DEPARTMENT OF PHYSICS
Fazl Ali College, Mokokchung

COURSE OUTCOME

BSc

I-SEMESTER

Mathematical Physic-I
Core 1 (PHC 1.11)

The course builds a foundation of various applied field in science and technology. The course comprises of the study of vectors, laws of motion, momentum, energy, rotational motion, gravitation, fluids, elasticity and special relativity. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO1: Differential Equations and their applications in solving the problems in various fields of Physics.

CO2: Vector for studying force, torque, velocity, acceleration etc which explain the motion of the object.

CO3: Gradient of a scalar field and, divergence, curl of vector field, which is extensively used in electromagnetic fields, gravitational fields and fluid flow.

CO4: Orthogonal curvilinear Coordinate systems such as polar, cylindrical and spherical, to define the location or distribution of physical quantities in different frame of references.

CO5: The concept of Probability, which is utilized extensively in statistical thermodynamics and quantum physics.

Core 2 (PHC 1.21)
Mechanics

The students would learn about the behaviour of physical bodies. The course builds a foundation of various applied field in science and technology. The course comprises of the study of vectors, laws of motion, momentum, energy, rotational motion, gravitation, fluids, elasticity and special relativity. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO1: The laws on motion, Motion of objects in different frame of references, Rocket, Centre of mass, Galilean transformation and its applications, Conservation laws and its application, The concept of work, energy and force

CO2: The concept of collision and its applications, Physics of rotational dynamics and its application to different geometrical shaped bodies.

CO3: The non-inertial frames: pseudo forces, examples involving the centrifugal force and coriolis force, Motion of objects in different co-ordinate system, gravitational and central force motion.

CO4: The physics of elasticity and fluid motion, different types of oscillation and its related equations of motion, the concepts of resonance, power dissipation and quality factor

CO5: Special theory of relativity and its applications to understand length contraction, time dilation, relativistic addition of velocities, conservation of momentum and variation of mass, relativistic momentum, relativistic energy, and mass-energy relation.

II-SEMESTER

Core 3 (PHC 2.11)

Electricity and Magnetism

It gives an opportunity for the students to learn about the fundamental interactions of electricity and magnetism, both as separate phenomena and as a singular electromagnetic force.
After successful completion of the course, the students are expected to have gained a clear understanding of:

CO1 : Electric Field and its applications to various charge distributions, Electric Potential, Divergence of vector field, Laplace equation, Poisson's equation, Uniqueness theorem, Electric dipole and electrostatic energy

CO2 : Method of electrical images and its applications, Dielectric properties of matter, different types of capacitors and relation between electric field, electric polarization and electric displacement vectors.

CO3 : Magnetic field, Biot Savart's law and its applications, magnetic dipole, Ampere's circuital law and its applications, Curl, Divergence Vector potential , Magnetic force, Torque and Magnetic properties of matter

CO4 : Electromagnetic induction, Reciprocity theorem, Energy stored in magnetic field, concepts of Maxwell's equations, displacement current and electric circuits for DC and AC.

CO5 : Network theorems and its applications, Ballistic galvanometer, Electromagnetic damping, logarithmic damping and CDR.

III-SEMESTER

CORE 5 (PHC 3.11)

MATHEMATICAL PHYSICS-II

The emphasis of the course is to provide a mathematical framework for solving problems of interest to Physics. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO1: The fundamentals and applications of Fourier series, Fourier and Laplace transforms and their inverse transforms

CO2: The different methods of solving second order differential equations and familiarized with singular points and Frobenius method. Learn Legendre, Bessel, Hermite and Laguerre Differential Equations.

CO3: The Special functions like Gamma function, Beta function, Delta function, Dirac delta function.

CO4: The error and its propagation, concept and applications of least square fit.

CO5: The solutions to partial differential equations using separation of variables and their applications to solve Laplace's Wave equation and Diffusion Equation.

CORE 6 (PHC 3.21)
THERMAL PHYSICS

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The kinetic theory of gases and molecular collision.

CO-2: The real gases behavior from Joule-Thomson and Vander Waal

CO-3: Thermo dynamical variables, process, Laws and applications.

CO-4: The Concept of Entropy, thermodynamical potential and their applications.

CO-5: The phase transition equation of first and second order. Maxwell four thermodynamical relation and their applications.

CORE 7 (PHC 3.31)
ANALOG SYSTEMS AND APPLICATIONS

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The different types of semiconductor diodes such as Rectifier and Zener diodes and their applications.

CO-2: The Bipolar Junction Transistor and its biasing for designing an amplifier

CO-3: The analysis of Transistor amplifier in terms of ac and hybrid model of a transistor.

CO-4: The concept of Negative and Positive feedback of an amplifier and their applications to design a stable amplifier and oscillator respectively.

CO-5: The architecture of Operational Amplifier (OP-AMP) and its various linear and nonlinear applications.

IV-SEMESTER

CORE 8 (PHC 4.11)
MATHEMATICAL PHYSICS-III

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen. After successful completion of the course, the students are expected to have gained a clear understanding of

CO-1: The real and complex number and analysis of physics problems with complex numbers.

CO-2: The Integration of a function of a complex variable. Residues and Residue Theorem and their application in solving Definite Integrals.

CO-3: Fourier Transforms and Fourier Integral theorem.

CO-4: Laplace Transform (LT) of Elementary functions and the properties of LTs

CO-5: Application of Fourier Transforms to differential equations such as one dimensional Wave and Diffusion/Heat Flow equations. Application of Laplace Transforms to 2nd order Differential Equations such as Damped Harmonic Oscillator, Simple Electrical Circuits, Coupled differential equations of 1^{st} Order.

CORE 10 (PHC 4.31)
DIGITAL SYSTEMS AND APPLICATIONS

After successful completion of the course, the students are expected to have gained a clear understanding of

CO-1: The decimal, binary, octal and hexadecimal number systems and their inter conversion. This help to understand the basic arithmetic operation in the respective number system domains.
The concept of Boolean laws and Karnaugh-Map to simplify the complex digital
CO-2: circuits.
Data processing circuit such as multiplexer, demultiplexers, encoder and decoder.
The various type of flip flops and the applications of master slave J-K flip flop for
CO-3: designing the counter, registers and memory circuits.
CO-4: The internal architecture of 8085 microprocessor and assembly language program for various applications such as arithmetic and control operations,

CO-5:

V- SEMESTER

CORE 11 (PHC 5.11)
QUANTUM MECHANICS

The course provide a fundamental theory in physics that facilitate a description of the physical properties of nature at the scale of atoms and subatomic particles. It is the foundation of all quantum physics including quantum chemistry, quantum field theory, quantum technology, and quantum informationAfter successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: Development of quantum mechanics.

CO-2: The linear vector spaces, concept of basis and operators, Hilbert space, bra and ket notation.

CO-3: The use of commutation relations to explain the outcome of measurement.

CO-4: The concept and principles of quantum mechanics to calculate observables on known wave functions.

CO-5: The time-dependent and time-independent Schrödinger equations and its applications on simple potentials.

CORE 12 (PHC 5.21)
SOLID STATE PHYSICS

Solid-state physics deals with the properties of solids, from the atomic level onwards. The course facilitate to apply classical and quantum theory to understand the physical properties of physics. It empowers to build models to explain several phenomena in solid state. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The first principles, evaluate and validate experimental results, and draw logical conclusions thereof.

CO-2: Different Lattice types, the concepts of reciprocal lattice and crystal diffraction.

CO-3: The magnetic properties of matters and the superconductivity exhibiting in some materials.

CO-4: The concept of phonons and the difference in lattice vibration of monoatomic and diatomic chains.

CO-5: The dielectric properties of insulators and predict electrical and thermal properties of solids and explain their origin.

CORE 13 (PHC 6.11)
ELECTROMAGNETIC THEORY

The course on electrodynamics is an attempt to study the interaction of electric current with magnetic field. The course starts from the basic experimental laws and the well known accepted concepts by imparting the required mathematical concepts, identities and the theorem of vector analysis. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: Maxwell equations with its applications and the potentials formulations of electrodynamics are imparted.

CO-2: Gauge transformations with the physical concept of electromagnetic field energy density.

CO-3: The propagation of electromagnetic wave in unbounded and bounded media.

CO-4: The liner, circular and elliptical polarization of electromagnetic wave.

CO-5: The Rotatory polarisation along with the Fresnel's theory of optical rotation, along with the wave guides and optical fibers.

CORE 14 (PHC 6.21)
STATISTICAL MECHANICS

The course provide mathematical framework that applies statistical methods and probability theory to large assemblies of microscopic entities. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The concepts of microstate and macrostate and the role of entropy and free energy from the view point of statistical mechanics.

CO-2: The relation between thermodynamics parameters such as temperature, pressure, entropy and specific heat capacity from the distributions functions.

CO-3: Maxwell-Boltzmann's distribution and the role of partition function.

CO-4: Fermi-Dirac and Bose-Einstein distributions and their applications to different set of particles and their reduction to the Boltzmann's distribution.

CO-5: The applications of the principles of statistical mechanics to many Physics problems.

DISCIPLINE SPECIFIC ELECTIVES 1
(PHD 5.11(A))
CLASSICAL DYNAMICS

The course on classical dynamics is an attempt to impart the unified body of knowledge of mechanics that furnishes the basic concepts for the whole of physics. The course along with the tutorials will help the students to formulate theories that describe the motion of macroscopic bodies. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The classical mechanics to describe various complex mechanical systems along with the generalized coordinates with the concept of degrees of freedom.

CO-2: The Lagrangian and Hamiltonian formulation and their applications different physical system.

CO-3: The theory of small oscillation and its relevance in classical mechanics.

CO-4: The special theory of relativity, Lorentz transformation and the concept of four vectors, space like, time like and light like.

CO-5: The rasic relativistic kinematics and the application of fluid mechanics to various relevant systems.

DISCIPLINE SPECIFIC ELECTIVES 2
(PHD 5.21(a))
NANO MATERIALS AND APPLICATIONS

The emphasis of the course is on basic introduction about nanophysics and its applications in solving problems of interest to physicists. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: Nanoscale Systems: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures , density of states of materials at nano scale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equation

CO-2: Synthesis of Nanostructure Materials: Top down and Bottom up approach, Physical vapor deposition (PVD), Chemical vapor deposition (CVD). Sol-Gel, Hydrothermal synthesis.
Characterization: X-Ray Diffraction. Optical Microscopy. Electron Scanning Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy.

CO-3: Optical Properties: Concept of dielectric constant for nanostructures and charging of nanostructure, Optical properties of hetero structures and nanostructures.

CO-4: Electron Transport: Coulomb blockade effect, Defects and impurities: Deep level and surface defects.

CO-5: Applications: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage.

VI-SEMESTER

DISCIPLINE SPECIFIC ELECTIVES 3
(PHD 6.11(a))
ADVANCED MATHEMATICAL PHYSICS-I

The course impart knowledge about various mathematical tools employed to study physics problems. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The canonical momenta and pair of variables and the usages of Poisson brackets and Lagrange brackets.

CO-2: The group theory and symmetric elements.

CO-3: The variable calculus and the concept of lagrange equation and the application in simple problems.

CO-4: Baye’s theorem, repeated trails and explain various special probability distributions.

DISCIPLINE SPECIFIC ELECTIVES 3
(PHD 6.11(a))
ADVANCED MATHEMATICAL PHYSICS –II

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The calculus of variation and its application in diverse problems of physics

CO-2: Poisson Brackets and Lagrange Brackets and their properties.

CO-3: Group theory which is a pre-requisite for deeper understanding of crystallography, particle physics, quantum mechanics and energy bands in solids.

CO-4: The probability theory

CO-5: The Special Probability distributions

DISCIPLINE SPECIFIC ELECTIVES 4
(PHD 6.21(a))
ASTRONOMY AND ASTROPHYSICS

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The basics of astronomy and its scales

CO-2: The positional astronomy and understand the concepts of time , calendar etc.

CO-3: The concept of astronomical techniques.

CO-4: The different component of solar system and Star formation and its evolution

CO-5: Basic concept of general relativity and test of general relativity

MSc.
COURSE OUTCOME
I-SEMESTER
MPHC-1.11
Classical Mechanics

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: Lagrangian and Hamiltonian equations and their applications to different mechanical system

CO-3: Routhian procedure in relation to complex mechanical systems, canonical transformation with the concept of generating method. Hamilton Jacobi method. Generalised coordinates for rigid bodies to different dynamical systems.

CO-4: The theory of small oscillation and its application to different physical systems.

CO-5: The special theory of relativity and the fundamentals of fluid mechanics.

MPHC 1.21
Quantum Mechanics-I

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The key concepts and principles of quantum mechanics.

CO-2: One dimensional harmonic oscillator and discuss its algebraic method and analytical method.

CO-3: The Dirac-Delta potential and its bound state wave functions, concept of scattering matrix and transfer matrix.

CO-4: The theory of angular momentum and spin matrices, orbital angular momentum and Clebsch-Gordan coefficients.

CO-5: The Schrödinger equation for identical particles, energy Eigen values for positronium and muonic hydrogen, helium atom, para and ortho helium.

MPHC 1.31
MATHEMATICAL PHYSICS

The course imparts knowledge about various mathematical tools employed to study physics problems. After successful completion of the course, the students are expected to have gain a clear understanding of:

CO-1: Imbibe effective scientific and/or technical communication abilities among the students.

CO-2: Fourier ,Laplace and inverse Laplace transform and its applications.

CO-3: The concept of Tensors and various properties associated with tensors.

CO-4: Identify special functions like Lengendre D.E, Bessel D.E and Hermite and its applications.

CO-5: Group theory and symmetric elements.

MPHC 1.41

Statistical Mechanics

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The fundamental difference between classical and quantum statistics and learn about quantum statistical distribution laws.

CO-2: The concept of ensemble in statistical mechanics to a range of situations.

CO-3: The important examples of ideal Fermi and Bose systems.

CO-4: Ising model and mean field theory for first and second order phase transition.

CO-5. An analytic ability to solve problems relevant to statistical mechanics.

II- SEMESTER

MPHC-2.11

Electrodynamics

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: Maxwell equations and the electrodynamics' potentials, propagation of electromagnetic wave in different medium.

CO-2: Wave guides and resonant cavities and their applications.

CO-3: Retarded potentials and radiations.

CO4: Relativistic Electrodynamics.

MPHC-2.21

Quantum Mechanics II

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The non-degenerate and degenerate perturbation theory, fine structure of hydrogen and its corrections, Zeeman Effect and hyperfine splitting.

CO-2: The variational method and its applications to ground state solution of hydrogen and helium atom.

CO-3: Approximation methods for time-independent problems like the WKB approximations.

CO-4: The time dependent perturbation theory for different quantum systems.

CO-5: The theory of scattering and calculations of scattering cross-section, optical theorem, Born approximation, partial wave analysis, etc.

MPHC 2.31
NUCLEAR AND PARTICLE PHYSICS

The course offers students to gather advanced knowledge in Nuclear Physics. The different nuclear interactions and the corresponding nuclear potentials and its cross section. The knowledge help to pursue for an advanced course in Nuclear and particle physics. After successful completion of the course, the students are expected to have gain a clear understanding of:

CO-1: The nuclear operties and nuclear decay associated with apha, beta and gamma decay.

CO-2: The cross section involved in nuclear reactions and explain nuclear models.

CO-3: The quarks, and the properties of neutrino and experiments involving sub-atomic particles.

MPHC 2.41
Condensed Matter Physics-I

The emphasis of the course is in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: Crystal structure, lattice vibrations, free electron theory of metals

CO-2: Kronig Penny model for band structure of solids, Brillouin zones in two and three dimension, Fermi surfaces of metals.

CO-3: Intrinsic and extrinsic semiconductors, variation of Fermi level with temperature and carrier concentration, conductivity and their variation with temperature, direct and indirect band gap semiconductors.

CO-4: Dielectrics and Ferroelectrics properties of the solids

CO-5: Magnetic Properties of the solids

III-SEMESTER

MPHC 3.11

EMBEDDED SYSTEMS: INTRODUCTION TO MICROCONTROLLERS

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: Difference of the microprocessor and microcontroller. The internal architecture of the 8085 microprocessor and their data addressing mode. Programming model of 8085. The assembly language programming for 8085.

CO-2: The internal architecture of 8051 microcontroller and their pin diagram. Data addressing mode. Programming model of 8051. Set of instruction under the five category namely, Data transfer, Arithmetic operation, Logical operation, bit processing and program flow control.

CO-3: The assembly language and C language programming for 8085 microcontroller.

CO-4: 8051 timers and counter programming. Concept of Interrupt. Interfacing of 8051 microcontroller to peripherals such as Parallel and serial ADC, DAC interfacing, LCD interfacing.

CO-5: Embedded system development environment, trends in embedded industry. Arduino microcontroller and its pin diagram. Basic programming for Arduino.

MPHC 3.21

ATOMIC AND MOLECULAR SPECTROSCOPY

This course gives an opportunity for the students to learn about the different atomic models and atomic as well as molecular spectra. The course includes the study of molecular structure and spin resonance spectroscopy and serve as macroscopic as well as microscopic investigating tool for understanding physical as well as chemical phenomenon of atoms and molecules.
After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1 : Different atom models, Spin orbit interaction and production of fine structure and hyperfine structure of spectral lines.

CO-2 : Molecular structure particularly hydrogen molecule ion and hydrogen molecule, Variation method of chemical bonding and its application, calculation of moment of inertia and bond length of diatomic and linear triatomic molecule .

CO-3 : Molecular spectra by studying electronic, rotational and vibrational energies of molecule individually as well as together, Pure rotational Raman spectra and study of diatomic molecule under various conditions

CO-4 : Nature of spinning particles, Electron spin resonance (ESR) and production of fine and hyperfine fine structure, Nuclear magnetic resonance (NMR) spectroscopy and its applications.

CO-5 : Nuclear quadrupole resonance (NQR), Mössbauer spectroscopy, Auger spectroscopy, X-ray photoelectron spectroscopy, Scanning tunnelling spectroscopy and Circular dichroism spectroscopy

DISCIPLINE SPECIFIC ELECTIVE 1
MPHD 3.11(a)
CONDENSED MATTER PHYSICS-II

The emphasis of the course is on crystal imperfection, superconductivity, nano science and its applications in solving problems of interest to physicists. Students are to be examined on the basis of problems.

After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: Crystal Imperfections and Diffusion in Solids:

CO-2: Superconductivity: The phenomenon of superconductivity, Perfect conductivity and Meissner effect, Electrodynamics of superconductivity: London's equations, Thermodynamics of the superconducting phase transition: Free energy, entropy and specific heat jump Ginzburg-Landau theory of superconductivity: GL equations, GL parameter and classification into Type I and Type II superconductors, The BCS theory,

CO-3: Nano Physics: Nano materials, bottom up and top down approaches, elementary properties of nano materials and applications,

CO-4: Thin Film Physics: Mechanism of thin film formation, Formation stages of thin films, Condensation and nucleation, Thermodynamic theory of nucleation, Growth and coalescence of islands, Electrical properties of semi conductor thin films, Transport in dielectric thin films, Dielectric properties of thin films, optical properties of thin films,

CO-5: Thin Films Preparation, Measurement & Characterization: Chemical vapour deposition(CVD), Sol-gelfilm deposition, Scanning electron microscopy (SEM), Energy dispersive analysis of X-rays (EDAX), UV-VISspectroscopy, X-ray photoelectron spectroscopy (XPS), Scanning tunneling microscopy(STM), Atomic force microscopy (AFM).

DISCIPLINE SPECIFIC ELECTIVE 2
MPHD 3.21(a)
ASTRONOMY AND ASTROPHYSICS

The aim of teaching this paper is to understand the fundamental, principles , physics concepts in Astrophysics and astrophysical processes and systems ranging from our Sun to evolution of star. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The concept of Positional astronomy:

CO-2: The knowledge of Astronomical Measurements and techniques.

CO-3: The concepts of Energy transport and structure formation in stars.

CO-4: The stellar structure and evolution.

CO-5: The method of interaction of radiation with matter

IV-SEMESTER

COMPUTATIONAL PHYSICS
MPHC 4.11

The students will learn a selection of computational methods and techniques, how these can be used to solve problems within different field of Physics The students will be able to solve a given problem using one or more computational methods. Make a program and run the program and then analyse the obtained result. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: The concepts of rounding off rules and error. Introduction of Numerical analysis & Algebraic Equations

CO-2: Numerical solution of Matrices and Linear Algebric Equations

CO-3: Interpolation & Curve Fitting of data

CO-4: Numerical Differentiation and Integration

CO-5: Numerical solution of differential equation using one or more computational methods.

MPHD 4.11(a)
Atmospheric Physics

In this course, students shall study the thermodynamics of the atmosphere, Cloud Physics and atmospheric electricity, dynamic meteorology, atmospheric instability general circulation, tropical dynamics and numerical modeling. After successful completion of the course, the students are expected to have gained a clear understanding of:

CO-1: Thermodynamics of dry and moist air: Hydrostatic equilibrium: Vertical stability and instability of the atmosphere, Tropical convection, the development of thunderstorms.

CO-2: Cloud classification. Warm and cold cloud microphysics, global electrical circuit, electrical structure of the storms, lightning discharge and mechanism.

CO-3: Inertial and non inertial frame, equations of fundamental forces: Equation of motion in rotating coordinates. Mass and energy conservation laws, inertial flow, geostrophic, gradient and thermal wind. Concept of atmospheric circulation, vorticity and divergence.

CO-4: Barotropic, baroclinic and Kelvin-Helmholtz instability. Structure, evolution and properties of planetary boundary layer. Internal and external gravity waves, inertia waves, Rossby waves,

CO-5: Zonal and meridional circulation models, Climate variability and forcing, low frequency atmospheric oscillation such as Madden-Julian oscillation and Elnino southern oscillation . Basic principles of Numerical Weather Prediction model.

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