispersions, Gels and Gelation, • Liquid Crystals; Structures and Textures in Liquid Crystals. Polymers;
	Week-14 (02 Lectures)	• Molecular Weight, Molecular Structure, Stereo and Geometric Isomerism, • Thermoplastics, Thermosets and Elastomers,
	Week-15 (02 Lectures)	• Crystallinity of Polymers, • Copolymers, Biological Molecules, Concept of Self Assembly in Block • Copolymers and Biomolecules.

Assignments:
Each student will be given a topic to prepare an assignment just like a research report and will be graded accordingly.

Presentations:
Each student will present in the class about topic assigned to him/her as assignment. This will be graded accordingly on the basis of content, communication skill, way of presentation and answers to the questions asked.

Attendance:
At least 70% attendance is compulsory to sit in the midterm and final term examination

Mathematical Methods of Physics

MS Program

Course name: Mathematical Methods of Physics (03 Credit hours) Course Code: 653

Marks distribution:

Assignments+Quizzes+Presentation	30 %
OHT1+OHT2	30 %
Final Term Exam	40 %

Objective(s):

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

Recommended Books:

1. 1. Mathematical Methods for Physicists, Arfken & Weber (Academic Press, 6th edition, 2005).
2. 2. Mathematical Methods for Physicists, Tai L. Chow (Cambridge University Press, 2002).

Fourier series: introduction and general properties, convergence of trigonometric series	02 Lectures
Gibbs phenomenon, Parseval's theorem, applications to various phenomena.	02 Lectures
Integral transform, development of the Fourier integral, Fourier transform, inversion theorems	02 Lectures
Fourier transform of derivatives, convolution theorem, momentum representation, transfer functions	02 Lectures
Complex arguments in Fourier transforms. Laplace transform, Laplace transform of derivatives,	02 Lectures
Convolution products and Faltung's theorem, inverse, Laplace transform.	02 Lectures
Partial differential equations. Separation of variables in three dimensions,	02 Lectures

Mathematical Methods of Physics

method of characteristics. Boundary value problems.	
Integral transforms, generating functions, Neumann series, separable (degenerate) kernels, Hilbert–Schmidt theory, integral equations.	02 Lectures
Calculus of variations: dependent and independent variables, Euler-Lagrange equation and applications	02 Lectures
Several independent and dependent variables, Lagrange multipliers, variational principle with constraints	02 Lectures
Rayleigh–Ritz variational technique, application to discrete mesh	02 Lectures
Nonlinear methods and chaos, the logistic map,	02 Lectures
Sensitivity to initial conditions and parameters, nonlinear differential equations.	02 Lectures
Probability: definitions and simple properties, random variables,	02 Lectures
Binomial distribution, Poisson distribution, Gauss's normal distributions, statistics.	02 Lectures

Quantum Mechanics

Course Code	Phys - 634
Course Title & Credit Hours	Quantum Mechanics 3Cr.h
Name of Faculty (Name & Department)	
Program & Department (Course Offered in)	MS- Physics (2 year)
Prerequisites by Course(s) and Topics	Quantum mechanics
Assessment Instruments with Weights (Homework, Quizzes, Midterms, Final, Assignments, Presentations, Lab work, etc.)	Assignment+ Quizes 30% OHT-I + OHT-II 30% Final Term 40%
Textbook (or **Laboratory Manual** for Laboratory Courses)	1. Modern Quantum Mechanics (2nd Edition) by J. J. Sakurai, JimJ. Napolitano, Addison-Wesley, 2010. 2. Principles of Quantum Mechanics (2nd Edition) by R. Shankar,Plenum Press, 1994. 3. Quantum Mechanics by Dirac, P. A. M (Oxford University Press 1. Quantum Mechanics (Vol. 1) by Claude Cohen-Tannoudji, Bernard Diu, Frank Laloe, Wiley-VCH, 1992.
Reference Material	1. B.H. Bransden & C.J. Joachain, Introduction to Quantum Mechanics' Longman Scientific & Technical London (1990) 2. J.S. Townsend, A Modern Approach to Quantum Mechanics' McG raw Hill Book Company, Singapore (1992). 3. Wesley publishing Company, Reading Mass.(1980). 4. R.L. Liboff, 'Introductory Quantum mechanics.' Addison Wesley Publishing Company, Reading Mass (1980) 5. Bialynicki-Birula, M. Cieplak & J. Kaminski, 'Theory of Wuantua', Oxford university press, New York (1992).

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Quantum Mechanics

<table>
<tr><td></td><td colspan="2">6. W. Greiner Relativistic Quantum Mechanics'. Springer Verlag, Berlin (1990)
7. F. Schwable, ' Quantum Mechanics', Narosa publishing House, New Delhi (1992)
8. David J. Grifffiths, Introduction to Quantum Mechanics, PRENTICE Hall, Int., Inc.
9. S. Gasiorowicz, Quantum physics, John Wiley & Sons, Inc, Singapore.</td></tr>
<tr><td>Course Goals</td><td colspan="2">1. To understand the uses 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</td></tr>
<tr><td rowspan="4">Topics to be covered in the Course, with Number of Lectures on Each Topic (Assume 15-week instruction and one-hour lectures)</td><td>Week 1 (01 Lectures)</td><td>Waves and particles: Introduction to fundamental idea of Quantum mechanics.</td></tr>
<tr><td>Week 2 (01 Lectures)</td><td>Electromagnetic waves and photons; Light quanta and the plank-Einstein relations, wave particle duality, Analysis of young double slit experiment, Quantum unification of two aspect of light, The Principle of spectral decomposition, Material particle and matter waves; The de Broglie relations, Wave functions: the Schrodinger equation, Quantum description of a particle Wave packets; Free particle, Form of the wave packet at given time, Heisenberg uncertainty relation, Time evolution of free wave packet, Particle in a time independent Scalar potential; Separation of variables. Stationary states, one dimensional square potential</td></tr>
<tr><td>Week 3 (01 Lectures)</td><td>Order of magnitude of the wave length associated with the material particle, Constraints imposed by the uncertainty relation, the uncertainty relation and the atomic parameters, An experiment illustrating the uncertainty relation, A simple treatment of a two dimensional wave packet, the relation between one and three dimensional problem, One dimensional Gaussian wave packet: spreading of wave packet, Stationary state of a particle in one dimensional square well, behavior of wave packet at a potential step.</td></tr>
<tr><td>Week 4 (01 Lectures)</td><td>The mathematical tool of quantum mechanics:
One particle wave function space; Structure of the wave function space, Discrete orthonormal basis in wave function</td></tr>
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		space, Introduction of basis not belonging to wave function space, State Space: Dirac notation; introduction, ket vectors and bra vectors, Linear operators, Hermitian conjugation Representation in the state space; Relation characteristic of an orthonormal basis, Representation of kets and bras, Representation of operators, Eigen value equation: Observables; Eigen values and Eigen vectors of an operators, Observables, Sets of commuting observables, Two important example of representation and observables; {lr>} and {lp>} repsentations, The R and P representation.
	Week 5 (01 Lectures)	The Schwartz inequality, Review of some useful properties of linear operator, Unitary operators, A more detail study of {lr>} and {lp>} repsentations, Some general properties of two observables, Q and P, The parity operator.
	Week 6 (01 e ct ur es)	**The postulates of quantum mechanics:** Introduction, Statement of the postulates; Description of the state of the system, Description of a physical quantities, the measurement of a physical quantities, time evolution of a system, Quantization rule, the physical interpretation of the postulates, Postulates concerning observables and their measurements,
	Week 7 (01 Lectures)	Quantization of certain physical quantaties, The measurement process, mean value of an observable, The root mean square deviation, Compatibility of observables, The physical implication of the Schrodinger equation; General properties of Schrodinger equation, The case of conservative system, The superposition principle and Physical prediction; Probability amplitudes and interference effects, Case in which several states can be associated with the same measurement result.
	Week 8 (01 Sessions)	Practical in infinite potential well, Study of the probabity current in some special cases, Root mean square deviation of two conjugate observables, measurements bearing on only one part of a physical system, The density operator, The evolution operator, The Schrodinger and Heisenberg picture, The Gauge invariance, Propagator for the Schrödinger equation.
	Week 9	Application of the postulate to the simple cases: Spin1/2 and two-level system.

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Quantum Mechanics

	Week 10 (01 Lectures)	**Spin1/2 particle:** Experimental demonstration, Quantization of the angular momentum, theoretical description, Illustration of the postulate in the case of a spin1/2; Actual preparation of a various spin states, spin measurements, Evolution of spin ½ in a uniform magnetic field, General study of two-level system; Outline of the problem, Static aspect, Dynamical aspect: oscillation of the system between two unperturbed state.
	Week 11 (02 Weeks)	Pauli matrices, Diagnalization of 2cross2 matrices, Fictitious spin1/2 associated with two level system, system of two spin ½ particles, spin ½ density matrix, spin ½ particles in a static magnetic field and a rotating field, A simple model of ammonia molecule, coupling between a stable and unstable state.
	Week 12 (01 Lectures)	**The one-dimensional harmonic oscillator:** Introduction; Importance of harmonic oscillator in physics, the harmonic oscillator in classical mechanics, General properties of quantum mechanical Hamiltonian, Eigen values of the Hamiltonian; Notation, Determination of the spectrum, Degeneracy of the eigen values, Eigen State of the Hamiltonian; The {lϕn>} representation, Wave function associated with the stationary state, Discussion; Mean value and root mean square deviation of X and P in a state {lϕn>}, Properties of the ground state, Time evolution of mean values
	Week-13 (01 Lectures)	Some example of harmonic oscillator, Study of the stationary state in the {lr>} representation, Solving the eigen value equation of the harmonic oscillator by the polynomial method, Study of the stationary state in the {lp>} representation, the isotropic three-dimensional harmonic oscillator, A charged harmonic oscillator in uniform electric field, Coherent quasi classical state of harmonic oscillator.
	Week-14 (01 Lectures)	**General properties of angular momentum in Quantum mechanics:** Introduction; The importance of angular momentum, Commutation relation; Orbital angular momentum, Generalization. definition of angular momentum, Statement of the problem, General theory of angular momentum; Definition and notation, Eigen values of J^2 and J_z, Standard {lk, j, m>}

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Quantum Mechanics

		representation, Application to the orbital angular momentum; Eigen values and eigen function of L^2 and L_z, physical consideration. Spherical harmonics, Angular momentum and rotation, Rotation of diatomic molecules, Study of the stationary state in the {lp>} representation, Angular momentum of stationary state two-dimensional harmonic oscillator, A charged particle in magnetic field: Landau levels.
	Week-15 (01 Sessions)	**Particle in a central potential: the hydrogen atom:** Stationary state in a central potential; Outline of the problem, Separation of variable, Stationary state of the particle in a central, Motion of the centre of mass and Relative motion for a system of two Interacting particle; Motion of the centre of mass and Relative motion in Classical mathematics, Separation of variable in Quantum mechanics, The hydrogen atom; Introduction, The Bohr model, Quantum mechanical theory of the hydrogen atom, Discussion of the result. Hydrogen like system, a soluble example of the central potential, Probability current associated with the stationary state of the hydrogen atom, the hydrogen atom placed in a uniform magnetic field, Study of some atomic orbitals. Hybrid orbitals, Vibrational –rotational levels of diatomic molecules.

Assignments:
Each student will be given a topic to prepare an assignment just like a research report and will be graded accordingly.

Presentations:
Each student will present in the class about topic assigned to him/her as assignment. This will be graded accordingly on the basis of content, communication skill, way of presentation and answers to the questions asked.

Attendance:
At least 75% attendance is compulsory to sit in the midterm and final term examination

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Radiation Physics

Course Code	PHYS-617	
Course Title & Credit Hours	Radiation Physics, 3Cr.h	
Name of Faculty **(Name & Department)**	Physics, KIU	
Program & Department (Course Offered in)	MS- Physics(2 year)	
Prerequisites by Course(s) and Topics	Not Applicable	
Assessment Instruments with Weights (Homework, Quizzes, Midterms, Final, Assignments, Presentations, Lab work, etc.)	Assignment+Quiz+Ppt 30% OHT1+OHT2 30% Final Term 40%	
Textbook (or **Laboratory Manual** for Laboratory Courses)	1. Physics for Radiation Protection (2nd Edition) by James E. Martin (2006) 2. An Introduction to Health Physics (4th Edition) By Herman Cember,(2002)	
Reference Material	1. Introduction to Nudear Engineering (3rd Edition) By Lamarsh ,(1998) 2. Measurement and Detection of Radiation (2nd Edition) Nicholas Tsoulfanidis, Taylor & Francis (1995) 3. Radiation Detection and Measurement(3rd edition) By Glenn F. Knoll (2006) 4. Radiation Oncology Physics: A handbook for Teachers and Students by E B Podgorsak Sponsored by IAEA	
Course Goals	This unit will cover (i) Understanding various kinds of Radiations (ii) Sources of Radiations specially Gamma Rays (iii) How radiations; alpha, beta, gamma,neutrons and comic rays interact with matter (iv) Their detection and measurement (v) Health effects of *ionizing radiations* (vi) *Radiation Protection &Shielding*	
Topics to be covered in the Course, with Number of Lectures	**Week 1** **(02 Lectures)**	**Sources of Radiation** • Discovery of radiation

Radiation Physics

on Each Topic (Assume 15-week instruction and one-hour lectures)		• Types of ionizing radiation • Sources of Ionizing Radiations
	Week 2 (02 Lectures)	•
	Week 3 (02 Lectures)	• Mechanisms of Radiation emission • Transformation Kinetics • attenuation, half-value layer • Linear attenuation coefficient • Mass attenuation coefficient • Thomson scattering
	Week 4 (02 Lectures)	• Interaction of radiation with matter • Alphas, betas, gammas, nutrons
	Week 5 (02 Lectures)	**Dosimetric quantities** • Fluence • Absorbed dose • Kerma • Interrelationships of units
	Week 6 (02 Lectures)	• Collision stopping power • Range • Mean stopping power
	Week 7 (02 Lectures)	**Charged particle interactions** • Restricted Stopping Power • Straggling and Scattering • Electron Range • Energy Deposition • Bremsstrahlung yield • Bremsstrahlung targets
	Week 8 (02 Sessions)	• *Radiation Detection Instuments* • *HPGe* • *TLDs* • *Survey meters*
	Week 9	• *Biological Effects of Ionizing Radiations*
	Week 10	• ***Biological basis for Radiation***

	(02 Lectures)	***Safety.***
	Week 11 (02 Weeks)	• *Radiation standards and Laws*
	Week 12 (02 Lectures)	• *Review research papers*
	Week-13 (02 Lectures)	• *Review research papers*
	Week-14 (02 Lectures)	• *Lab Work, hands on study of radiation dosimetery*
	Week-15 (02 Sessions)	• *Lab Work, hands on study of radiation dosimetery*

Assignments: Assignment will be given every week .the student will have to submit the assignment in the next class. Assignment will be graded on the basis of quality and timely submission.

Attendance:
75% attendance is compulsory to sit in the midterm and final term examination

Research Methodology and Statistical Application

Course Code	**PHY-625**	
Course Title & Credit Hours	**Research Methodology 03 Credit Hours**	
Name of Faculty (Name & Department)	**Department of Physics KIU.**	
Program & Department (Course Offered in)	**Department of Physics,**	
Prerequisites by Course(s) and Topics	**English, Statistics and Mathematics**	
Assessment Instruments with Weights	**OHT(1+2) 30%** **Final Term 40%** **Assignment /Quizzes/Presentation 30%**	
Reference Textbook	1. Introduction to research methodology (recommended books), Research Methodology (Methods and Techniques), Second Revised Edition, C.R Kothari, 2. Introduction to Research Methods(Graduate Studies and Research Office Addis Ababa University), compiled by Abiy Zegeye, Alemayehu Worku, Daniel Tefera, Melese Getu, Yilma Sileshi	
Reference Material	**1.** X	
Course Goals	**understand the fundamentals of research and methods used in the entific writings.**	
	Week (1) (01 Lectures)	An Introduction Meaning of Research, Objectives of Research Motivation in Research, Types of Research Research Approached, Significance of Research Research Methods versus Methodology Research and Scientific Method Importance of Knowing How Research is Done Research Process, Criteria of Good Research Problems Encountered by Researchers in Pakistan Comparison to Developed World.
	Week 1 (01 Lectures)	Defining the Research Problem, What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem Technique Involved in Defining a Problem, An Illustration
	Week 2 (02 Lectures)	Research Design, Meaning of Research Design Need for Research Design, Research Methodology Features of a Good Design Important Concepts Relating to Research Design Different Research Designs

		Basic Principles of Experimental Designs Developing a Research Plan
	Week 3 (02 Lectures)	Methods of Data Collection Collection of Primary Data Observation Method Some Other Methods of Data Collection Collection of Secondary Data Selection of Appropriate Method for Data Collection
	Week 4-6 (06 Lectures)	What is a scientific research proposal? Scientific Research Proposal Format, Common Mistakes in Writing a Scientific Research Project Proposal, Scientific Research Proposal Example, introduction to standard SOPs, LOI, Personal statement, Different Steps in Writing Report Layout of the Research Report Types of Reports/scientific writings Oral Presentation, Aim and motivation – Principles and ethics, Literature survey – Abstraction of a research paper – Access using Internet web tools – e-mail – Impact and usefulness of the research problem – Role of research guide – Guidance and rapport – Preparation and presentation of Scientific reports; need and methods – Power point and poster – Writing of synopsis and dissertation and thesis. Plagiarism checking, research articles(letters, reports, review articles, communication and abstract image)
	Week 7-9 (06Lecture)	important tools to use data analysis (origin)
	Week-10-12 (06 Lectures)	Important tools for bibliography of scientific writings (use of endnote, mendelay desktop for references), styles of references, adjusting the styles from the given software, ethics and roles in references and citations.
	Week-13-16 (08 Lectures)	One complete project by utilizing all the knowledge and information as gain from the previous all sections.
Assignments: Every Student shall be responsible to submit the given assignments. **Assignments submitted after the due dates shall be graded as zero marks. Apology shall not be entertained.**		
Quizzes: There shall be quizzes after completion of every chapter, decided during the semester teaching. **Be alert to take (write) your quiz on the announce date. There shall be no makeup quizzes, students remain absent in the quizzes shall be graded as zero marks. Apology shall not be entertained.**		
Attendance: At least 80% attendance is compulsory to write the midterm and semester examination.		
Meetings with Students: Students are free to meet with the course Instructor to discuss the course related issues.		

Statistical Physics

Course Code	**PHY-662**	
Course Title & Credit Hours	**Statistical Physics 3Cr.h**	
Name of Faculty (Name & Department)	**Department of Physics KIU.**	
Program & Department (Course Offered in)	**Department of Physics, MS-II**	
Prerequisites by Course(s) and Topics	**Heat and Thermodynamics**	
Assessment Instruments with Weights	**OHT1+OHT2 30%** **Final Term 40%** **Assignment /Quizzes 30%**	
Textbook	Introduction to Statistical Physics, Kerson Huang, (Taylor and Francis, 2001).	
Reference Material	**1.** Statistical Mechanics, Raj Kumar Pathria, 2 nd edition (India, 1996).	
Course Goals	**understand the fundamentals of heat and thermodynamics.**	
	Week 1 (02 Lectures)	Intensive and extensive quantities, thermodynamic variables, thermodynamic limit, thermodynamic transformations.
	Week 2 (02 Lectures)	Classical ideal gas, first law of thermodynamics, application to magnetic systems, heat and entropy, Carnot cycle.
	Week 3 (02 Lectures)	Second law of thermodynamics, absolute temperature, temperature as integrating factor, entropy of ideal gas.
	Week 4 (02 Lectures)	The energy equation, Conditions for equilibrium, Helmholtz free energy, Gibbs potential.
	Week 5 (02 Lectures)	Maxwell relations, chemical potential. First-order phase transition, condition for phase coexistence.
	Week 6 (02 Lectures)	The statistical approach: phase space, distribution function, micro-canonical ensemble, the most probable distribution, Lagrange multipliers.
	Week 7 (02Lectures)	Maxwell-Boltzmann distribution: pressure of an ideal gas, equipartition of energy.
	Week 8 (02Lectures)	Entropy, relation to thermodynamics, fluctuations, Boltzmann factor.
	Week 9 (02Lectures)	Transport phenomena: collisionless and hydrodynamic regimes, Maxwell's demon, non-viscous hydrodynamics,
	Week 10 (02Lectures)	Sound waves, diffusion, conduction, viscosity.

Statistical Physics

	Week 11 (02 Weeks)	Quantum statistics: thermal wavelength, identical particles, Fermi and Bose statistics, pressure, entropy, free energy, equation of state,
	Week 12 (02 Lectures)	Fermi gas at low temperatures, application to electrons in solids and white dwarfs.
	Week-13 (02 Lectures)	The Bose gas: photons, phonons, Debye specific heat, Bose-Einstein condensation, equation of state, liquid helium.
	Week-14 (02 Lectures)	Canonical and grand canonical ensembles, partition function, connection with thermodynamics, fluctuations. Minimization of free energy, photon fluctuations, pair creation.
	Week-15 (02 Lectures)	The order parameter, Broken symmetry, Ising spin model, Ginsburg Landau theory, mean-field theory, critical exponents, fluctuation-dissipation theorem, correlation length, universality.
Assignments: Every Student shall be responsible to submit the given assignments. **Assignments submitted after the due dates shall be graded as zero marks. Apology shall not be entertained.**		
Quizzes: There shall be quizzes after completion of every chapter, decided during the semester teaching. **Be alert to take (write) your quiz on the announce date. There shall be no makeup quizzes, students remain absent in the quizzes shall be graded as zero marks. Apology shall not be entertained.**		
Attendance: At least 80% attendance is compulsory to write the midterm and semester examination.		
Meetings with Students: Students are free to meet with the course Instructor to discuss the course related issues.		