PROGRAMME STRUCTURE

Unit Table (B.Sc./B.Ed.)

The units offered for each major are outlined as follow.

Pass in Form 7 with 200 out of 400 marks with 50% minimum marks in English and any 3 subjects including the majoring subjects **OR** Foundation Science with GPA of 2.00 or more.

Physics

PHY504	**Mechanics and Fluids**	**12**	**Lautoka/Labasa/Nabua**
PHY505	**Electricity and Magnetism**	**12**	**Lautoka/Labasa/Nabua**
PHY510	**Oscillations, Waves and Optics**	**12**	**Lautoka/Labasa/Nabua**
Elective Units			
PHY501	Applied Physics	**12**	**Lautoka/Labasa/Nabua**
PHY502	Applied Electronics	**12**	**Lautoka/Labasa/Nabua**
PHY503	Electronics and Instrumentations	**12**	**Lautoka/Labasa/Nabua**
PHY506	Introductory Physics	**12**	**Lautoka/Labasa/Nabua**
PHY508	Introduction To Astronomy	**12**	**Lautoka/Labasa/Nabua**
Year-2			
PHY607	**Thermodynamics and Statistical Mechanics**	**15**	**Lautoka**
PHY609	**Modern Physics**	**15**	**Lautoka**
Elective Units			
PHY601	Environmental Physics	**12**	**Lautoka**
PHY602	Electronics / Electronic Circuits	**12**	**Lautoka**
PHY603	Electromagnetism	**12**	**Lautoka**
PHY604	Astronomy	**12**	**Lautoka**
PHY606	Medical Physics	**12**	**Lautoka**
Year-3			
PHY704	**Quantum Mechanics and Atomic Physics**	**20**	**Lautoka**
PHY707	**Nuclear and Particle Physics**	**20**	**Lautoka**
Elective Units			
PHY703	Renewable and Sustainable Energy	**20**	**Lautoka**
PHY704	Quantum Mechanics and Atomic Physics	**20**	**Lautoka**
PHY706	Solid State & Semiconductor Physics	**20**	**Lautoka**
PHY708	Principles of Energy Conservation and Utilization	**20**	**Lautoka**
PHY709	Radiation Detection and Measurement	**20**	**Lautoka**
Pre-Degree			
PHY402	**Foundation Physics I**		**Lautoka/Labasa/Nabua**
PHY403	**Foundation Physics II**	**10**	**Lautoka/Labasa/Nabua**
PHY301	**Preliminary Physics I**	**10**	**Lautoka/Labasa/Nabua**
PHY301	**Preliminary Physics II**	**10**	**Lautoka/Labasa/Nabua**

FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING SCIENCE AND TECHNOLOGY

Faculty of Science, School of Sciences, Department of Physics

Bachelor of Science in Physics

PHY504 Mechanics and Fluids (Core)

Mechanics: Measurement and units, vectors and vector multiplication, motion in one and two dimensions, analysis of projectile motion, forces and Newton's laws of motion, friction and its properties, circular motion.

Energy of a system, kinetic energy and work, potential energy and energy conservation, conservative and non-conservative forces, systems of particles, conservation of momentum, collisions, Rotational kinematics and dynamics, moments of inertia, torque, rolling motion of a rigid body.

Angular momentum, conservation of angular momentum, static equilibrium and elasticity, gravitation, momentum conservation and rocket motion, motion under a central force, Kepler's laws and planetary motions, satellite motion, Coriolis theorem, gravitational field, escape velocity.

Fluids: Density and pressure, Pascal's and Archimedes' principle, ideal fluids, streamlines and continuity, Beroulli's equation.

Recommended Texts:

1. Serway R.A. and Jewett J.W.Jr. (2008), Physics for Scientists and Engineers, (7th Edition), Brook/Cole Publishing.
2. Halliday, D. Resnick, R. And Walker, J. (2011), Fundamentals of Physics, Extended Version, John Wiley.
3. Young, H.D. and Freedman, R.A. (1996) University Physics, Extended Version, Addison-Wesley Publishing.

PHY505 Electricity and Magnetism (Core)

Electric Charge and Coulombs law, E-field of continuous charge distributions, E-field lines, The motion of charge particle in uniform E-field, conductors, electric flux, Gauss' law and its applications, electric potential, potential due to point charges and continuous charge

distributions, capacitors and dielectrics, The energy stored in a capacitor, Electric current, and current density, resistance and resistivity, electric conduction, electric power, electromotive force, resistors in series and parallel, Kirchoff's laws, RC circuits, electrical meters, household wiring, magnetic fields and forces, motion of charge particle in a magnetic field, magnetic force on a current carrying conductor, torque on a current loop, Hall effect and applications, Biot-Savart law, Ampere's law, magnetic field of a solenoid, Gauss' law in magnetism, Magnetism in matter, Magnetic field of the earth, Faraday's law of induction, Lenz law, motional emf and its applications, generators and motors, eddy currents, inductance, RL circuits, The energy stored in magnetic fields, mutual inductance, oscillations in an LC circuit, AC sources, resistors, inductors and capacitors in AC circuits, RLC series circuit, power in an AC circuit, transformer and power transmission, displacement current, Maxwell's equations and Hertz discoveries, Plane EM waves, an introduction to properties and production of EM waves.

Recommended Texts:

1. Serway R.A. and Jewett J.W.Jr. (2008), Physics for Scientists and Engineers, (7th Edition), Brook/Cole Publishing.
2. Halliday, D. Resnick, R. And Walker, J. (2011), Fundamentals of Physics, Extended Version, John Wiley.
3. Young, H.D. and Freedman, R.A. (1996) University Physics, Extended Version, Addison-Wesley Publishing.

PHY506 Introductory Physics (Elective)

Mechanics: Measurements and Uncertainties (SI units, dimensional analysis), Vectors and scalars, displacement, velocity and acceleration, force and equilibrium, Newton's laws of motion and friction forces. Energy theorem, work done, Kinetic and potential energies, conservation of energy, Impluse-Momentum Theorem, Law of conservation of momentum, collisions in one and two dimensions, centre of mass.

Fluids: Density, pressure and depth, Pascal's principle, fluids in motion, Equation of continuity, Bernoulli's equation and its applications.

Thermodynamics: Temperature, thermal expansion, heat, internal energy, specific heat capacity, phase change, kinetic theory of gases, thermodynamic system, laws of thermodynamics, heat engines, Carnot efficiency, Refrigerators and Heat pumps.

Food Physics: Physical principles and their applications in Food Technology such as wave motion, conservation of mass, elasticity, Rheological and interfacial properties of materials.

Electronics: Conductors and insulators, Coulomb's Law, electric field, capacitors and dielectrics and Biomedical Applications.

Electricity: Electromotive force and current, Ohm's law, resistance, electric power, alternative current, series and parallel circuits, internal resistance, Capacitors and their parallel and series

combinations, RC Circuits, measurements of current and voltage in circuits, Electrical safety and physiological effects of current.

Recommended Texts:

1. Serway R.A. and Jewett J.W.Jr. (2008), Physics for Scientists and Engineers, (7th Edition), Brook/Cole Publishing.
2. Halliday, D. Resnick, R. And Walker, J. (2011), Fundamentals of Physics, Extended Version, John Wiley.
3. Young, H.D. and Freedman, R.A. (1996) University Physics, Extended Version, Addison-Wesley Publishing

PHY510 Oscillations, Waves and Optics (Core)

Oscillations: Particle in simple harmonic motion (SHM), energy of a simple harmonic oscillator, SHM and circular motion, simple pendulum, physical pendulum and tensional pendulum, damped oscillations, forced oscillations and resonance.

Waves: Travelling waves, speed of waves on strings, reflection and transmission of waves, rate of energy transfer by sinusoidal waves on strings, linear wave equation, pressure variation of sound waves, speed of sound waves, intensity of sound waves, Doppler effect. Waves in interference, waves under boundary conditions, standing waves and beats

Optics: Ray optics and wave optics to explain propagation of light through media; reflection and refraction at plane and spherical mirrors; refraction through thin spherical lenses; optical instruments; aberrations in mirrors and lenses.

Electromagnetic Waves and Wave Optics: Displacement current, Maxwell's equations, plane electromagnetic waves, momentum and radiation pressure, production of electromagnetic waves ay an antenna, Young's double slit experiment, constructive and destructive interference, the Michelson Interferometer, diffraction pattern, resolution power, the diffraction grating, diffraction of X-rays by crystals and polarization of light.

Recommended Texts:

1. Serway R.A. and Jewett J.W.Jr. (2008), Physics for Scientists and Engineers, (7th Edition), Brook/Cole Publishing.
2. Halliday, D. Resnick, R. And Walker, J. (2011), Fundamentals of Physics, Extended Version, John Wiley.
3. Young, H.D. and Freedman, R.A. (1996) University Physics, Extended Version, Addison-Wesley Publishing.

PHY601 Environmental Physics (Elective)

The Essentials of Environment: Economic System, Solar System, Solar Radiation, Solar Spectrum, Ozone and UV radiation.

Interaction of Light with Matter: Attenuation of Solar radiation in Atmosphere, Balckbody Radiation, Planck's Law, Stefan Boltzmann Law and Wien's Law.

Momentum Transfer, Mass Transfer (gases and Water Vapour), Diffusion, Mass Transfer by Ventilation, Water Loss trough Lungs during Respiration andHeat Transfer Mechanisms.

Soil Temparature and Heat Flow: Heat Flow in Soil, Volumetric Heat capacity, Thermal Conductivity and Annual temperature Changes in Soil.

Micrometeorology: Turbulent Transfer, Profiles and Fluxes.

Recommended Texts:

1. Serway R.A., Faughn, J. S., Vuille, C. and Bennett, C. A. (2006), College Physics, (Enhanced 7th Edition), Thomson Books/Cole Publishing.
2. Cutnell, J. D. and Johnson, K. W. (2009), Physics, 8 Edition, Wiley Plus.

PHY602 Electronics (Elective)

Network analysis using series and parallel equivalents, voltage and current divider rules, Kirchhoff's laws, nodal voltage analysis, mesh current analysis, Thevenin and Norton's theorems, principle of superposition, Energy stored in capacitances and inductances, Transient response in RC and LC circuits, AC circuits involving phasors and complex impedances, Power in an AC circuit, Resonance in RLC circuit, Transformer and power transmission, Transfer functions of simple circuits, First-order low pass and high pass filter circuits, Decibels, logarithmic frequency scales, Bode plots, p-n junction diode, I-V characteristics, Schockley model, application in rectifiers, clippers and limiters, Zener diode and its applications, optoelectronic diodes: LED, photodiodes, optocouplers., pnp and npn structures; input and output characteristics of BJT, active, saturation and cutoff regions, common-emitter configuration, common-base configuration, common collector configurations, transistor as an amplifier, Q-point and loadline concept, DC biasing methods

Basic principles of operational amplifiers, transfer characteristics, offset parameters, differential gain, CMRR, Practical applications of operational amplifiers, linear circuits, Differential amplifiers, Positive feedback, Barkhausen criterion, Wien Bridge oscillator, phase shift oscillator, Colpitt's oscillator, Hartley oscillator, Calculations of frequency and amplitude of oscillator, Binary system, Boolean algebra, Logic gates, logic families, de Morgan theorem, Karnaugh maps, Adder circuits, Combinational and sequential logic circuits, Multiplexer and demultiplexer, decoders, encoders, BCD to seven-segment displays flip- flops, registers and counters.

Recommended Texts:

1. A.R. Hambley (2011), Electrical Engineering - Principles and Applications 5th Edition, Prentice Hall
2. R. Boylestad and l. Nashelsky (1998), Electronic devices and circuit theory, 7th Edition, Prentice Hall [hereafter referred as BN(1998)]
3. P. Horowitz and W. Hill (1994), Art of Electronics, 2nd Edition, Cambridge University Press [hereafter referred as HH(1994)]

PHY603 Electromagnetism (Elective)

Vector algebra, Vector fields and calculus, Coordinate transforms, Coulomb's law and electric field intensity, Electric flux density and Gauss law, Electric Potential, Poisson and Laplace equation, Energy density, Electric dipole, charges and force on conductors, Bound charges and Polarization in dielectrics, Boundary conditions applicable to conductors and dielectrics; Uniqueness theorem, BV value problems using method of images, separation of variables, BV problems in resistance and capacitance and linear dielectrics, Lorentz Force law, current density, Continuity equation, Magnetic dipole, Magnetic torque and moment, Applications of Biot Savart's law and Ampere's law, Magnetic vector and scalar potentials, Magnetization and bound currents, Application of Ampere's law in magnetized material, Magnetic boundary conditions, Magnetic fields in linear and non-linear media, Magnetic properties of matter, Inductance, Magnetic energy density, Magnetic circuits, Faraday's law, Displacement current, Maxwell's equations, Time varying potentials and harmonic fields, EM wave propagation in free space, dielectric media and conducting media, EM power and Poynting vector.

Recommended Texts

1. Elements of Electromagnetics, 3thEdition, by Mathew N.O. Sadiku, 2003
2. Introduction to Electrodynamics, 3thEdition, by David J. Griffiths, 2003

PHY604 Astronomy (Elective)

The Dawn of Astronomy: Ancient Astronomy, The Copernican Revolution, Kepler's Cosmology, Newton and Gravity.

Timekeeping and the Celestial Sphere: The Constellations, Celestial Coordinate System, Precession of the Earth's Rotation Axis, Lunar and Orbit Phase, Solar Eclipses, Lunar Eclipses and Tides.

Over View of Solar System: Sizes and Scales, Resolution and Rotation of Planets, Conservation of Angular Momentum.

The Earth: The Interior of the Earth, Geological Differentiation, Plate Tectonics, Evidence for Plate Tectonics, Consequences of Plate Tectonics, The Earth's Atmosphere, Weather and

Climate, Consequences of Rotation for Weather, The Earth's Magnetic Field, Auroras: The Northern and Southern Lights

The Moon: Intrinsic and Orbital Properties**,** Tides and Gravitational Locking**,** Surface Properties**,** Interior and Geological Activity**,** Theories of Formation

The Planet Mercury: General Features of Mercury**,** The Surface and Interior of Mercury

The Planet Venus: General Features of Venus, The Cloud Layer, The Atmosphere of Venus, A Runaway Greenhouse Effect?, The Surface Features of Venus**,** A Comparison of Venus and Earth.

The Planet Mars: General Features**,** Surface Features**,** Atmosphere and Interior**,** Viking: The Search for Life, The Moons of Mars.

The Planet Jupiter: General Features of Jupiter**,** The Atmosphere of Jupiter**,** The Great Red Spot**,** The Interior of Jupiter**,** The Magnetic Field of Jupiter**,** Jupiter's Ring.
The Jovian Moons: The Moon Io: a Seething Interior and Active Surface**,** The Moon Europa: Cue Ball of the Satellites**,** The Moon Ganymede: Laboratory for Tectonic Motion**,** The Moon Callisto: Geologically Dead**,** The Other Moons of Jupiter.

The Planet Saturn: General Features of Saturn, Surface and Interior**,** The Ring System**,**The Moons of Saturn.

The Planet Uranus: General Features of Uranus, Surface and Interior**,** The Ring System**,** The Moons of Uranus.

The Planet Neptune: General Features of Neptune**,** Surface and Interior**,** The Rings of Neptune**,** The Moons of Neptune.

The Planet Pluto: General Features of Pluto**,** Surface and Interior**,** The Moon Charon.

Comets: General Features of Comets**,** Comet Hyakutake**,** Comet Hale-Bopp**,** Halley's Comet**,** Collisions of Comets with other Bodies**,** Small Comets?

Asteroids: General Features of Asteroids**,** Earth-Crossing Asteroids

Meteors: Meteors and Meteor Showers**,** Classification of Meteorites**,** Meteorite Impacts

Recommended Texts

1. Ian Morison, *Introduction to Astronomy and Cosmology*, Latest Edition.
2. David A. Rothary, Neil McBride and Lain Gilmour, An Introduction to the Solar System, Latest Edition.
3. Kutner, Marc L., Astronomy: A Physical Prespective, Latets Edition.
4. Frank H. Shu, The Physical Universe: An Introduction to Astronomy, Latest Edition.

PHY606 Medical Physics (Elective)

Static Forces: Equilibrium and Stability, Equilibrium Consideration for the human body, Stability of the human body under the action of an external force, Skeletal Muscles, Levers, The Elbow, The Hip, The Back, Standing Tip-Toe on One Foot and Dynamic aspects of posture.

Friction: Standing at an Incline, Friction at the Hip Joint, Spine Fin of a Catfish.

Translational Motion: Vertical Jump, Effect of Gravity on the Vertical Jump, Running High Jump, Range of a Projectile, Standing Broad Jump, Running Broad Jump (Long Jump), Motion through Air, Energy Consumed in Physical Activity.

Angular Momentum: Forces on a Curved Path, A Runner on a Curved Track, Pendulum, Walking, Physical Pendulum, Speed of Walking and Running, Energy Expended in Running, Alternate Perspectives on Walking And Running, Carrying Loads.

Elasticity and Strength of Materials: Longitudinal Stretch and Compression, Bone Fracture: Energy Considerations, Impulsive Forces, Fracture Due to a Fall: Impulsive Force Considerations, Airbags: Inflating Collision Protection Devices, Whiplash Injury, Falling from Great Height, Osteoarthritis and Exercise.
Insect Flight: Hovering Flight, Insect Wing Muscles, Power Required for Hovering, Kinetic Energy of Wings in Flight, Elasticity of Wings.

Fluids: Force and Pressure in a Fluid, Pascal's Principle, Hydrostatic Skeleton, Archimedes' Principle, Power Required to Remain Afloat, Buoyancy of Fish, Surface Tension, Soil Water, Insect Locomotion on Water, Contraction of Muscles, Surfactants.

The Motion of Fluids: Bernoulli's Equation, Viscosity and Poiseuille's Law, Turbulent Flow, Circulation of the Blood, Blood Pressure, Control of Blood Flow, Energetics of Blood Flow, Turbulence in the Blood, Arteriosclerosis and Blood Flow, Power Produced by the Heart, Measurement of Blood Pressure.

Heat and Kinetic Theory: Heat and Hotness, Kinetic Theory of Matter, Transfer of Heat, Transport of Molecules by Diffusion, Diffusion through Membranes, The Respiratory System, Surfactants and Breathing, Diffusion and Contact Lenses.

Electricity: The Nervous System, The Neuron, Electrical Potentials in the Axon, Action Potential, Axon as an Electric Cable, Propagation of the Action Potential, An Analysis of the Axon Circuit, Synaptic Transmission, Action Potentials in Muscles, Surface Potentials, Electricity in Plants, Electricity in the Bone, Electric Fish.

Electrical Technology: Electrical Technology in Biological Research, Diagnostic Equipment, The Electrocardiograph, The Electroencephalograph, Physiological Effects of Electricity, Control Systems, Feedback, Sensory Aids, Hearing Aids, Cochlear Implant.
Optics: Nature of light, structure of the Eye, Lens System of the Eye, Retina, Resolving Power of Eye, Threshold of Vision, Vision and the Nervous System.

Atomic Physics: The Atom, Spectroscopy, Quantum Mechanics, Electron Microscope, X-rays, X-ray Computerized Tomography, Lasers, Lasers Surgery.

Nuclear Physics: The Nucleus, Magnetic Resonance Imaging, Nuclear Magnetic Resonance, Imaging with NMR, Functional Magnetic Resonance Imaging (FMRI), Radiation Therapy, Food Preservation by Radiation, Isotopic Tracers, Laws of Physics and Life.

Recommended Texts

1. Russell K. Hobbie, Intermediate Physics for Medicine and Biology, 4th Edition, Springer.
2. Paul Davidovits, Physics in Biology and Medicine, 3rd Edition, Elsevier.
3. Mark Strikman, Kevork Spartalian and Milton, W. Core, Applications of Modern Physics in Medicine.

PHY607 Thermodynamics and Statistical Mechanics (Core)

Thermodynamics:
Basic concepts of thermodynamics, thermal equilibrium and thermometry; First law of thermodynamics; heat, work and internal energy, calorimetry, heat capacity and specific heat, Kinetic theory of gasses; Molecular model of an ideal gas, principle of equipartition of energy, distribution of molecular speeds; Heat pumps and refrigerators; Carnot engine, Second law of thermodynamics: concept of entropy, entropy changes in various processes, An introduction to Phase transitions and real gasses.

Statistical Mechanics:
Assumptions of statistical mechanics, state of a particle in phase space, unit cell in phase space, density of states $g(E)$ and distribution function $f(E)$; Maxwell-Boltzmann statistics: molecular energies and molecular speeds, Specific heat of solids, Rayleigh-Jeans law for blackbody radiation; Quantum statistics: Bose-Einstein statistics and Fermi-Dirac statistics, Bose-Einstein condensation, Planck's radiation law, electrons in a metal

Recommended Texts:

1. Serway R.A. and Jewett J.W.Jr. (2008), *Physics for Scientists and Engineers*, (7th Edition), Brooks/Cole Publishing (Referred hereafter as (Serway 2008)).
2. Serway R.A., Moses, C.J., and Moyer, C.A. (2005), Modern Physics, Thmoson, Brooks/Cole (Hereafter referred as (SMM 2005))
3. Roy B.N. (1982) *Fundamentals of Classical and Statistical Thermodynamics*, John Wiley & Sons (Referred hereafter as (Roy 2002).

4. Zemansky M.W. and Dittman R.N. (1997) *Heat and Thermodynamics* (7th Edition), Mc Graw-Hill (Referred hereafter as (Zemansky 1997).
5. Beiser, A. (2003). Concepts of Modern Physics, 6th Edition, McGraw-Hill

PHY608 Modern Physics

Relativity: Principle of Galilean relativity, the Michelson-Morley experiment, Einstein's special theory of relativity, time dilation, length contraction, Lorentz transformation, relativistic momentum, rest mass and rest energy, equivalence of mass and energy.

Dual nature of radiation and matter waves: . Blackbody radiation, Raleigh-Jeans law, Planck's law, Photo-electric effect, X-ray spectra, Bragg's law, Compton effect, wave-particle duality, pair production, De Broglie hypothesis, electron diffraction, Heisenberg's uncertainty principle, concept of wave packets.

Atomic, Nuclear Physics and radioactivity: Atomic spectra of gases, line spectra of atomic hydrogen, Bohr model of hydrogen atom, systematics of stable nuclei, radio-active decay processes, nuclear forces, radio-active series, radio-active dating.

Recommended Texts

1. Krane, K., *Modern Physics*, Wiley, 1983. (referred as KK)
2. R. A. Serway, C.J. Moses and C.A. Moyer, *Modern Physics*, 3rd Ed., Hartcourt Brace, 2005 (hereafter referred to as SMM)
3. Serway R.A. and Jewett J.W.Jr. (2010), Physics for Scientists and Engineers, (8th Edition), Brook/Cole Publishing (referred as SJ)
4. Beiser, A., *Concepts of Modern Physics*, 6th edition, McGraw-Hill, International Edition, 2003.
5. A.P. Arya, *Elementary Modern Physics*, Addison-Wesley, 1974

PHY703 Renewable and Sustainable Energy (Elective)

The sun, measurements and estimation of solar radiation, the electrical national power grid in Fiji , solar thermal, photovoltaic, wind energy, ocean energy, geothermal energy, tidal energy, fuel cells, bio-energy, hydroelectric, energy storage, evaluation of energy resources, fossil fuels, environmental effects of renewable and non-renewable energies. The module also covers hydrogen economy and its implications.

Recommended Texts:

1. Vogel, W and Kalb, H (2007). *Solar Thermal Plants*, USA: John Wiley & Sons.
2. Goetzberger, A. and Hoffmann, V. U.(2005). *Photovoltaic Power Systems*, USA: Springer.
3. Kordesh, K. and Simader, G. (1996). *Fuel cells and Their Applications*, USA: VCH.

4. Mathew, S (2006). Wind Energy: *Fundamentals, Resource Analysis and Economics*, London: Springer.
5. Twidell, J and Weir, T (2006) "*Renewable Energy Resources*", 2nd edition, Taylor and Francis, USA.
6. Johansson, T. B., Kelly, H., Reddy, A.K.N., and Williams, R (1993). "*Renewable Energy: Sources for fuels and electricity*", Island Press.
7. Masters, G.M. (2004) – "*Renewable and efficient electric power systems*", John Wiley & Sons, New Jersey.
8. Muhammad Iqbal, An Introduction to Solar radiation (1983), Academic Press.
9. John A. Duffie and William A. Beckman, Solar Engineering of Thermal Processes (2006), John Wiley & Sons

PHY704 Quantum Mechanics and Atomic Physics (Core)

Quantum Mechanics: Introduction to quantum mechanics, quantum mechanical operators, Heisenberg uncertainty relation, Time-independent Schrödinger equation, stationary states, Eigen-states and eigenvalues, bound states in a potential, infinite square well potential, potential step, free particle, probability current, parity operator, and harmonic oscillator.

Atomic Physics: Hydrogen atom, origin of the quantum numbers, electronic probability density, radiative transitions, selection rules, electron spin, Stern-Gerlach experiment, normal and anomalous Zeeman's effect, exclusion principle, periodic table, electronic structure of elements, spin-orbit coupling, and total angular momentum, x-ray and atomic spectra, molecular bonding and electronic spectra of molecules.

Recommended Texts

1. Beiser, A., *Concepts of Modern Physics*, 6th edition, McGraw-Hill, International Edition, 2003.
2. R. A. Serway, C.J. Moses and C.A. Moyer, *Modern Physics*, 2nd Ed., Hartcourt Brace, 1997 (hereafter referred to as SMM)
3. A.P. Arya, *Elementary Modern Physics*, Addison-Wesley, 1974
4. **Krane, K., *Modern Physics*, Wiley, 1983**.
5. H. Semat and J.R. Albright, *Introduction to Atomic and Nuclear Physics*, Chapman and Hall, 1972
6. R. Eisberg and R. Resnick, *Quantum Physics of Atoms, Molecules, Solids, Nuclei and Partcles*, Wiley, 1974
7. Bransden, B. H. and C. J. Jochain, Physics of Atoms and molecules, Latest Edition, Prentice Hall; Pearson Educational.
8. Haken, H. and H. C. Wolf, The Physics of atoms and Quanta, Springer.

PHY706 Solid State and Semiconductor Physics (Elective)

Solid State Physics: Crystal Structure and interatomic forces, x-ray, neutron, and electron diffraction in crystals, reciprocal lattice, lattice Vibrations and Phonons, thermal properties, The free-electron model, energy bands in solids, Electron movement in crystals, Metals and Fermi surfaces, dielectric and optical properties of solids, defects in solids, superconductivity.

Semiconductors: Distinction between metals, semiconductors and insulators, energy band and band theory, position and importance of Fermi energy, direct and indirect band gap, density of states, electrons and holes, charge and effective mass, Fermi Dirac and Boltzmann distribution, intrinsic and extrinsic semiconductors, doping, generation and recombination.

Transport phenomena: conduction, mobility, resistivity and the Hall effect, drift and diffusion.

Semiconductor devices: *p-n* junction, energy band diagrams, minority carrier injection, recombination, depletion layer in junction, current voltage relationship.

Fabrication of semiconductor devices: Crystal growth, formation of defects during fabrication processes and their effects on the performance of devices

Recommended Texts:

1. **C. Kittel: *Introduction to Solid State Physics*. 8th Ed., John Wiley, 2005.**
2. J.P. McKelvey: *Solid State and Semiconductor Physics*. R.E. Krieger Pub. Co., Florida, 1986.
3. Sze, S. M. Physics of Semiconductor Devices: Physics and Technology, 3rd Edition, John Wiley, New York, 2006.
4. Gibbons, J. F. Semiconductor Electronics, McGraw-Hill: USA.
5. Smith, R. A. Semiconductors, Cambridge University press.
6. Rolf Enderlein, Fundamentals of Semiconductor Physics and Devices, World Scientific Publishing Co.
7. Singh, J. (1993), Physics of Semiconductors and Their Heterostructures, McGraw-Hill.
8. Wenckebach, W. T. (1999), Essentials of semiconductor Physics, Wiley
9. Singh, J. (2007), Electronic and Optoelectronic Properties of semiconductor Structures, Cambridge University Press.

PHY707 Nuclear and Particle Physics (Core)

Nuclear Physics: Nuclear constituents, nuclear sizes and shapes, spin and magnetic moment of nucleons, nuclear forces, liquid drop model of the nucleus, nuclear shell model, nuclear reactions, alpha, beta and gamma decays, nuclear fission and fusion, energy production in stars, nuclear radiation detectors and particle accelerators.

Particle Physics: The fundamental forces in nature, antiparticles, mesons, virtual particles, classification of particles, conservation laws, strange particles, particle resonances and quarks.

Recommended Texts

1. Beiser, A., *Concepts of Modern Physics*, 6th edition, McGraw-Hill, International Edition, 2003.
2. R. A. Serway, C.J. Moses and C.A. Moyer, *Modern Physics*, 3rd Ed., Hartcourt Brace, 2005 (hereafter referred to as SMM)
3. A.P. Arya, *Elementary Modern Physics*, Addison-Wesley, 1974
4. Krane, K., *Modern Physics*, Wiley, 1983.
5. R. Eisberg and R. Resnick, *Quantum Physics of Atoms, Molecules, Solids, Nuclei and Partcles*, Wiley, 1974

PHY708 Principles of Conservation and Utilization of Energy (Elective)

Students are exposed to a variety of area in energy demand, utilization and conservation. This course provides an understanding of Global energy scenario, National energy potential and demand. The course also covers the principles for energy conservation, energy management, energy planning, energy audit, energy efficiency and conservation, energy conservation in domestic and commercial buildings, energy efficient electrical services, energy efficient lights and economics of energy projects.

Recommended Texts:

1. Clive Beggs, Energy management, Supply and Conservation, 2nd edition, Elsevier, 2009.
2. Yogi Goswami, D. and Frank Kreith, Energy Conservation, 2007.
3. George Tchobanoglous and Frank Kreith, Handbook of Solid Waste management, Mc Graw Hill.
4. Capehart, B.L, Kennedy, W.J and Turner, W.C. (2006). *Guide to Energy Management*, New York:CRC
5. Turner, W.C, and Doty, S. (2006). *Energy Management Handbook*. Georgia:Fairmont Press.
6. Capehart, B.L, Kennedy, W.J and Turner, W.C. (2006). *Guide to Energy Management*, New York:CRC

PHY709 Radiation detection and Measurement (Elective)

Introduction to Radiation Measurements, Errors and Radiation Counting, Review of Atomic and Nuclear Physics, Energy Loss and Penetration of Radiation through Matter, Gas-Filled Detectors, Scintillation Detectors, Semiconductor Detectors.

Recommended Texts

1. Nicholas Tsoulfanidis, Nicholas Tsoulfanidis, Sheldon Landsberger, *Measurement and Detection*, 4th Edistion, CRS Press.
2. Glenn F. Knoll, *Radiation Detection and Measurement*, 4th Edition, Wiley.