Course Contents for Subjects with Code: PHY

This document only contains details of courses having code **PHY**.

Code	Subject Title	Cr. Hrs	Semester
PHY-101	Elementary Mechanics	3	I
Year	Discipline		
1	Physics		

Vector derivatives and operations, divergence theorem, Stokes' theorem, particle dynamics with emphasis on effect of frictional and drag forces on motion, non-inertial frames and pseudo forces, work-energy theorem, conservative and non-conservative forces, two particle and many-particle systems, centre of mass of solid objects, momentum changes in a system of variable mass.

Collisions in the center-of-mass reference frame, rotational dynamics with emphasis on Parallel-axis theorem, moment of inertia of bodies of various shapes, combined rotational and translational motion.

Angular momentum, angular velocity and stability of spinning objects, gravitational effect of a spherical mass distribution, Kepler's laws of planetary motion.

Books Recommended:

Physics Vol. I by Resnick, Halliday and Krane, 4th Edition, John Wiley and Sons Inc, New York, 1992.

Physics Vol. I by Resnick, Halliday and Krane, 5th Edition, John Wiley and Sons Inc, New York, 2002.

Fundamental of Physics by Halliday Resnick and Krane, 5th Edition, John Wiley and Sons Inc, New York, 1999.

University Physics 8th Edition by Sears, Zemansky and Young, Addison-Wesley, Reading (MA), USA, 2000.

Physics by Alonso and Finn: Addison-Wesley, Reading (MA), USA, 1999.

Code	Subject Title	Cr. Hrs	Semester
PHY-102	Waves, Oscillations and Optics	3	I

Year	Discipline
1	Physics

Simple and damped harmonic oscillations, forced oscillations and resonance, mechanical waves, traveling waves, wave equation and power and intensity in wave motion, principle of superposition, Doppler effect of sound waves.
Interference from thin films, Michelson interferometer, Fresenel's biprism and its use, diffraction from multiple slits, diffraction grating, X-ray diffraction and structure of matter, polarization, description of polarization states, rotation of plane of polarization, holography.

Books Recommended:

1. *Physics Vol. I & II (extended)* by Resnick, Halliday and Krane, 4th Edition, John Wiley and Sons Inc, New York, 1992.
2. *Physics Vol. I &* II by Resnick, Halliday and Krane, 5th Edition, John Wiley and Sons Inc, New York, 2002.
3. *Fundamental of Physics* by Halliday Resnick and Krane, 5th Edition, John Wiley and Sons Inc, New York, 1999.
4. *University Physics* 8th Edition by Sears, Zemansky and Young, Addison-Wesley, Reading (MA), USA, 2000.
5. *Physics* by Alonso and Finn: Addison-Wesley, Reading (MA), USA, 1999.

Code	Subject Title	Cr. Hrs	Semester
PHY-103	Electricity and Magnetism	3	II
Year	Discipline		
1	Physics		

Electric field of continuous charge distributions, dipole in an electric field, Applications of Gauss' law, calculating the field from the potential, capacitor with dielectric, electric current density and Ohm's law, semiconductors and superconductors, magnetic force on a charged particle, magnetic force on a current, torque on a current loop, magnetic dipole, Biot-Savart Law, Ampere's law, Faraday's Law, Lenz's Law, motional E.M.F, induced electric fields, Gauss' law for magnetism, origin of atomic and nuclear magnetism, magnetization, magnetic materials, induced magnetic fields and displacement current, Maxwell's equations, generating an electro-magnetic wave, traveling waves and Maxwell's equations, energy transport and the Poynting vector.

Books Recommended:

Physics Vol. II (extended) by Resnick, Halliday and Krane, 4th Edition, John Wiley and Sons Inc, New York, 1992.

Physics Vol.II (extended) by Resnick, Halliday and Krane, 5th Edition, John Wiley and Sons Inc, New York, 2002.

Fundamental of Physics by Halliday Resnick and Krane, 5th Edition, John Wiley and Sons Inc, New York, 1999.

University Physics 8th Edition by Sears, Zemansky and Young, Addison-Wesley, Reading (MA), USA, 2000.

Physics by Alonso and Finn: Addison-Wesley, Reading (MA), USA, 1999.

Code	Subject Title	Cr. Hrs	Semester
PHY-104	Thermodynamics and Kinetic Theory	3	II
Year	Discipline		
1	Physics		

Kinetic theory of the ideal gas, work done on an ideal gas, internal energy of an ideal gas, intermolecular forces.
Statistical mechanics, statistical distribution and mean values, distribution of molecular speeds, distribution of energies, Brownian motion.
Heat and Thermodynamics; heat, different theories of heat, specific heat, gram molecular specific heat, laws of thermodynamics, Zeroth law, first law, second law, third law of thermodynamics, reversible and irreversible processes, indicator diagram, entropy, law of increase of entropy, temperature-entropy diagram, Maxwell's thermodynamics relations, TDS equations, Clapeyron's equation, entropy and second law of thermodynamics, reversible and irreversible processes, second law of thermodynamics, Carnot Cycle, Carnot engine, thermodynamic temperature scale, entropy, low temperature physics.
Thermoelectricity, Seebeck effect, Peltier effect, thermocouple.

Books Recommended:

1. *Physics Vol I.&II (extended)* by Resnick, Halliday and Krane, 4th Edition, John Wiley and Sons Inc, New York, 1992.
2. *Physics Vol I &II (extended)* by Resnick, Halliday and Krane, 5th Edition, John Wiley and Sons Inc, New York, 2002.
3. *Fundamental of Physics* by Halliday Resnick and Krane, 5th Edition, John Wiley and Sons Inc, New York, 1999.
4. *University Physics* 8th Edition by Sears, Zemansky and Young, Addison-Wesley, Reading (MA), USA,
5. 2000.
6. *Physics* by Alonso and Finn: Addison-Wesley, Reading (MA), USA, 1999.

Code	Subject Title	Cr. Hrs	Semester
PHY-111	Physics-I (Mechanics & Optics)	3	I

Year	Discipline
1	Chemistry-II, Mathematics-I, Statistics-I

Mechanics Vector Operations

Vector in 3 dimensions; Vector derivatives and operation; Gradient, Divergence and Curl of a vector; Divergence Theorem; Stokes Theorem.

Particle Dynamic

Advanced application of Newton's laws Dynamics of Uniform motion; Equations of motion; Time dependent forces; Effect of drag forces on motion; Non inertial frames and pseudo forces; Non inertial frames and Pseudo forces; Limitations of Newton's Laws.

Work, Energy and Power

Work done by a constant force, work done by a variable force (1-dimensions); Work done by a variable (2-dimension) Work energy theorem, General proof of work energy theorem. Power: Reference Frames.

Conservation of Energy

Conservative, and non conservative forces; One dimensional conservative system; 2,3 dimensional conservative system; Conservation of energy in a system of particles system two practical system. Center of mass of solid object; Momentum changes in system of variable mass.

Collisions

Inelastic collision conservation of momentum during collision in center of Mass reference frame.

Rotational Dynamics

Angular momentum; angular velocity; Overview of rotational Dynamics; Parallel axis theorem; Determination of momentum of interstice of various shapes; Rotational dynamics of rigid bodies; combined rotational and transitional motion. Stability of spinning objects, the spinning Top.

Gravitation

Review of basic concepts of gravitation. Gravitational effect of a spherical mass distribution; Gravitational Potential Energy; Gravitational field & potential; Universal Gravitational Law.

Bulk Properties of Matters

Elastic Properties of Matter; Fluid Statistics; Fluid Dynamics; Bernoulli Equation; Viscosity.

Optic Topic

Nature of light; Light as an Electro magnetic wave; Interference; Adding of Electromagnetic wave using phasors; Interference from thin films; Michelson Interferometer; Fresnel Biprism and its use; Diffraction; Diffraction from multiple slits; Diffraction grating; Holography; Polarization; Description of polarization states; Rotation of plane of polarization.

Recommended Books:

1. Physics Vol. I & II (extended) by Resnick, Halliday and Karne, 4th and Sons Inc, New York.
2. Fundamentals of Physics by Halliday Resnick and Krane, John Wiley and Sons Inc, New York.

3. University Physics 8th Edition by Sears, Zemansky and Young, Addison – Wesley, Reading (MA), USA
4. Physics by Alonso and Finn; Addison-Wesley, Reading (MA) USA.

Code	Subject Title	Cr. Hrs	Semester
PHY-112	Physics Lab-I (Mechanics & Optics)	1	I

Year	Discipline
1	Chemistry-II, Mathematics-I, Statistics-I

1. Surface tension by capillary rise.
2. Study of compound pendulum and estimate of value of 'g'
3. Elastic constants by spiral spring
4. Modulus of rigidity by dynamic method and static method of Maxwell's Needle.
5. Spring Constant by static and dynamic method.
6. Modulus of rigidity by dynamic method.

Recommended Books:

1. Physics Vol. I & II (extended) by Resnick, Halliday and Karne, 4th and Sons Inc, New York.
2. Fundamentals of Physics by Halliday Resnick and Krane, John Wiley and Sons Inc, New York.
3. University Physics 8th Edition by Sears, Zemansky and Young, Addison – Wesley, Reading (MA), USA.
4. Physics by Alonso and Finn; Addison-Wesley, Reading (MA) USA.

Code	Subject Title	Cr. Hrs	Semester
PHY-113	Physics-II (Waves & Oscillation)	3	II
Year	Discipline		
1	Chemistry-II, Mathematics-I, Statistics-I		

Harmonic Oscillations:
Simple harmonic oscillation (SHM); Application of S H M; S H M and uniform circular motion, combinations of Harmonic motion Damped Harmonic Motion.

Wave Topic:
Mechanical waves; Traveling waves; Waves speed; Waves equation; Power and intensity in wave motion; Principle of superposition. (Basic ideas);

Sound Topic:
Beats Phenomenon; Doppler Effect.

Thermodynamics and Kinetic Theory of Gases:
Kinetic theory of the ideal gas, wok done on an ideal gas internal energy of an ideal gas Intermolecular forces.

Statistical Mechanics:
Statistical, Distribution and Mean values; Distribution of molecular speeds; Brownian motion.

Heat: Review of previous concepts; First law of Thermodynamics; Transfer of heat;

Entropy and Second law of Thermodynamics:
Reversible and irreversible Process, Second Law; Cycle; Carnot engines Thermodynamic temperature scale; Entropy; Joule – Thomson effect

Recommended Books:

1. Physics Vol. I & II (extended) by Resnick, Halliday and Karne, 4th and Sons Inc, New York.
2. Fundamentals of Physics by Halliday Resnick and Krane, John Wiley and Sons Inc, New York.
3. University Physics 8th Edition by Sears, Zemansky and Young, Addison – Wesley, Reading (MA), USA.
4. Physics by Alonso and Finn; Addison-Wesley, Reading (MA) USA.

Code	Subject Title	Cr. Hrs	Semester
PHY-114	Physics Lab-II (Waves & Oscillation)	1	II
Year	Discipline		
1	Chemistry-II, Mathematics-I, Statistics-I		

1. Thermo-Couple, Thermal e.m.f. and temperature diagram.
2. Determination of 'J' Electrical Method (Calendar and Barnes Method) with compensation for heat loss.
3. Velocity of Sound by Kundt's tube.
4. Frequency & A.C. mains by Sonometer.
5. Frequency & A.C. mains by Melde's Approvals
6. Use of sextant and measurement of altitude with it
7. Wavelengths of sodium D lines by Newton's Rings.
8. Wavelengths of light by Fresnel's biprism
9. Wavelength of light by diffraction grating
10. Measurement of the Rotation of the Plane of Polarization
11. Resolving Power of diffraction grating
12. Determination of the radius of Lycopodium Particles

Recommended Books:

1. Physics Vol. I & II (extended) by Resnick, Halliday and Karne, 4th and Sons Inc, New York.
2. Fundamentals of Physics by Halliday Resnick and Krane, John Wiley and Sons Inc, New York.
3. University Physics 8th Edition by Sears, Zemansky and Young, Addison – Wesley, Reading (MA), USA.
4. Physics by Alonso and Finn; Addison-Wesley, Reading (MA) USA.

Code	Subject Title	Cr. Hrs	Semester
PHY-121	Mechanics and Wave Motion (IT)	3	I

Year	Discipline
1	Information Technology

To teach students calculus based general physics by way of learning about the following topics in depth: Measurement and vectors, Motion in one, two and three dimensions, Newton's laws of motions, Work and energy principles, Laws of conservation of momentum and energy, One- and two-dimensional collisions, Rotational kinematics and dynamics, Conservation of angular momentum, Gravitation, Oscillations and waves.

Textbook

1. Resnick, Halliday and Krane, *Physics*, vol. 1. ISBN: 978-0-471-32057-9

Recommended Book

1. University Physics, vol. 1, by Sears and Zemansky, ISBN-10: 0201603365

Code	Subject Title	Cr. Hrs	Semester
PHY-122	Electricity & Magnetism (IT)	3	II

Year	Discipline
1	Information Technology

The primary objective of the course is to teach student calculus based general physics, particularly basic concepts of thermodynamics, electricity, and magnetism. The following topics will be covered in the course: Temperature, Thermal expansion, Kinetic theory and the ideal gas, Heat and First law of thermodynamics, Entropy and Second law of thermodynamics, Review of Vectors, Electric Charge and Coulomb's law, Electric field, Gauss's law, Electric potential, Capacitors and dielectrics, Current and resistance, Ohm's Law, Simple resistive circuits (series and parallel), Magnetic field, Ampere's law, Faraday's law of induction, Lien's Laws, Ampere's Law and its applications.

Prerequisites
Mechanics and Wave Motion (IT)

Text Book

1. Halliday, Resnick, and Walker, *Fundamentals of Physics Extended*, Sixth Edition, ISBN: 978-0-471-32000-5

Recommended Books

1. Sears and Zemansky, *University Physics*, vol. 1 and 2. ISBN-10: 0201603365

Code	Subject Title	Cr. Hrs	Semester
PHY-201	Concepts of Modern Physics	3	III
Year	Discipline		
2	Physics		

Quantum physics: Thermal radiation (black body radiation), quantization of energy, The photoelectric effect, Einstein's photon theory, the Compton effect, line spectra, wave behavior of particles, Testing de Broglie's hypothesis, waves, waves packets and particles, Heisenberg's uncertainty principle, Wave function, Schrödinger equation, trapped particles and probability densities, the correspondence principle, dual nature of matter (waves and particles).
Atomic physics: The atomic structure of hydrogen, Bohr's theory, angular momentum of electrons, electron spin, X-ray spectrum, development of periodic table, laser.
Nuclear physics: Discovering the nucleus, some nuclear properties, radioactive decay, measuring ionizing radiation, natural radioactivity, nuclear reaction.
Energy from the nucleus, nuclear fission, nuclear reactor, thermonuclear fusion, controlled thermonuclear fusion.
Solid state physics: Electrons in solids, free electron gas, semiconductors and insulators, semiconductor devices, superconductivity.

Books Recommended:

1. *Physics Vol. II (extended)* by Resnick, Halliday and Krane, 4th Edition, John Wiley and Sons Inc, New York, 1992.
2. *Physics Vol.II (extended)* by Resnick, Halliday and Krane, 5th Edition, John Wiley and Sons Inc, New York, 2002.
3. *Fundamental of Physics* by Halliday Resnick and Krane, 5th Edition, John Wiley and Sons Inc, New York, 1999.
4. *University Physics* 8th Edition by Sears, Zemansky and Young, Addison-Wesley, Reading (MA), USA, 2000.
5. *Physics* by Alonso and Finn: Addison-Wesley, Reading (MA), USA, 1999.
6. *Concepts of Modern Physics* by A. Beiser: McGraw-Hill, New York, USA, 1988.

Code	Subject Title	Cr. Hrs	Semester
PHY-202	General Physics Lab-I	2	III
Year	Discipline		
2	Physics		

1. The Harmonic Oscillation of Helical springs-parallel and series connection of spring
2. Measuring moments of inertia of different bodies disc-Hollow of Solid cylinder
3. Measurement of the speed of sound in air
4. Coherence & width of spectral lines
5. Diffraction intensity at slit of double slit system
6. Stephen-Boltzmann's law of Radiation
7. Characteristics curve of a solar cell
8. Magnetic field of paired coils in Helmoltz coils

Code	Subject Title	Cr. Hrs	Semester
PHY-203	Basic Electronics	3	IV
Year	Discipline		
2	Physics		

Circuit Analysis: Network theorems, AC circuit analysis using the j operator.
Semiconductor Devices and Applications: The pn junction diode, Rectifier circuits, Clippers, Clampers, Voltage multipliers.
Bipolar Junction Transistor and Its Biasing: Basic transistor configurations, The dc biasing circuits and bias stabilization.
Field Effect Transistor and FET DC Biasing:
The depletion-mode JFET, The depletion-mode MOSFET, The enhancement-mode FET, The dc biasing circuits and bias stabilization.
Bipolar Junction Transistor Models: The r_C model, The hybrid equivalent model, Graphical determination of h-parameters, Variation of transistor parameters.
BJT Small-Signal Analysis: The CE fixed-bias, self-bias and voltage-divider amplifiers, The emitter follower, The CB amplifier, Complete hybrid equivalent model.
FET Small-Signal Analysis: The JFET fixed bias, self-bias, voltage-divider and source-follower amplifiers.

Books Recommended:

1. *Basic Electronics by B. Grob, 8th Edition, Glencoe-McGraw-Hill, New York, NY (USA), 2002.*
2. *Introductory Circuit Analysis by Robert L. Boylestad, 6th Edi., Merril Publ. Co. Columbus, Ohio (USA) 1990.*
3. *Electronic Devices by Thomas L. Floyd: 5th Edition Prentice-Hall Inter. Inc., Englewood Cliffs, (USA), 1999.*
4. *Electronic Principles by Albert P. Malvino, 5th Edition Glencoe-McGraw-Hill Book Co., New York (USA) 1993.*
5. *Introductory Electronic Devices and Circuits by Robert T. Paynter, Prentice-Hall Intern. Inc. Upper Saddle River N.Y. USA, 1997*
6. *Electronic Devices and Circuit Theory by Robert Boylestad and Louis Nashelsky 6th Edition, Prentice-Hall International, Inc., (USA), 1996*
7. *Electronic Devices and Circuits, by Theodre F. Bogart, Jr. 4th Edition, Prentice-Hall, Upper Saddle River, NJ (USA) 1997.*
8. *Electronic Circuits and Systems, by J. D. Ryder, Charles M. Thomson, Prentice-Hall Inc. Englewood Cliffs, New Jersey (USA) 1976.*

Code	Subject Title	Cr. Hrs	Semester
PHY-204	General Physics Lab-II	2	IV
Year	Discipline		
2	Physics		

Interference of light Fresnel Biprism
Measurement of wavelengths of sodium light, difference of wave lengths and thickness of thin film e.g. mica using Michelson interferometer.
The determination of Cauchy's constants using spectrometer.
Determining the modulus of elasticity.
Investigating the Fourier transforms: simulation of the Fourier analysis and synthesis.
Determining resistances using a Wheatstone bridge.

Code	Subject Title	Cr. Hrs	Semester
PHY-211	Physics-III (Electricity & Magnetism)	3	III
Year	Discipline		
2	Chemistry-II, Mathematics-I, Statistics-I		

Electrostatics
Electric Charge; Conductors and Insulators; Vector form of coulomb's law.
Electric Field
Electric field of continuous charged stribution; Point charge in an electric field; Dipole in an electric field. Gauss's Law; Application of Gauss's Law (Integral Form).
Electric Potential
Calculating the field from the potential; Capacitors and dielectrics; Capacitor with dielectric.
Electric Current
Electric Current; Ohm's Law; Energy transfer in the electric circuit; Semiconductors; Super conductor.
DC Circuits
Calculating the current in a single loop, multiple loops; voltages at various elements of a loop; RC circuits.
Magnetism Magnetic Field Effects
Magnetic field, B. Magnetic force on a charged particle magnetic force on a charged particle magnetic force on a current; Torque on a current loop; Magnetic dipole.
Ampere's Law
Biot-Savart Law; Ampere's Law.
Faraday's Law of Electromagnetic Induction
Faraday's Law; Lenz's Law; Motional E.M.F. Induced electric fields.
Magnetic Properties of Matter
Gauss Law for Magnetism; Origin of Atomic and Nuclear magnetization; Magnetic Materials.
Inductance
Inductance; LR Circuits; Energy stored in magnetic field; Electromagnetic; Oscillation.
Alternating Current Circuits
Alternating Current; Single loop RLC circuit; Power in a.c. circuits; Transformer.
Maxwell's Equations
Summarizing ht electromagnetic equation; Induced magnetic fields & displacement current; Maxwell's equations.
Electromagnetic Waves
Generating an electromagnetic wave; Traveling waves and Maxwell's equation; Energy transport and the Poynting Vector.
Electronics
Semiconductor materials; Junction diode; Transistor; Transistor, biasing; Transistor as an amplifier; Amplification with feedback; Oscillators; Logic Gates

Recommended Books:
1. Physics Vol. I & II (extended) by Resnick, Halliday and Karne, 4th and Sons Inc, New York.
2. Fundamentals of Physics by Halliday Resnick and Krane, John Wiley and Sons Inc, New York.

3. University Physics 8th Edition by Sears, Zemansky and Young, Addison – Wesley, Reading (MA), USA.
4. Physics by Alonso and Finn; Addison-Wesley, Reading (MA) USA.

Code	Subject Title	Cr. Hrs	Semester
PHY-212	Physics Lab-III (Electricity & Magnetism)	1	III
Year	Discipline		
2	Chemistry-II, Mathematics-I, Statistics-I		

1. Measurement of resistance using a neon flash bulb and condenser
2. I-H Curve by Magnetometer
3. Conversion of a Pointer Galvanometer into a voltmeter
4. Conversion of a Pointer Galvanometer into an ammeter
5. Calibration of a meter and voltmeter by potentiometer
6. Low resistance by Carey Foster bridge
7. Charge sensitivity of a ballistic galvanometer taking into account Logarithmic decrement
8. Comparison of capacities by ballistic galvanometer
9. Determination of temperature coefficient of a resistance
10. Measurement of magnetic field by fluxmeter or by search coil method.
11. Measurement of H by earth inductor.

Recommended Books:

1. Physics Vol. I & II (extended) by Resnick, Halliday and Karne, 4th and Sons Inc, New York.
2. Fundamentals of Physics by Halliday Resnick and Krane, John Wiley and Sons Inc, New York.
3. University Physics 8th Edition by Sears, Zemansky and Young, Addison – Wesley, Reading (MA), USA.
4. Physics by Alonso and Finn; Addison-Wesley, Reading (MA) USA.

Code	Subject Title	Cr. Hrs	Semester
PHY-213	Physics-IV (Concepts of Modern Physics)	3	IV

Year	Discipline
2	Chemistry-II, Mathematics-I, Statistics-I

Quantum Physics:
Thermal Radiations (Black body radiation); The quantization of Energy; The Photoelectric effect; Einstein's photon theory; The Compton effect; Line Spectra.

Wave Nature of Matter:
Wave behavior of particles; Testing De Broglie's hypothesis; Waves, Wave packets and particles; Heisenberg's uncertainty principle (HUP); Wave Function; Schrödinger Equation.

States and Energy Levels:
Trapped Particles and Probability; Densities; The correspondence principles; Dual nature of matter (waves & particles)

Atomic and Nuclear Physics Atomic Structure of Hydrogen:
Bohr's Theory; Angular Momentum of Electrons; Electron Spin; X-ray Spectrum; X-Ray & Atomic number; Development of periodic table; Laser.

Nuclear Physics:
Discovering the nucleus; Some nuclear properties; Radioactive decay; Alpha decay; Beta decay; Measuring ionizing radiation (Units); Natural Radioactive; Nuclear Reactions; Energy from the nucleus; Nuclear fission; Nuclear Reactors; Thermonuclear Fusion (T.N.F.); Controlled Thermonuclear Fusion.

Practical Paper:
Mechanics, Thermodynamics, Sound, Optics and Electricity or Magnetism:

Special theory of Relativity:
Trouble with classical Mechanics; Postulates of Relativity; The Lorentz Transformation inverse transformation Consequences of Lorentz transformation; Relativistic momentum; Relativistic energy.

Recommended Books:

1. Physics Vol. I & II (extended) by Resnick, Halliday and Karne, 4th and Sons Inc, New York
2. Fundamentals of Physics by Halliday Resnick and Krane, John Wiley and Sons Inc, New York.
3. University Physics 8th Edition by Sears, Zemansky and Young, Addison – Wesley, Reading (MA), USA.
4. Physics by Alonso and Finn; Addison-Wesley, Reading (MA) USA.

Code	Subject Title	Cr. Hrs	Semester
PHY-214	Physics-IV (Concepts of Modern Physics)	1	IV

Year	Discipline
2	Chemistry-II, Mathematics-I, Statistics-I

1. Variation of photo-electric current with the intensity of light
2. Measurement of Planck's constant using spectrometer
3. Determination of e.m. of electron by deflection method
4. Determination of ionization potential of mercury
5. Acceptor circuit
6. Rejecter circuit
7. Characteristic curves of G.M. Counter
8. Setting up half and full wave rectifiers and the study of the waveshape on oscilloscope effect of smoothing circuit on ripple voltage.
9. To set up a transistor as an oscillator and to measure its frequency by an oscilloscope
10. Triode valve as a single stage voltage amplifier and measurement of its gain by an oscilloscope
11. To draw the characteristics of a semi-conductor diode.
12. Setting up a single stage transistor amplifier and measurement of voltage gain
13. Determination of range of Alpha Particles
14. Stopping power for alpha particles in air equivalent of Mica, Ag, Cu and Al.
15. Absorption coefficient of Beta-particles, using and End-on-Geiger Counter
16. To study the voltage current characteristics of an electric Discharge in gases at low pressures
17. Production of vacuum and its rought measurement with a monometer
18. Production of X-rays and the demonstration of their effect on a fluorescent screen.
19. To set up a High-Frequency Oscillator and measure its frequency, with a wave meter.

Recommended Books:

1. Physics Vol. I & II (extended) by Resnick, Halliday and Karne, 4th and Sons Inc, New York.
2. Fundamentals of Physics by Halliday Resnick and Krane, John Wiley and Sons Inc, New York.
3. University Physics 8th Edition by Sears, Zemansky and Young, Addison – Wesley, Reading (MA), USA.
4. Physics by Alonso and Finn; Addison-Wesley, Reading (MA) USA.

Code	Subject Title	Cr. Hrs	Semester
PHY-301	Classical Mechanics	3	V
Year	Discipline		
3	Physics		

Historical development of classical mechanics, Newtonian mechanics and its limitations, Lagrangian formulation in generalized coordinates, calculus of variation, Hamilton's principle, Lagrange's equation, space time symmetries and conservation laws, homogeneity and isotropy, cyclic coordinates, integrals of motion.

Central force, two-body central problem, Kepler's problem, planetary orbits and their equations, perturbation of orbits.

Legendre's transformation, Hamiltonian and Hamilton's equations of motion, Routhian, configuration space, phase space and state space.

Canonical transformations and their properties, canonical transformation of the free particle Hamiltonian, Poisson brackets and their properties, Poisson's theorems, invariance of Poisson's brackets under canonical transformations.

Books Recommended:

1. *Classical Mechanics* by H. Goldstein, Addison-Wesley, Reading, 1950.
2. *Mechanics* by L. D. Landau and E. M. Lifshitz, , Pergamon ,Oxford. 1960.
3. *Classical Mechanics* by J. W. Leech Methuen and Co. Ltd., London, 1958.
4. *Classical Mechanics* by V. D. Barger and M. G. Olsson, McGraw-Hill, New York, 1995.
5. *Analytical Mechanics* by L. N. Hand and J. D. Finch, Cambridge University Press, Cambridge, 1998.

Code	Subject Title	Cr. Hrs	Semester
PHY-302	Mathematical Methods of Physics-I	3	V
Year	Discipline		
3	Physics		

Vectors, divergence theorem, Green's theorem, Stokes's theorem, curvilinear coordinates, orthogonal curvilinear coordinates, gradient in orthogonal curvilinear coordinates, divergence and curl in orthogonal curvilinear coordinates, Laplacian, spherical polar coordinates.

Complex numbers, Euler's formula, De Moivre's theorem, elementary functions, analytic functions of complex variables, Cauchy-Riemann equation, harmonic functions, complex integration, Cauchy's theorem, Cauchy's integral formula, Taylor and Laurent series, Contour integrals, singularities and residues, residue theorem, poles on the real axis, branch points and integrals of multivalued functions.

Tensors, coordinate transformation, rank of a tensor, covariant and contravariant tensors, Tensor algebra, metric tensor, Christoffel symbols, equation of geodesic, Riemann tensor.

Books Recommended:

1. *Advanced Engineering Mathematics* by E. Kreyszig, Wiley, New York, 1999.
2. *Mathematical Methods for Physicists* by G. B. Arfken and H. J. Weber, A. Press, New York, 1995.
3. *Mathematical Methods for Physics and Engineering* by K. F. Riley, M. P. Hobson and S. J. Bence, ambridge University Press, Cambridge, 1997.
4. *Complex Variable* by Murray R Spiegel, Schaum's outlines series, McGraw Hill 1974.

Code	Subject Title	Cr. Hrs	Semester
PHY-303	Solid State Physics-I	3	V
Year	Discipline		
3	Physics		

Crystal structure, periodic arrays of atoms, fundamental types of lattices, index system for crystal planes, simple crystal structures, direct imaging of atomic structure, non-ideal crystal structures, reciprocal lattice, Diffraction of waves by crystals, scattered wave amplitude, Brillouin zones, Fourier analysis of the basis, quasi crystals, crystal binding and elastic constants, crystals of inert gases, ionic crystals, covalent crystals, metals, hydrogen bonds, analysis of elastic strains, elastic compliance and stiffness constants, elastic waves in cubic crystals.
Vibrations of crystals with monatomic basis, two atoms per primitive basis, quantization of elastic waves, phonon momentum, inelastic scattering by phonons, Phonon heat capacity, anharmonic crystal interactions, thermal conductivity, electronic heat capacity.
Noncrystalline solids, diffraction pattern, glasses, amorphous ferromagnets and semiconductors

Books Recommended:

1. *Introduction to Solid State Physics* by C. Kittle, 7th Edition, John Wiley & Sons, Inc. 1996.
2. *Solid State Physics* by Neil W. Ashcroft, N. David Mermin, CBS Publishing Asia Ltd. 1987.
3. *Solid State Physics* by J. S. Blakemore, Cambridge University Press, 1991.

Code	Subject Title	Cr. Hrs	Semester
PHY-304	Electronic Devices and Circuits	4	V
Year	Discipline		
3	Physics		

BJT and FET Frequency Response: General Frequency Considerations, Low-frequency analysis-Bode Plot, Low-frequency Response in BJT and FET Amplifiers, The Miller effect, High-frequency Response in BJT and FE amplifiers, Multistage Effects.
Negative Feedback and Oscillator Circuits: Feedback Concepts, Feedback Types, Practical Feedback Circuits, Oscillator Operation, Phase-shift Oscillator, Colpitts and Hartley Oscillator, Armstrong Oscillator, Wien Bridge Oscillator, Crystal Oscillator. Astable Multivibrator, Monosatble Multivibrator, Bistable Multivibrator, Schmitt-trigger circuit.
Power Amplifiers: Class A, Class B and Class C Amplifiers, Class AB Amplifier, Other Power Amplifier Circuits, Power Transistor and Heat Sink.
Operational Amplifiers: Differential Amplifier Circuit, Inverting and Non-inverting configuration, frequency response operational amplifier, OPAM Basics, Practical OPAM Circuits, Constant-gain Amplifier, Voltage Summing,Voltage Buffer.
Power Supplies: Capacitor Filter, π-Filter, π-R Filter, Discrete Transistor Voltage Regulation, Regulation by Zener Diode.
Special Diodes: Varactor, Light Emitting Diode, Zener Diode, Photodiode, Tunnel Diode, Shockley Diode, SCR, Light-activated SCR, Diac, Triac, Unijunction Transistor, LCD.
Introduction to Digital Electronics: The Number Systems, combinational and sequential systems, adder circuits and flip-flops.

Books Recommended:

1. *Electronic Devices* by Thomas L. Floyd: 5th Edition Prentice-Hall Inter. Inc., Englewood Cliffs, (USA), 1999.
2. *Electronic Principles* by Albert P. Malvino, 5th Edition Glencoe-McGraw-Hill Book Co., New York (USA) 1993.
3. *Introductory Electronic Devices and Circuits* by Robert T. Paynter, Prentice-Hall Intern. Inc. Upper Saddle River N.Y. USA, 1997
4. *Electronic Devices and Circuit Theory* by Robert Boylestad and Louis Nashelsky 6th Edition, Prentice-Hall International, Inc., (USA), 1996
5. *Electronic Devices and Circuits,* by Theodre F. Bogart, Jr. 4th Edition, Prentice-Hall, Upper Saddle River, NJ (USA) 1997.
6. *Electronic Circuits and Systems,* by J. D. Ryder, Charles M. Thomson, Prentice-Hall Inc. Englewood Cliffs, New Jersey (USA) 1976.
7. *Digital Technology* by Louis Nashesky, John Wiley and Sons, New york (USA), 1983.
8. *Digital Fundamentals* by Thomas L. Floyd, #rd Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA), 1986.
9. *Digital Systems* by Ronald J.Tocci, Prentice-Hall Intern. Inc., Englewood Cliffs (USA), 1995.

Code	Subject Title	Cr. Hrs	Semester
PHY-305	Quantum Mechanics-I	3	V

Year	Discipline
3	Physics

Quantum Mechanics of One dimensional Problems: Review of concepts of classical mechanics, State of a system, Properties of one dimensional potential functions, Functions and expectation values, Dirac notation and Hermitian operators, Solutions of Schrodinger equations for free particles, The potential carrier problems, The linear harmonic Oscillator.
Formalism of Quantum Mechanics: The state of a system, Dynamical variables and operators, Commuting observable, Heisenberg Uncertainty relations, Time evaluation of a system, Schrodinger and Heisenberg pictures, Symmetry principles and conservation laws.
Angular Momentum: Orbital angular momentum, Angular momenta, The eigenvalues and eigen functions of L and Lz.
Schrodinger Equation in Three Dimensions: Separation of Schrodinger equation in cartesian coordinates, Central potentials, The free particle, three dimensional square well potential, The hydrogenic atom, Three dimensional square well potential, The hydrogenic atom.

Books Recommended:

1. *Introductory Quantum Mechanic* by B.H. Bransden & C.J. Joachain, Longman Scientific & Technical London, 1990.
2. *A Modern Approach to Quantum Mechanics* by J.S. Townsend, McGraw Hill Book Company, Singapore, 1992.
3. *An Introduction Quantum Mechanics* by W.Greiner, Addison Wesley Publishing Company, Reading Massachusetts, 1980.
4. *Introductory Quantum Mechanics* by R.L. Liboff, Addison Wesley Publishing Company, Reading Massachusetts, 1980.
5. *Theory of Quanta* by Bialynicki-Birula, M. Cieplak & J.Kaminski, Oxford University Press, New York, 1992.
6. *Relativistic Quantum Mechanics* by W.Greiner, Springer Veriag, Berlin, 1990.
7. Quantum Mechanics by F. Schwable, Narosa Publishing House, New Delhi, 1992.

Code	Subject Title	Cr. Hrs	Semester
PHY-306	Physics Lab-III (Modern Physics)	4	V
Year	Discipline		
3	Physics		

1. Determining the specific Heat of Solids
2. To determine the characteristic of G. M. tube and measure the range and maximum energy of β particles.
3. Characteristics of G.M. counter and study of fluctuations in random process.
4. Determining velocity of viscous fluids using a falling-ball viscometer.
5. Determining the specific heats of solids.
6. Measuring magnetic field of (i) a straight conductor and (ii) a pair of coils in the Helmholtz configuration.

Code	Subject Title	Cr. Hrs	Semester
PHY-307	Mathematical Methods of Physics-II	3	VI
Year	Discipline		
3	Physics		

Special functions, Hermite polynomial, Legendre and associate Legendre polynomial, Laguerre polynomial, Bessel function, Neumann function, Hankel function, Modified and spherical Bessel function, Gamma function, error function.
Fourier series, cosine and sine series, change of interval, Fourier integral, complex form of Fourier series, Fourier transform, Fourier transform of derivatives, convolution theorem, Laplace transform, Laplace transform of derivatives, applications of Fourier and Laplace transforms.
Boundary value problem in physics, boundary value problems and series solution, the Sturn-Liouville problem, non-homogeneous boundary value problem and Green's function, Green's function for one-dimensional problem, eigenfunction expansion of Green's function, Green's function in higher dimensions, Green's function for Poisson's equation, quantum mechanical scattering problem.

Book Recommended:

1. *Advanced Engineering Mathematics* by E. Kreyszig, Wiley, New York, 1999.
2. *Mathematical Methods for Physicists* by G. B. Arfken and H. J. Weber, A Press, New York, 1995.
3. *Mathematical Methods for Physics and Engineering* by K. F. Riley, M. P. Hobson and S. J. Bence, Cambridge University Press, 1997.

Code	Subject Title	Cr. Hrs	Semester
PHY-308	Solid State Physics-II	3	VI
Year	Discipline		
3	Physics		

Energy levels in one dimension, effect of temperature on the Fermi-Dirac distribution, free electron gas in three dimensions, heat capacity of the electron gas, experimental electrical resistivity of metals, umklapp scattering, motion in magnetic fields, Hall effect, thermal conductivity of metals, ratio of thermal to electrical conductivity, nanostructures.

Nearly free electron model, origin of the energy gap, magnitude of the energy gap, Bloch functions, wave equation of an electron in a periodic potential, crystal momentum of an electron, solution of the central equation, empty lattice approximation, approximate solution near a zone boundary, number of orbital in a band, metals and insulators.

Band gap, equation of motion, effective mass, physical interpretation of the effective mass, effective masses in semiconductors, silicon and germanium, intrinsic carrier concentration, intrinsic mobility, impurity conductivity, donor states, acceptor states, thermal ionization of donors and acceptors, thermoelectric effects, semimetals, superlattices.

Books Recommended:

1. *Solid State Physics* by Blakemore: Cambridge University Press, 1991.
2. *Solid State Physics* by Neil W. Ashcroft and David Mermin: CBS Publ. Co. 1987.
3. *Introduction to Solid State Physics* by C. Kittle 7th Edition: John Wiley and Sons Inc. 1996.

Code	Subject Title	Cr. Hrs	Semester
PHY-309	Quantum Mechanics-II	3	VI
Year	Discipline		
3	Physics		

Matrix Mechanics: Linear vector space, orthogonal systems, linear transformations, matrices, change of basis, Hilbert space, Dirac Notation, matrix representation, diagonalization, examples.
Identical Particles and Second Quantization: Indistinguishability of identical particles, Systems of identical particles, Quantum dynamics of identical particle systems. Angular momenta and spin 1/2 boson operators,
Approximate Methods: Time independent perturbation theory for non degenerate levels, The variational method, The WKB approximation, Time dependent perturbation theory.
The Theory of Scattering: Scattering experiments and cross sections, Potential scattering, The method of partial waves, The Bom approximation.

Books Recommended:

1. *Introductory Quantum Mechanic* by B.H. Bransden & C.J. Joachain, Longman Scientific & Technical London, 1990.
2. *A Modern Approach to Quantum Mechanics* by J.S. Townsend, McGraw Hill Book Company, Singapore, 1992.
3. *An Introduction Quantum Mechanics* by W.Greiner, Addison Wesley Publishing Company, Reading Massachusetts, 1980.
4. *Introductory Quantum Mechanics* by R.L. Liboff, Addison Wesley Publishing Company, Reading Massachusetts, 1980.
5. *Theory of Quanta* by Bialynicki-Birula, M. Cieplak & J.Kaminski, Oxford University Press, New York, 1992.
6. *Relativistic Quantum Mechanics* by W.Greiner, Springer Veriag, Berlin, 1990.
7. Quantum Mechanics by F. Schwable, Narosa Publishing House, New Delhi, 1992.

Code	Subject Title	Cr. Hrs	Semester
PHY-310	Digital Electronics	3	VI

Year	Discipline
3	Physics

Number Systems: Binary, octal, hexadecimal number system, conversion of different systems, Digital codes.
Implementations of Logic Functions by Logic Gates:
Boolean algebra, logic gates and their application in logic design, Karnaugh maps and its use in some design problems, code converter logic design.
Analog to Digital Conversion: Digital to analog conversion, converter Specifications.
Synchronous Logic: Sequential logic, Flip Flops; R-S, T, D, Master-Slave J-K Flip Flop, basic binary ripple counter, modulus counters, parallel and up-down counter application as digital time (clock), arithmetic functions, shift registers, semi-conductor memory, programmable logic devices, (GAL, PAL).
Digital Computer: Concept of computer system

Books Recommended:

1. *Introduction to Digital Computer Technology* by Mashelsky (Wiley),
2. *Pulse Digital and Switching Wave forms* by Millman and Taub (McGraw-Hill)
3. *Electronic and Radio Engineering* by F.E. Terman McGraw-Hill.

Code	Subject Title	Cr. Hrs	Semester
PHY-311	Computational Physics-I	3	VI
Year	Discipline		
3	Physics		

Physics problems solving using Numerical methods, Euler-Newton method for solving differential equations, the trapezoidal rule for numerical quadrature and applications of random number, brownian motion, solution of integral equations, linear algebra, solution of linear algebraic equations, sorting and curve fitting.
Programming techniques in practical applications to advanced Physics problems.
Introduction to simulation techniques and computer graphics**,** use of computation and computer graphics to simulate the behavior of complex Physical systems, computational techniques in investigating and visualizing fundamental physics, scientific packages, introduction to Scientific work bench for problem solving in electronics.

Books Recommended:

1. *Computational Physics* by J.M. Thijssen, CUP (1999).
2. *Computational Methods in Physic, Chemistry and Biology by* P.Harrison, John Willey and Sons (2001).
3. *A First Course in Computational Physics* by Paul L. Devries, John Willey and Sons. N.Y. (1994).
4. *Computational Physics* by Henry J. Gardner, World Scientific, Singapore (1997).
5. *Numerical Recipes: The Art of Scientific Computing* by William H. Press, Brian P. Flannery, Saul A. Teukolsky, and William T. Vetterling Cambridge University Press, (1988).
6. *Mathematica for Physics*: Robert L. Zimmerman Addison Wesley Publishing Company, 1994.

Code	Subject Title	Cr. Hrs	Semester
PHY-312	Physics Lab-IV (Electronics)	4	VI
Year	Discipline		
3	Physics		

The students will have to perform at least EIGHT experiments from the list given below:

1. Design a full-wave rectifier and study its output without and with a capacitor filter.
2. Design a full-wave rectifier and study its output with a π-filter.
3. Design a regulated power supply using Zener diode and study its regulation.
4. Design clipper and clamping circuits and study the output waveshapes.
5. Design circuits for logic gates (NOT, OR, NOR, AND, NAND, XOR) using discrete components.
6. Design differentiator and integrator circuits and study output waveshapes.
7. Design a CE amplifier and study its frequency response. Determine its low- and upper-limit frequencies and also the bandwidth.
8. Design an emitter amplifier and determine its input and output impedance.
9. Design an RC phase-shift oscillator and determine its frequency by Lissajous figures.
10. Design an astable multivibrator and determine its frequency.
11. Design a transformer-coupled class A power amplifier and determine its ac power delivered to the load and percent efficiency.

Code	Subject Title	Cr. Hrs	Semester
PHY-401	**STATISTICAL MECHANICS**	**3**	**VII**

Year	Discipline
4	**Physics**

Course Outlines:

Classical statistical mechanics, phase space description of physical systems, macro systems and microsystems, ensembles, entropy in statistical mechanics, micro canonical ensemble, canonical ensemble, grand canonical ensemble, diatomic molecules, heat capacities of diatomic gasses and crystals. Quantum statistics, basic concept of quantum statistics, Pauli exclusion principle, Bose-Einstein and Fermi-Dirac distributions, frequency spectrum of a black body and Planck's radiation law, Liouville's theorem, equality of probability for the perfect gas, energy distribution of conduction electrons in metals, degree of gas degenerations, completely degenerate Fermi-Dirac gas, concept of fluctuations, Bose-Einstein condensation, introduction to density matrix approach.

Books Recommended:

1. *Elementary Statistical Physics* by C. Kittle John Wiley, New York, 1958.
2. *Fundamentals of Statistical and Thermal Physics* by R. Reif McGraw-Hill Education - Europe; January 1, 1965.
3. *Modern Physics An Introducing to its Mathematical Language* by William A. Blanped.
4. *Statistical Physics* by A.J. Pointon, publisher Longman, 1967.

Code	Subject Title	Cr. Hrs	Semester
PHY-402	**CLASSICAL ELECTRODYNAMICS-I**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Equation of Poisson and Laplace, applications of Laplace's equation to problems (conductors and dielectrics) having spherical cylindrical and Cartesian symmetry, electrical images (conductors and dielectrics).

Electric Current: Nature of the current, current density and equation of continuity, Ohm's law, steady current in media without sources of e.m.f., approach to electrostatic equilibrium.

Magnetic induction, force on current carrying conductors, Biot-Sawart law, Ampere's circuital law, the magnetic vector and scalar potentials, the magnetic field of a distant circuit.

Magnetic Properties of Matter: Magnetisation, vectors M and H produced by magnetized materials field equation, boundary conditions on the field vectors.

Maxwell's Equations and their Applications: Maxwell's equations and the generalization of the Ampere's law, electromagnetic energy, vector and scalar potentials, gauge transformations (Lorentz gauge, coulombs guage), pressure of radiations.

Books Recommended:

1. *Classical Electrodynamics* by Jackson, Wiley, 1975.
2. *Electricity and Magnetism* by W. J. Duffin, McGraw-Hill, 1990.
3. *Electromagnetism* by I.S. Grant and W. R. Phillips Wiley, 1990.
4. *Introduction to Electrodynamics* by D. Griffiths Prentice Hall, 1989.

Code	Subject Title	Cr. Hrs	Semester
PHY-403	**NUCLEAR PHYSICS-I**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Basic Properties of Nucleus: Size and mass of the nucleus, nuclear spin, magnetic dipole moment, electric quadrupole moment, parity and nuclear statistics.

Detectors: Passage of charged particles through matter, ionisation chamber, proportional counter, scintillation counter, semi-conductor detector, emulsion technique, bubble chamber, Particle Accelerators: Linear and orbital accelerators, Van de Graff, betatron, synchrocyclotorn, proton synchrotoron.

Radio-Active Decay: Theory of alpha decay, and explanation of observed phenoma, measurement of β-ray energies, the magnetic lense spectrometer, Fermi theory of β-decay, neutrino hypothesis, theory of gamma decay, multipolarity of gamma-rays, nuclear isomerism.

Nuclear Forces: Yukawa theory, proton-proton and neutron-proton scattering, charge independence and spin dependence of nuclear force, isotopic spin, Nuclear Models: Liquid drop model, shell model, collective model.

Books Recommended:

1. *Nuclei and particles* by E. Serge, 1980.
2. *A Text Book of Nuclear Physics* by C.M.H. Smith, Pergamon Press Oxford, 1966.
3. *Nuclear Physics* by I. Kaplan, Addison-Wesley, 1980.
4. *Introductory Nuclear Physics* by Krane, 1980.
5. *Concepts of Modern Physics* by Beiser, 1980.

Code	Subject Title	Cr. Hrs	Semester
PHY-404	**RELATIVITY AND COSMOLOGY**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Special Relativity, Galilean relativity, concept of ether, Michelson-Morley experiment, Eistein's postulates of special relativity, Lorentz transformations, structure of spacetime, Minkowski spacetime tensors, the light-cone, line element, four-vectors, relativity of simultaneity, time dilation, proper time, length contraction, twin paradox, velocity transformation and velocity addition. Relativistic Mechanics, Force equation in relativity, rest mass, kinetic and total energy, conservation of energy and momentum.

Elements of Tensor Calculus: Manifolds and coordinates, curves and surfaces, tensor fields, geodesics, Riemann tensor, metric tensor, Einstein's tensor.

General Relativity: Principles of general relativity, equation of geodesics deviation, Einstein's field equations.

Cosmology: Newtonian cosmology, cosmological redshift, Hubble's law, microwave background, the Big Bang, FRW metric.

Books Recommended:

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

Code	Subject Title	Cr. Hrs	Semester
PHY-405	**MEDICAL PHYSICS-I (THEORY)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Interactions of lonising Radiation with Matter: Introduction; Beta-rays, range-energy relationship, mechanism of energy loos, lonization and excitation, Bremsstrahlung, Alpha-rays, Rang-energy relation – ship, Energy transfer, Gamma-rays, exponential absorption, interaction mechanisms, Pair production, Compton scattering, photoelectric absorption, photodisintegration, Combined effect, Neutrons, Production classification, interaction, Scattering, Absorption.

Radiotherapy: Introduction, The development of radiotherapy, Radiotherapeutic aims, External beam therapy, Brachytherapy, Unsealed source therapy, Requirements for accuracy and precision, Quality assurance, The role of medical physics.

Medical Imaging: Diagnostic X-rays, Production of X-rays, Absorption of x-ray to other planes, Partial volume effect, Artifacts, Contrast agents in conventional radiography and CT, Diagnostic Ultrasound, Doppler effect, Radionuclide imaging, positron emission tomography (PET), Magnetic resonance imaging (MRI), Contrast agents for MRI.

Books Recommended:

1. *Introduction to Health Physics by Herman Cember. 3rd Ed. McGraw Hill, New York, 1996.*
2. *Thwaits, Radiotherapy Physics by sssJ.R. Williams, D.I ,OxfordUniversity Press, New York, 1993.*
3. *Diagnostic Imaging, by Peter Armstrong and Martin L. 4th Ed., Blackwell Science Ltd. Oxford, 1998.*
4. *Radiologic Science of Technologists by Stewart C. Bushong , 5th Ed. Mosby, 1993.*
5. *Fundamentals of Radiation Dosimetry, by J. R. Greening, 2nd Ed. Adam Hilger Ltd., Bristol 1985.*
6. *Radiation Detection and Measurement, by Knol G.F., 2nd Ed. Willey, New York, 1980.*
7. *Press Health Physics by Dathren, Pergamon.*
8. *Physics of Medical Imaging, by Edwin G.A.Aird, Heinemann, 1988.*

Code	Subject Title	Cr. Hrs	Semester
PHY-406	**MEDICAL PHYSICS-II (LAB)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Students are required to study the functioning and data analysis obtained from various machines used in nuclear medicine and medical physics. The students have to work in some hospitals where these machines are available. The list of these machines is as under:

1. X-ray Machine
2. Electro Cardiograph
3. Gamma Camera
4. Mammography Machine
5. Various Machines used in Radiotherapy

The students will have also to learn handling of radioactive material in different hospitals.

Code	Subject Title	Cr. Hrs	Semester
PHY-407	**PARTICLE PHYSICS-I**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Particle Classification: Quantum numbers, leptons, hadrons, baryons, mesons, quarks.

The Fundamental Interactions: The electromagnetic coupling, the strong coupling, the weak coupling. Symmetry Transformation and Conservation Laws: Translation in space, rotation in space, the group SU (2), systems of identical particles, parity, isospin charge conjugation, time reversal, G parity, CPT theorem.

The Electromagnetic Field: Gauge invariance and Maxwell's equations, polarization and photon spin, angular momentum, parity and C parity of the photon.

Books Recommended:

1. *Nuclear and Particle Physics* by Burcham, E. E. and Jobes, M., Longman, (1995).
2. *Introduction to Nuclear and Particle Physics* by Das, A. and Ferbel, T., Johan Wiley and Sons, (1994).
3. *Concepts of Particle Physics* by Gottfried, K. and Weisskopt, F., Vol. 1, Oxford University Press, (1986).
4. *Introduction of elementary Particles* by Griffiths, D., John Wiley and Sons, (1987).
5. *Nuclear and Particle Physics* by Williams, W.S.C., Oxford University Press, (1995).
6. *A Modern Introduction to Particle Physics* by Fayyazudding and Riazuddin, World Scientific, (1992)
7. *Quarks and Leptons* by Halzen F and Martin A.D., Wiley, (1984).

Code	Subject Title	Cr. Hrs	Semester
PHY-408	**PARTICLE PHYSICS-II**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

The Klein-Gordan Equation: Non relativistic quantum mechanics, Lorentz covariance and 4 vector notation, the Klein Gordon equation, the Feynman-Stuckelberg interpretation of $E < 0$ solutions, non relativistic perturbation theory (brief review), rules for scattering amplitudes in the Feynman-Stukelberg approach.

The Dirac Equation: Covariant form of the Dirac Equation, Dirac γ-matrices, conserved current and the adjoint equation, free particle spinors, anti particles, normalization of spinors and the completeness relations, bilinear covariants, zero mass fermion, the two-component neutrino.

Books Recommended:

1. *Relatvistic Quantum Mechanics* by Bjorken, J. D. and Drell, S. D., McGraw-Hill, (1964) International Edition reprinted in (1995).
2. *Quarks and Leptons* by Halzen, F. and Martin, A.D., John-Wiley and Sons (1984).
3. *Quantum Mechanics* by Riazuddin and Fayyazuddin, World Scientific, (1990).
4. *Introduction to Elementary Particles* by Griffiths, D., John-Wiley and Sons, (1987).

Code	Subject Title	Cr. Hrs	Semester
PHY-409	**COMMUNICATION ELECTRONICS-I (THEORY)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Amplitude modulation principles: Modulation, AM, FM, pulse modulation, power relationships, assignable frequency spectrum, band selection.

AM transmitters: Circuits, high level modulation, double modulation, AM with pulse width modulation, low level modulation.

AM radio receivers and transmitters: Superheterodyne receiver, double conversion receivers, receiver circuits: IF Amplifiers, AM detectors, automatic gain control, audio amplifiers, squelch, receiver schematics, loudspeakers, AM stereo.

Frequency Modulation Principles: Modulated wave, FM radio frequency band, direct and indirect frequency modulation (Phase Modulation), carrier phase in the frequency-modulated wave,FM detectors, stereo FM, FM receiver.

Television: Scanning principles, deflection systems, video camera tubes, video picture, signal, TV receiver Front end, color TV receivers.

Books Recommended:

1. *Electronic Communication* by Kennedy George, McGraw Hill, 1992.
2. *Electronic Fundamentals* by Thomas L. Floyd, 2nd. Ed., Maxwell-Macmillan, New York, 1991.
3. *Essential of Communication Electronics* by M. Slurzberg and W. Osterfield, National Book Foundation, Islamabad, 1991.
4. *Introduction to Linear Electrical Circuits and Electronics* by M. C. Kelly and B. Nichols, John Wiley, New York, 1988.
5. *Electronic Circuits Handbook* by Michael Tooley, BPB Publications, New Delhi, 1994.
6. *Introduction to Electronic Design* by F. H. Mitchell Jr. and Mitchell Sr., Prentice Hall, London, 1988.
7. Digital Principles and Applications by A. P. Malvino and D. P. Leach, 4th Ed., McGraw Hill, New York, 1986.
8. Perspectives in communication by U.R. Rao, Pub. World Scientific, 1987.
9. Digital Electronics By C. E. Strangio, Prentice Hall, London, Latest Edition
10. Digital Computer Electronics By Malvino A. P. and Brown J.A., McGraw Hill School Publishing Company, 1993.
11. Electronics for Today by Tom Duncan, OxfordUniversity Press.

Code	Subject Title	Cr. Hrs	Semester
PHY-410	**COMMUNICATION ELECTRONICS-II (LAB)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

1. Design and study the application of operational amplifier (current to voltage converter, Instrumentation amplifier, buffer, voltage clamp, integrator, differentiator, low and high pass filter, half –wave rectifier etc.).
2. Design sinusoidal oscillators and function generators.
3. Design RF transistor oscillator, Convert it into a transmitter. detect the transmitted wave by a radio receiver (both for AM & FM).
4. Circuit study and fault finding of audio-oscillator/ commercial radio and T.V.
5. Design and construct an analog to digital and digital to analog converters using IC's.

Code	Subject Title	Cr. Hrs	Semester
PHY-411	**ADVANCED ELECTRONICS-I (THEORY)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Operational amplifiers: Ideal operational amplifier, differential amplifier, emitter coupled differential amplifier, offset error and voltages/currents, operational amplifier parameters and applications, frequency response of operational amplifiers.

Combinational Digital Circuits and Systems: Overview of number system, digital codes and circuits, Arithmetic circuits, Decoders/Encoder and multiplexers.

Sequential Logic; Flip-flops, latches, JK, T and D flip-flops, Master-slave flip-flops.

Register and Counters; Shift registers, ripple and Synchronous binary counters, Analog to digital conversion and digital to analog conversion, conversion errors.

Memory and programmable logic: ROM and RAM, memory decoding, error detection and correction, PLD, PLA and PAL.

Control Logic Design: Microoperations, shifter unit, micriprogrammed control, ALU and control of microprocessor unit.

CPU addressing modes: Address field and modes, stack organization, data transfer instructions, data manipulation instructions, program interrupt. Input-output interface, design of a CPU, pipeline processing.

Books Recommended:

1. *Introduction to Digital Computer Technology* by Mashelsky (Wiley),
2. *Pulse Digital and Switching Wave forms* by Millman and Taub (McGraw-Hill)
3. *Microwave Principles*, by Reich-Skalmik-Ordung-Kranss.
4. *Microwave Measurements* by Gingston.
5. *Electronic and Radio Engineering* by F.E. Terman McGraw-Hill.
6. *Integrated Electronics* by Millman and Halkias.
7. *Microprocessors (principles and application)* 2nd Eddition by *Gilmore, (1996).*
8. *Computer Engineering, Hardware design* by M. Morris Mano, Prentice Hall (1988)

Code	Subject Title	Cr. Hrs	Semester
PHY-412	**ADVANCED ELECTRONICS-II (LAB)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

1. Design of a UJT relaxation oscillator of a variable frequency, measure frequency and amplitude of the output.
2. Design RF transistor oscillator, Convert it into a transmitter. detect the transmitted wave by a radio receiver (both for AM & FM).
3. Design an inverting and non-investing D.C. amplifier, measurement of parameters of a given IC operational amplifier.
4. Design and study the application of operational amplifier (current to voltage converter, Instrumentation amplifier, buffer, voltage clamp, integrator, differentiator, low and high pass filter, half –wave rectifier etc.).
5. Design a fixed and self bias transistor binary and triggering of binary, using IC's construct and study RS, JK (Master slave), T and D flip-flops.
6. Design and study of a half and full adder with different Boolean expression using IC's.

Code	Subject Title	Cr. Hrs	Semester
PHY-413	**MATERIALS SCIENCE-I (THEORY)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Introduction to materials; properties of the materials; Types of Materials (i) metallic materials & (ii) Non metallic materials); Selection of Materials; Bonds in Solid; Ionic Bonding, Covalent Bonding, Metallic Bonding, Van der Waals Bonding, Secondary Bonding, & Mix bonding, Effect of Bond type on structure and properties such as density, stability, melting point, stiffness and electrical properties.

Crystallography or crystal structure; The Space of Lattice, Crystal systems and Brass Lattice, Principal Metallic Crystal Structures, Atom Position in Cubic Unit Cells, Directions in Cubic Unit cells, Miller Indices for Crystallographic Planes in Cubic Unit Cells, Crystallographic Planes and directions in Hexagonal Unit Cells, Comparison of FCC, HCP, and BCC Crystal structures, Volume, Planar, and Linear Density Unit Cell Calculations, Polymorphism or Allotropy, Crystal Structure Analysis.

Non-Metallic Materials: Composite Materials, Ceramic Materials, Polymeric Materials, Semi-conductor / Electronic Materials.

Books Recommended:

1. *Introduction to Physical Metallurgy* by S.H.Avner, McGraw-Hill Book Comp. New York, 1999.
2. *Materials Science and Engineering and Introduction* by W.D. Cluster, John Wiley & Sons (USA), 1999.
3. *Principles of Materials Science and Engineering* by W.F. Smith, McGraw-Hill Book Comp, New York, 1999.
4. *Material Science & Metallurgy* by O.P. Khanna, DhanpatRai& Sons Delhi, 1994.

Code	Subject Title	Cr. Hrs	Semester
PHY-414	**MATERIALS SCIENCE-II (LAB)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Note: The students are required to do at least ten experiments from the following list:

Classification of Materials,

To classify the given specimen of materials into Metallic materials and non-metallic materials

a. Metals and alloys

b. Ferrous and Non-Ferrous metals

c. Ferrous and Non-Ferrous alloys

1. Study of furnace (Heat-Treatment Furnace) and a thermocouple pyrometer.
2. Study/understanding and working of a Metallurgical Microscope.
3. Study/understanding and working of a Metallurgical Microscope.
4. Study the microstructure of a given metals/alloys.
5. To determine the hardness of a given metallic material by

a. Vicker's Hardness testing Machine.
b. Brinell Hardness Testing Machine
c. Rockwell Hardness Testing Machine.

6. Study the relationship of Vicker's, Brinell and Rockwell hardness of given material.
7. To study the Mechanical Properties of a given sample.
8. To perform mechanical testing of polyethene.
9. To determine heat deflection temperature of given sample of polymer (Acrylic).
10. To perform thermogravimertric analysis of given polymeric materials & determine decomposition temperature.
11. To fabricate ceramic material by slip casting technique.
12. To determine the thermal shock resistance of the given material.
13. To study the thermal changes occurring in the given clays on heating with differential thermal analysis.(for refractory spalling index).
14. To determine the % age loss of moisture of the given clay.
15. To calculate moisture contents in the given sample of ceramics material.
16. To determine the %age water absorption in the given sample of refractory material.
17. To determine the loss in ignition in the given sample of clay.
18. To determine the porosity and density of a given refractory material.

Code	Subject Title	Cr. Hrs	Semester
PHY-415	**BIOPHYSICS-I (THEORY)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Nature and scope of biophysics; Molecular Structure of Biological Systems; Chemical binding, energies and bonds; Energy transfer and transformation in photosynthesis and biological membranes; Dynamics of biological systems; Fundamental concepts of thermodynamics, aqueous and ionic equilibrium of living cells; Other biotransport processes; Long and short distance transports; Viscoelestic properties of biomaterials.

Books Recommended:

1. *Radiation Biophysics* by L.Alpen Edward, Academic Press, (1988).
2. *Biophysics—An Introduction*. John Wiley and Son, (2002).
3. *Molecular Biophysics: Structures in Motion*, OxfordUniversity Press UK, (1999).
4. *Biophysics* by Glaser Rowland (2001). Springer Verlag, Berlin.
5. *Biophysical Thermodynamics* by T. Haynie Donald, Cambridge, University Press UK, (2001).

Code	Subject Title	Cr. Hrs	Semester
PHY-416	**BIOPHYSICS-II (LAB)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

The students are required to perform the following experiments:

1. Study of transport processes in plants
2. Study of membrane potential and redox
3. Study of germination and growth biology magnetized and irradiated seeds
4. Monitoring studies of body temperature in organisms under stress

Code	Subject Title	Cr. Hrs	Semester
PHY-417	**METEOROLOGY AND CLIMATOLOGY-I (THEORY)**	**3**	**VII**

Year	Discipline
4	**Physics**

Course Outlines:

Synoptic Meteorology: Composition & structure of atmosphere, ICAO standard atmosphere, Weather elements, Air mass classification, Thermodynamic characteristics, General Circulation.
Atmospheric thermodynamics, First law of thermodynamics and enthalpy, adiabatic processes and potential temperature, The second law of thermodynamics, entropy, thermodynamics of water vapour and moist air, thermodynamic properties of the water substance, phase transition of water, water vapour and most air,Clausius-Clapeyron'squation,Aerological diagrams, selection of coordinates, choice of diagram, analysis of tephigram.

Methods of Surface Observations & Codes: Reading of routine observations, barometric corrections & reduction, reading, setting & maintenance of thermometers, surface codes, Aeronautical codes (Speci&Metar)

Books Recommended:

1. *Hand Book Of Applied Meteorology by Hougton (Publisher: Wiley), 1st Edition, 1985.*
2. *Atmospheric Chemistry & Global Change by Guy. P. Brasseur (Publisher: Oxford), 1st Edition, 1999.*
3. *Statistical Analysis In Climate Research by Hans Vonstorch (Publisher: Cambridge), 1st Edition, 2001.*
4. *Meteorology by Moran Morgan (Publisher: Ma cMillion), 3rd Edition, 1991.*
5. *Climatology by OlixerHidore (Publisher: Merrill), 1st Edition, 1984.*
6. *Dynamical & Physical Meteorology by Haltiner& Martin (Publisher: McGraw Hill), 1st Edition, 1957.*
7. *Tropical Meteorology by Carlson (Publisher: The Pennsylvania State University), 1st Edition, 1981.*
8. *The Atmosphere by Frederick K. Lutgens (Publisher: Prentice Hall), International Edition, 1998.*
9. *The Status of Climate Variation In Pakistan & Its Impact by SMRC.No.10 SAARC Met. Research Centre, 1st Edition, 2004.*
10. *Atmospheric Physics by J.V.Irinarne (Publisher: D.Reidel Pub. Co.), 1st Edition, 1980.*
11. *Applied Climatology by Russell D. Thompson (Publisher: Routledge), 1st Edition, 1997.*
12. *Essentials of Meteorology by C. Donald Ahrens (Publisher: Brooks/Calc), 3rd Edition, 2001.*
13. *Atmospheric Science by John M. Wallace (Publisher: Academic Press), 1st Edition, 1997.*

Code	Subject Title	Cr. Hrs	Semester
PHY-418	**METEOROLOGY AND CLIMATOLOGY-II (LAB)**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

The students are required to do the following experiments:

1. Mean Sea Level Surface Map Analysis, frontal analysis.
2. Upper air map analysis, streamline-isotach analysis.
3. Analysis of polar & geostationary satellite images.
4. Recording of observations, wind-vane, anemometer, anemograph, hyetograph.

Code	Subject Title	Cr. Hrs	Semester
PHY-419	**SOLID STATE PHYSICS-I**	**3**	**VII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Introduction: The solid state problem, the Born-Oppenheimer approximation.

The One-Electron Approximation: Free electron gas model (FEG), applications of FEG, failure of FEG.

Effect of Non-Uniform Crystal Potential: The Bloch wave, the reciprocal lattice, the nearly free electron model (NFE) in one-dimension, the concept of energy band structure, the Fermi surface, Fermi velocity in NFE, The Bloch electron, the concept of effective mass.

Methods of Calculating Energy Band Structures: The LCAO method, the APW method, the OPW method, the concept of pseudopotentials,

Electron Interactions: The self-consistent calculations, the Hartree-Fock equation, plane-wave solution of the HF equation, problems.

Books Recommended:

1. *SolidState Physics* byAshcroft &Mermin, (1976).
2. *Introduction to SolidState Physics,* 7thEddition,by C. Kittle, (1996).
3. *Elementary SolidState Physics* by M. A. Omar, (1975).
4. *Quantum Theory of the SolidState*byj. Callaway, (1991).
5. *Principles of the Theory of Solids* byJ. M. Ziman, (1969).

Code	Subject Title	Cr. Hrs	Semester
PHY-421	**SOLID STATE PHYSICS-II**	**3**	**VII**

Year	Discipline
4	**Physics**

Course Outlines:

Optical Processes and Excitons: Optical reflectance, Kramer-Kronig relations, example, conductivity of collisionless electron gas, electron interband transitions, excitations, Frenkelexcitons Alkali halides, molecular crystals, weakly bound (Mott-Wannier) excitons, exciton condensation into electron-hole drops (EHD), Raman effect in crystals, electron spectroscopy with X-rays, energy loss of fast particles in a solid, summary.

Superconductivity:

Experimental survey, occurrence of superconductivity, destruction of superconductivity by magnetic fields, Meissner effect, heat capacity, energy gap, microwave and infrared properties isotope effect, theoretical survey, thermodynamics of the superconducting transition, London equation coherence length, BCS theory of superconductivity, BCS ground state, flux quantization in a superconducting ring, duration of persistent currents, type II superconductors, Vortex stat, estimation of H_{c1} and H_{c2}, Single particle tunneling, Dc Josephson effect, Ac Josephson effect, Macroscopic quantum interference, high-temperature superconductors, critical fields and critical currents, Hall number, fullerenes, summary,

Dielectrics and Ferroelectrics: Maxwell equations, polarization, macroscopic electric field, depolarization field, E_1, local electric field at an atom, Lorentz field, E_2, field of dipoles inside cavity, E_3, dielectric constant and polarizability, electronic polarizability, structural phase transitions, ferroelectric crystals, classification of ferroelectric crystals, displacive transitions, soft optical phonons, Landau theory of the phase transition, second-order transition, first-order transition, antiferroelectricity, ferroelectric domains, piezoelectricity, ferroelasticity, optical ceramics, summary.

Books Recommended:

1. *SolidState Physics byAshcroft &Mermin, (1976).*
2. *Introduction to SolidState Physics, 7th Edition,by C. Kittle, (1996).*
3. *Elementary SolidState Physics by M. A. Omar, (1975).*
4. *Quantum Theory of the SolidStatebyj. Callaway, (1991).*
5. *Principles of the Theory of Solids byJ. M. Ziman, (1969).*

Code	Subject Title	Cr. Hrs	Semester
PHY-422	**COMPUTATIONAL PHYSICS-II**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Simulation techniques-II , Physics problem solving, Motion of falling objects, Motion in single and multi dimensional, programming techniques in quantum mechanics, statistical mechanics and nuclear physics, Numerical solutions to Schrodinger's equations , Numerical integration and Monte Carlo Methods.

Laplace transformation, Solution of Linear Algebraic Equations, Sorting and Curve fitting, Interpolation and extrapolation, Special Functions, Differentiation and Integration of functions, Random Number Generation and Monte Carlo Integration, Fourier Transform Spectral Methods

Books Recommended:

1. *Computational Physics* by J.M. Thijssen, CUP (1999).
2. *Computational Methods in Physic, Chemistry and Biology by*P.Harrison, John Willey and Sons (2001).
3. *A First Course in Computational Physics* by Paul L. Devries, John Willey and Sons. N.Y. (1994).
4. *Computational Physics* by Henry J. Gardner, World Scientific, Singapore (1997).
5. *Numerical Recipes: The Art of Scientific Computing* by William H. Press, Brian P. Flannery, Saul A. Teukolsky, and William T. Vetterling Cambridge University Press, (1988).
6. *Mathematica for Physics*: Robert L. Zimmerman Addison Wesley Publishing Company, 1994.

Code	Subject Title	Cr. Hrs	Semester
PHY-423	**CLASSICAL ELECTRODYNAMICS-II**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Maxwell's Equations and their Applications: Green's function for time dependent wave equation, retarded scalar and vector potentials, radiation from an oscillating dipole, plane electromagnetic wave, plane waves in a conducting and non-conducting media, linear and circular polarization, and superposition of waves in one dimension, boundary conditions, reflection and refraction of electromagnetic waves at a plane interface between dielectrics, waves polarization by reflection and total internal reflection, reflection from a conducting medium, covariant formulation of electrodynamics, transformation laws of electromagnetic fields, the field of a uniformly moving and accelerated electron.

Plasma Physics: Introduction, electrical neutrality in a plasma, particle orbits and drift motion in a plasma, magnetic mirrors, the hydromagnetic equations, pinch effect, plasma oscillations and wave motion.

Lasers: Black body radiation, Induced emission and the gain coefficient, oscillations, output coupling, power and efficiency, optical resonators, fluctuation in lasers, solid state lasers, optical coupling, laser resonators, giant pulse techniques oscillators-amplifier lasers, power and energy supplies, high repetition rate laser, ruby laser, gas laser, semi-conductor diode laser, theory of p.n. junction laser, efficiency and thresh-hold current of diode lasers, applications of lasers.

Books Recommended:

1. *Classical Electrodynamics* by Jackson, Wiley, 1975.
2. *Electricity and Magnetism* by W. J. Duffin, McGraw-Hill, 1990.
3. *Electromagnetism* by I.S. Grant and W. R. Phillips Wiley, 1990.
4. *Introduction to Electrodynamics* by D. Griffiths Prentice Hall, 1989.

Code	Subject Title	Cr. Hrs	Semester
PHY-424	**NUCLEAR PHYSICS-II**	**3**	**VIII**

Year	Discipline
4	**Physics**

Course Outlines:

Nuclear Models: Liquid drop model, shell model, collective model. *Nuclear Reactions:* Conservation laws of nuclear reactions, Q-value of nuclear reaction, threshold energy, transmutation by photons, protons, deutrons and alpha particles, excited states of nucleus, energy levels, level width, Cross section from nuclear reactions, compound nucleus theory of nuclear reactions, limitations of compound nucleus theory, resonances, Breit-Wigner formula, direct reactions.
Neutron Physics: Neutron sources, radioactive sources, photo neutron sources, charged particle sources, reactor as a neutron source, slow neutron detectors, fast neutron detectors, slowing down of neutron, nuclear fission, description of fission reaction, mass distribution of fission energy, average number of neutrons released, theory of fission and spontaneous fission.

Thermonuclear Reactions: Fusion and thermonuclear process, energy released in nuclear fusion, carbon nitrogen & oxygen cycle, controlled nuclear fusion, D-D & D-T reactions.

Books Recommended:

1. *Nuclei and particles* by E. Serge, 1980.
2. *A Text Book of Nuclear Physics* by C.M.H. Smith, Pergamon Press Oxford, 1966.
3. *Nuclear Physics* by I. Kaplan, Addison-Wesley, 1980.
4. *Introductory Nuclear Physics* by Krane, 1980.
5. *Concepts of Modern Physics* by Beiser, 1980.

Code	Subject Title	Cr. Hrs	Semester
PHY-425	**MEDICAL PHYSICS-III**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Radiation Dosimetry: History of Absorbed Dose, Stochastic and Non-stochastic quantities, Units for Absorbed Dose, Absorbed Dose Calorimeters, Exposure and its measurements, The free-air chamber, Exposure measurement with calibrated cavity chamber. The concept of Kerma,absorbed Dose in air, Absorbed dose in other Materials, Factors converting Exposure to Absorbed Dose to wake, High energy calibrations, The Bragg-Gray Cavity theory.

Methods of Dosimetry: Calorimeters, lonisation Chambers, chemical Dosimetry, Thermoluminescence Dosimetry (TLD), Photographic Dosimeter, Scintillation Detectors, Other Dosimetric Systems.

Health Physics : Cardinal principles of radiation protection, Minimize time, Maximize distance, Maximize shielding, Time, Distance and shielding, Maximum permissible dose, whole-body occupational exposure, whole-body non-occupational exposure, partial bodyoccupational exposure, X-ray and pregnancy , Basic radiation safety criteria, effective dose-equivalent, allowable limit on intake (ALI) , inhaled radioactivity, derived air concentration, Gastrointestinal tract, Basis of radiation safety regulations.

Books Recommended:

1. *Introduction to Health Physics* by Herman Cember. 3rdEd. McGraw Hill, New York, 1996.
2. *Thwaits, Radiotherapy Physics* by sssJ.R. Williams, D.I ,OxfordUniversity Press, New York, 1993.
3. *Diagnostic Imaging,* by Peter Armstrong and Martin L. 4th Ed., Blackwell Science Ltd. Oxford, 1998.
4. *Radiologic Science of Technologists* by Stewart C. Bushong , 5th Ed. Mosby, 1993.
5. *Fundamentals of Radiation Dosimetry,* by J. R. Greening, 2nd Ed. Adam Hilger Ltd., Bristol 1985.
6. *Radiation Detection and Measurement,* by Knol G.*F*., 2nd Ed. Willey, New York, 1980.
7. *Health Physics* by Dathren, Pergamon Press.
8. *Physics of Medical Imaging,* by Edwin G.A.Aird, Heinemann, 1988.

Code	Subject Title	Cr. Hrs	Semester
PHY-426	**MEDICAL PHYSICS-IV (LAB)**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Students are required to study the functioning and data analysis obtained from various machines used in nuclear medicine and medical physics. The students have to work in some hospitals where these machines are available. The list of these machines is as under:

1. X-ray Machine
2. Electro Cardiograph
3. Gamma Camera
4. Mammography Machine
5. Various Machines used in Radiotherapy

The students will have also to learn handling of radioactive material in different hospitals.

Code	Subject Title	Cr. Hrs	Semester
PHY-427	**PARTICLE PHYSICS-III**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Hadron Spectroscopy: Formation experiments, partial wave formalism and the optical theorem, the Breit-Wigner resonance formula, baryon resonances, phase space considerations, production experiments.

The Quark Model: The group SU (3), quarks, hadrons (baryons, mesons in quark model, heave meson spectroscopy, the quarkonium model.

The Standard Model (qualitative treatment only): Unification of weak and electromagnetic interactions Glashow-Salam-Weinberg Model.

Books Recommended:

1. *Nuclear and Particle Physics* by Burcham, E. E. and Jobes, M., Longman, (1995).
2. *Introduction to Nuclear and Particle Physics* by Das, A. and Ferbel, T., Johan Wiley and Sons, (1994).
3. *Concepts of Particle Physics* by Gottfried, K. and Weisskopt, F., Vol. 1, OxfordUniversity Press, (1986).
4. *Introduction of elementary Particles* by Griffiths, D., John Wiley and Sons, (1987).
5. *Nuclear and Particle Physics* by Williams, W.S.C., OxfordUniversity Press, (1995).
6. *A Modern Introduction to Particle Physics* by Fayyazudding and Riazuddin, World Scientific, (1992)
7. *Quarks and Leptons* by Halzen F and Martin A.D., Wiley, (1984).

Code	Subject Title	Cr. Hrs	Semester
PHY-428	**PARTICLE PHYSICS-IV**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Electrodynamics of spinless particles: An "electron" in an electromagnetic field A^{μ} ,"spinless" electron – muon scattering, the cross section in terms of the invariant amplitude M, the decay rate in terms of M, "spinless" electron – electron scattering, electron – positron scattering: and application of crossing, invariant variables, the origin of the propagator.

Electrodynamics of Spin ½ Particles: An electron interacting with an electromagnetic field A^{μ} , Moller scattering $e^- e^- \rightarrow e^- e^-$, the process $e^- \mu^- \rightarrow e^- \mu^-$, trace theorems and properties of γ matrices, $e^- \mu^-$ scattering and the process $e^+ e^- \mu^+ \mu^-$, helicity conservation at high energies, survey of $e^+ e^- \rightarrow e^+ e^-$, $\mu^+ \mu^-$, $e^- \mu^- \rightarrow e^- \mu^-$ in the laboratory frame; kinematics relevant to the parton model, photons, polarization vectors, more on propagators, the electron propagator, the photon propagator, massive vector particles, real and virtual photons, Compton scattering $\gamma e^- \rightarrow \gamma e^-$, pair annihilation $e^+ e^- \rightarrow \gamma\gamma$, the + is prescription for propagators, Eeynman rules QED.

Books Recommended:

1. *Relativistic Quantum Mechanics* by Bjorken, J. D. and Drell, S. D., McGraw-Hill, (1964) International Edition reprinted in (1995).
2. *Quarks and Leptons* by Halzen, F. and Martin, A.D., John-Wiley and Sons (1984).
3. *Quantum Mechanics* by Riazuddin and Fayyazuddin, World Scientific, (1990).
4. *Introduction to Elementary Particles* by Griffiths, D., John-Wiley and Sons, (1987).

Code	Subject Title	Cr. Hrs	Semester
PHY-429	**COMMUNICATION ELECTRONICS-III (THEORY)**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Satellite Communication: Basic concept, earth station to earth station via satellite, service requirements, orbits, modulation and multiplexing, packetiser and depacketises, special problems in satellite communication.

Optical communication: Introduction of Optical Fibers, Optical sources and detection optical modulation techniques

Digital Communication: Spectral analysis and filtering theory, communication channels, entropy and source coding, data compression techniques, digital radio, spectrum communication systems, mobile wireless communication system.

Communication principles in earth observation: Remote sensing, sensors for optical remote sensing, remote sensing from space, environment and agricultural applications.

Books Recommended:

1. *Electronic Communication* by Kennedy George, McGraw Hill, 1992.
2. *Electronic Fundamentals* by Thomas L. Floyd, 2nd. Ed., Maxwell-Macmillan, New York, 1991.
3. *Essential of Communication Electronics* by M. Slurzberg and W. Osterfield, National Book Foundation, Islamabad, 1991.
4. *Introduction to Linear Electrical Circuits and Electronics* by M. C. Kelly and B. Nichols, John Wiley, New York, 1988.
5. *Electronic Circuits Handbook* by Michael Tooley, BPB Publications, New Delhi, 1994.
6. *Introduction to Electronic Design* by F. H. Mitchell Jr. and Mitchell Sr., Prentice Hall, London, 1988.
7. Digital Principles and Applications by A. P. Malvino and D. P. Leach, 4th Ed., McGraw Hill, New York, 1986.
8. Perspectives in communication by U.R. Rao, Pub. World Scientific, 1987.
9. Digital Electronics By C. E. Strangio, Prentice Hall, London, Latest Edition
10. Digital Computer Electronics By Malvino A. P. and Brown J.A., McGraw Hill School Publishing Company, 1993.
11. Electronics for Today by Tom Duncan, OxfordUniversity Press.

Code	Subject Title	Cr. Hrs	Semester
PHY-430	**COMMUNICATION ELECTRONICS-IV (LAB)**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

1. Design and study of decoder, encoder, multiplexer and demultiplexer circuits and compare the input output waveforms.
2. To construct and understand an operation of arithmetic logic unit and study of different arithmetic logic operations.
3. Design and construct active filters and study their frequency response.
4. Design and constricta infrared transmitter detected the transmitted wave.
5. Design and constricta ultrasonic transmitter and receiver.
6. Using microprocessor based trainer's and study the microve and optical communication and control the information from host personal computer.

Code	Subject Title	Cr. Hrs	Semester
PHY-431	**ADVANCED ELECTRONICS-III (THEORY)**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Electronic Devices (operation and characteristics): Tunnel and IMPATT diodes, Quantum-effect devices, MESFET and MODFET and Hot-Electron devices. LED, Gunn, and Laser diodes, photodetector, UJT and the basic sweep circuit, circuit to generate triggered sweep.

Radio communication: Production andpropagation of radio waves, direct waves, ground reflected, surface wave and space waves, formation of Ionospheric layer and their variations, skip distance.

Modulation and Detection: AM and FM modulation, bandwidth of FM signal, Angle Modulation, Vestigial Sideband and Single Sideband Modulation, Phase-locked Loop, Digital Communication, transmitter and superhetrodyne receiver.

Microwaves: Microwave spectrum and radar bands, properties of microwaves, production of microwave (klystron, magnetron, traveling wave oscillator), gunn oscillator, measurement of microwave power, radar system.

Books Recommended:

1. *Introduction to Digital Computer Technology* by Mashelsky (Wiley),
2. *Pulse Digital and Switching Wave forms* by Millman and Taub (McGraw-Hill)
3. *Microwave Principles*, by Reich-Skalmik-Ordung-Kranss.
4. *Microwave Measurements* by Gingston.
5. *Electronic and Radio Engineering* by F.E. Terman McGraw-Hill.
6. *Integrated Electronics* by Millman and Halkias.
7. *Microprocessors (principles and application)* 2nd Eddition by *Gilmore, (1996).*
8. *Computer Engineering, Hardware design* by M. Morris Mano, Prentice Hall (1988)

Code	Subject Title	Cr. Hrs	Semester
PHY-432	**ADVANCED ELECTRONICS-IV (LAB)**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

1. Synchronous and asynchronous BCD counters, Memory shift register with IC's.
2. Frequency counter and optional digital clock.
3. Circuit study and fault finding of stabilized power supply, Audio-oscillator/ CRO, multimeter/commercial radio and T.V.
4. Design and construct an analog to digital and digital to analog converters using IC's.
5. Design and study of decoder, encoder, multiplexer and demultiplexer circuits and compare the input output waveforms.
6. To construct and understand an operation of arithmetic logic unit and study of different arithmetic logic operations.
7. To construct and study of data storage and retrieval using semiconductor memory and understand the process of fetching an instruction and its operand with ALU.
8. Using microprocessor trainer's and study of microprocessor application working from host personal computer.

Code	Subject Title	Cr. Hrs	Semester
PHY-433	**MATERIALS SCIENCE-III (THEORY)**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Constitution of alloys: Metallic Solid Solutions, Solid Solubility, Phase Diagrams of Pure Substances.

Equilibrium phase diagrams; Iron-Iron Carbide diagram, Gibbs Phase Rule, Binary Isomorphous Alloy Systems, Binary Eutectic Alloy Systems, Nonequilibrium Solidification of alloys, Binary Eutectic Alloy Systems, Binary Monotectic Systems, Invariant Reactions, Phase Diagrams with Intermediate Phases and Compounds, Introduction to Ternary Phase Diagrams.

Corrosion: Definition, Types, its determination and protection.

Books Recommended:

1. *Introduction to Physical Metallurgy* by S.H. Avner, McGraw-Hill Book Comp. New York, 1999.
2. *Materials Science and Engineering and Introduction* by W.D. Cluster, John Wiley & Sons (USA), 1999.
3. *Principles of Materials Science and Engineering* by W.F. Smith, McGraw-Hill Book Comp, New York, 1999.
4. *Material Science & Metallurgy* by O.P. Khanna, DhanpatRai& Sons Delhi, 1994.

Code	Subject Title	Cr. Hrs	Semester
PHY-434	**MATERIALS SCIENCE-IV (LAB)**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Note: The students are required to do at least ten experiments from the following list:

1. To find out the corrosion rate of given specimen by loss in weight method.
2. To protect metals from corrosion – electroplating &colouring
3. To fabricate fiber-glass reinforced composite material by using hand-lay-up technique.
4. To determine and compare the specific heats of metallic and non-metallic materials.
5. To determine the plasticity of the given of clay.
6. To determine the effect on plasticity of the given sample of clay by adding (non plastic) impurity SiO_2
7. To measure the green strength of the given ceramic substance.
8. To determine the viscosity of a given sample of glass by penetrating method.
9. To study the process of enameling.
10. To study the process of glazing.
11. To measure the thermal conductivity of the given sample of refractory material.
12. To determine the thermal expansion coefficient of the given sample.
13. To determine the crushing strength of the given material.
14. Determine the %age linear shrinkage in the given sample of clay.
15. Determine the green compression strength of sample of clay.
16. Determine the green compression strength of sample of clay with the addition of impurity.
17. To apply the raw glaze and frit glaze on a ceramics body.

Code	Subject Title	Cr. Hrs	Semester
PHY-435	**BIOPHYSICS-III (THEORY)**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

The biomechanics of human body, blood circulation, swimming and flying; Physical factors of the environment; Biophysics of hearing, ifra and ultrasounds; Biomagnetism: Magnetic effects on humans and other organisms; Ionizing radiations; Radiobiological reactions; Vision, biosensing and biomechanics; Models approaches for propagation, ecological interactions, growth, differnciation evolution and neural process.

Books Recommended:

1. *Radiation Biophysics* by L.Alpen Edward, Academic Press, (1988).
2. *Biophysics—An Introduction*. John Wiley and Son, (2002).
3. *Molecular Biophysics: Structures in Motion*, OxfordUniversity Press UK, (1999).
4. *Biophysics* by Glaser Rowland (2001). Springer Verlag, Berlin.
5. *Biophysical Thermodynamics* by T. Haynie Donald, Cambridge, University Press UK, (2001).

Code	Subject Title	Cr. Hrs	Semester
PHY-436	**BIOPHYSICS-IV (LAB)**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

The students are required to perform the following experiments:

1. Determination of osmotic potential, pressure potential and water potential in plants
2. Ion uptake and balance of charge measurements
3. Study of biosensing and bioindication
4. Study of threshold of hearing, ECG and blood pressure monitoring in humans

Code	Subject Title	Cr. Hrs	Semester
PHY-437	**METEOROLOGY AND CLIMATOLOGY-III**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Dynamic Meteorology: Circulation &vorticity, Stokes theorem, Vorticity equation, Rossby waves.

Meteorological Instruments: Meteorological instruments used in thermometry, barometry, hygrometery, rainfall & snowfall measurement, wind measurement, cloud measurement, evaporation measurement, visibility measurement, sunshine measurement. introduction to weather radar systems, introduction to radiosonde equipment.

Climatology: Climatic elements; principles of climate classification; world climate classification; climates of Asia; climates of the sub-continent; the climate of Pakistan.

Climate change: Meteorological factors affecting climate; greenhouse gases; El-Nino, La-Nina.

Tropical Meteorology: Tropical Launch Internet Explorer Browser.lnkgeneral circulation, Diurnal variations of meteorological elements in the tropics, a survey of low-latitude weather disturbances; easterly waves; intertropical convergence zone. Monsoons, Tropical cyclones, structure and formation of cyclones.Aviation Meteorology: meteorological aspects of flight planning, Aviation hazards and their association with synoptic patterns, aircraft icing, turbulence, fog, thunderstorms, dust storms, low-level vertical wind shear, Jetstream formation & structure.

Books Recommended:

1. *Hand Book Of Applied Meteorology* by Hougton (Publisher: Wiley), 1st Edition, 1985.
2. *Atmospheric Chemistry & Global Change* by Guy. P. Brasseur (Publisher: Oxford), 1st Edition, 1999.
3. *Statistical Analysis In Climate Research* by Hans Vonstorch (Publisher: Cambridge), 1st Edition, 2001.
4. *Meteorology* by Moran Morgan (Publisher: Ma cMillion), 3rd Edition, 1991.
5. *Climatology* by OlixerHidore (Publisher: Merrill), 1st Edition, 1984.
6. *Dynamical & Physical Meteorology* by Haltiner& Martin (Publisher: McGraw Hill), 1st Edition, 1957.
7. *Tropical Meteorology* by Carlson (Publisher: The PennsylvaniaStateUniversity), 1st Edition, 1981.
8. *The Atmosphere* by Frederick K. Lutgens (Publisher: Prentice Hall), International Edition, 1998.
9. *The Status of Climate Variation In Pakistan& Its Impact* by SMRC.No.10 SAARC Met. Research Centre, 1st Edition, 2004.
10. *Atmospheric Physics* by J.V.Irinarne (Publisher: D.Reidel Pub. Co.), 1st Edition, 1980.
11. *Applied Climatology* by Russell D. Thompson (Publisher: Routledge), 1st Edition, 1997.
12. *Essentials of Meteorology* by C. Donald Ahrens (Publisher: Brooks/Calc), 3rd Edition, 2001.
13. *Atmospheric Science* by John M. Wallace (Publisher: Academic Press), 1st Edition, 1997.

Code	Subject Title	Cr. Hrs	Semester
PHY-438	**METEOROLOGY AND CLIMATOLOGY-IV (LAB)**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

The students are required to do the following experiments:

1. Tephigram analysis.
2. Atmospheric (barometric & aneroid) pressure, conversion of station level to mean sea level pressure.
3. Jetstream analysis.
4. Interpretation of weather radar rainfall & cloud analysis.

Code	Subject Title	Cr. Hrs	Semester
PHY-439	**SOLID STATE PHYSICS-III**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Phonons: Classical, Einstein and Debye models for specific heat, Hamiltonian of the electron-phonon interaction, renormalization of the effective electron mass, screening of the electron-phonon interaction, ionic crystals, the polaron.

Optical Properties: Macroscopic description and microscopic model, mirco-scopic theory of frequency-dependent dielectric constants, optical properties of semi-conductors, quantization of electromagnetic field, interaction of conduction electrons.

Transport Phenomenon: Semiclassical model of for conduction of metals, Boltzmann equation, relaxation time, conductivity equation.

Solids in External Magnetic Fields: Free electron approximation in magnetic field, Landau diamagnetism in free electrons, spin Hamiltonian, the Hubbard model, Pauli paramegnetism of conduction electrons, De Haas van Alphan effect, the quantum Hall effect.

Books Recommended:

1. *SolidState Physics* byAshcroft &Mermin, (1976).
2. *Introduction to SolidState Physics,* 7thEddition,by C. Kittle, (1996).
3. *Elementary SolidState Physics* by M. A. Omar, (1975).
4. *Quantum Theory of the SolidState*byj. Callaway, (1991).
5. *Principles of the Theory of Solids* byJ. M. Ziman, (1969).

Code	Subject Title	Cr. Hrs	Semester
PHY-440	**SOLID STATE PHYSICS-IV**	**3**	**VIII**
Year	Discipline		
4	**Physics**		

Course Outlines:

Ferromagnetism and Antiferromagnetism: Ferromagnetic order, curie point and the exchange integral, temperature dependence of the saturation magnetization, saturation magnetization at absolute zero, magnons, quantization of spin waves, thermal excitation of magnons, neutron magnetic scattering, ferromagnetic order, curie temperature and susceptibility of ferrimagnets, iron garnets, antiferromagnetic order, susceptibility below the Neel temperature, antiferromagnetic magnons. Ferromagnetic domains, anisotropy energy, transition region between domains, solitons, origin of domains, coercivity and hysteresis, single domain particles, geomagnetism and biomanetism, magnetic force microscopy, magnetic bubble domains, summary.

Magnetic Resonance: Nuclear magnetic resonance, equations of motion, line width, motional narrowing, hyperfine splitting, examples: paramagnetic point defects, knight shift, nuclear quadrupole resonance, ferromagnetic resonance, shape effects in FMR, spin wave resonance, antiferromagnetic resonance, electron paramagnetic resonance, exchange narrowing, zero-field splitting, priciple of master action, three-level maser, ruby laser, summary.

Books Recommended:

1. *SolidState Physics* byAshcroft &Mermin, (1976).
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