SYLLABUS OF B.SC. PHYSICS PROGRAMME UNDER CHOIC BASED CREDIT SYSTEM

CORE COURSES (DSC) of B.Sc. Physics programme

Semester	Paper Code	Title	Credits
I	PYC101	Section 1 :Mathematical methods & Mechanics Section 2 :Electrical circuit Theory	2T+1P 2T+1P
II	PYC102	Section 1 :Heat and Thermodynamics Section 2 :Properties of Matter & Acoustics	2T+1P 2T+1P
III	PYC103	Section 1: Waves & Oscillation Section 2 : Electronics	2T+1P 2T+1P
IV	PYC104	Section 1: Optics Section 2: Modern Physics	2T+1P 2T+1P

GENERIC ELECTIVE COURSES (GE) of B.Sc. Physics programme

PYG101: BASIC PHYSICS
PYG102 :OPTICS and INSTRUMENTATION
PYG103: ACOUSTICS AND NOISE CONTROL
PYG104: BIOPHYSICS and BIOMEDICAL INSTRUMENTATION

SKILL ENHANCED COURSES (SEC) of B.Sc. Physics programme

PYS101: NETWORK ANALYSIS
PYS102: COMPUTATIONAL PHYSICS using FORTRAN
PYS103: COMPUTATIONAL PHYSICS using C
PYS104: DOCUMENTATION AND VISUALIZATION
PYS105: ELECTRICAL AND ELECTRONIC INSTRUMENTATION
PYS106: MICROPROCESSOR ARCHITECTURE AND PROGRAMMING
PYS107: MICROCONTROLLER ARCHITECTURE AND PROGRAMMING
PYS108: PHOTOGRAPHY

CORE COURSES (DSC) OF B.SC. PHYSICS PROGRAMME

SEMESTER I

PYC101: MATHEMATICAL METHODS, MECHANICS and ELECTRICAL CIRCUIT THEORY

SECTION 1: MATHEMATICAL METHODS AND MECHANICS (Theory 2 Credits)

Mathematical methods [15 Lectures]

Matrices and determinants, Linear equations [**2]**

System of linear equations, matrices and determinants.

Elementary Vector Algebra **[2]**

Scalars and vectors, addition and subtraction of vectors, multiplication by a scalar, basis vectors and components, magnitude of a vector, unit vector, dot and cross product of vectors and their physical interpretation.

Complex numbers **[2]**

Complex numbers, notation of complex number, complex planes, physical meaning of complex quantities, exponential, logarithmic and trigonometric functions, hyperbolic functions. De'Moivre's Theorem, Roots of unity.

Limits and Continuity **[3]**

Definition, intervals and neighborhoods, algebra of limits, limits of trigonometric functions, exponential limits. Concept of continuity, left and right hand limits, graphical representation of continuity.

Differentiation **[3]**

Differentiation from first principles, derivative of polynomials, trigonometric, exponential, logarithmic functions and implicit functions. Rules of differentiation, Leibnitz theorem, higher order derivatives.

Integration **[3]**

Integration from first principles, integration as inverse of derivative, integration by inspection. Standard Integrals: (Algebraic, trignometric, exponential logarithmic), integration by parts, substitution methods, reduction formulae).

- **Mechanics [15 Lectures]**

Motion of a particle in one dimension **[10]**

Discussion of the general problem of one dimensional motion. Dependence of force in general on position, velocity and time. Motion under a constant force with illustrations - Atwood's machine, free fall near the surface of the earth. Motion along a rough inclined plane. The equation of motion, momentum and energy conservation theorems. Motion under a force which depends on time-general approach to the solution. Illustration using force of the type $F = F_o \sin(\omega t + \varphi)$. Motion under a conservative force dependent on position, potential energy. Motion under damping force depending on velocity - general dependence of resistive force on velocity. Motion in a medium with resistive force proportional to first power of velocity. Body falling under gravity in a resistive medium near the surface of the earth.

Motion in two dimensions : **[5]**

Equations of motion in plane polar coordinates. Momentum and energy theorems. Plane and vector angular momentum theorems.

Projectile motion in a non-resistive and resistive medium, (resistive force proportional to the first power of velocity).

Text Books & References

1. K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical methods for Physics and Engineering, Cambridge University Press (2006).
2. Robert Stainer and Philip Schmidt, Mathematics for Physics students, Schaum series, 2007.
3. K. R. Symon, Mechanics, Addison Wesley (1962).
4. R. G. Takawale and P. S. Puranik, Introduction to Classical Mechanics, Tata McGraw-Hill (1997).
5. C. Kittel, W. D. Knight, M. A. Rudderman, A. C. Helmhotz and B. J. Moyer, Berkeley Physics Course, Volume I, Mechanics, McGraw-Hill (1973).
6. Eugine Hecht, College Physics, Schaum Outline Series, 2011.
7. P. V. Panat, Classical Mechanics, Narosa Publishing, (2013).
8. D. S. Mathur, Mechanics, S. Chand & Co. (1981).
9. Gupta, Kumar and Sharma, Classical Mechanics, Pragati Prakashan, Merut (2008).

PYC101
MATHEMATICAL METHODS AND MECHANICS
Practical (any four) (1 credit)

Introduction to measurement techniques:

Range and least count of instruments, measurements using various instruments and error analysis (Vernier calipers, micrometer screw gauge, travelling microscope, spherometer, spectrometer).

1. Graphical analysis of one dimensional motion: Kinematics, plotting and interpretation of displacement, velocity and acceleration versus time graphs. Linear and non linear plots, determination of slopes and area under the curves for evaluation of physical quantities such as force, work and energy.
2. Motion in resistive medium (Experimentation/Simulation).
3. Atwood's machine.
4. Fly wheel: Determination of frictional couple and moment of inertia of a flywheel.
5. Projectile Motion (Experimentation/Simulation).
6. Bar pendulum
7. Conical Pendulum
8. Tortional pendulum.

PYC101

SECTION 2: ELECTRICAL CIRCUIT THEORY

(Theory 2 Credits)

Circuit Analysis **[7]**

Concept of constant current and constant voltage source, Maxwell's cyclic current method for circuit analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem (with proof) and their application to simple networks.

Inductance **[4]**

Self Inductance, self inductance of two parallel wires carrying equal current in opposite directions, Principle of non-inductive resistance coils, self inductance of co-axial cables, mutual inductance, coefficient of coupling, inductance in series and parallel.

Response of circuits containing L, C and R to DC **[6]**

Growth and decay of current in L-R circuit, Charging and discharging of capacitor in C-R circuit and in a series L-C-R circuit.

AC Circuits **[7]**

AC applied to L-R and C-R circuits, Inductive and Capacitive reactance, impedance and admittance, The j operator and vector or phasor method applied to LR, CR and LCR circuits. Series and parallel resonance. Q factor and Bandwidth. Graphic representation of resonance (Variation of resistance, inductive reactance, capacitive reactance with frequency)

Mutually Coupled L-R circuits **[3]**

AC applied to mutually coupled L-R circuits. Reflected impedance. Transformers, Effect of loading the secondary of a transformer.

AC Bridges **[3]**

General AC bridges, Maxwell's bridge, Maxwell's L/C bridge,De-Sauty's bridge. Wein's frequency bridge.

Text Books & References

1. J. Yarwood and J. H. Fewkes, Electricity and Magnetism. University Tutorial Press (1991).
2. D. N. Vasudeva, Fundamentals of Electricity and Magnetism, S. Chand and Company Ltd. New Delhi.(2012)
3. Brijlal and Subramaniam, Electicity and Magnetism, Ratan Prakashan, New Delhi. (1966).
4. Mahmood Nahvi, Joseph Edminister, Electrical Circuits, Schaum outline Series, (2002).
5. Thereja B.L. Text Book of Electrical Technology, S. Chand and Co Ltd. New Delhi (1990).
6. Sudhakar and Shammohan, Circuits and Networks Analysis and Synthesis, TMH, (2006).

PYC101

SECTION 2: ELECTRICAL CIRCUIT THEORY

Practical (any four) (1 credit)

1. Verification of Thevenin's Theorem.
2. Verification of Norton's theorem.
3. Response of LR and CR circuits to AC - phasor diagrams.
4. Step Response of CR circuit / LR Circuit.
5. De Sauty's Bridge and Maxwells L/C Bridge.
6. LCR Series and parallel resonance –Resonant frequency, Q value and Bandwidth.
7. Resistance of Mirror Galvanometer / Table Galvanometer by Shunting.
8. Figure of Merit of Mirror Galvanometer and Determination of Current and Voltage Sensitivity.

SEMESTER II

PYC102: HEAT & THERMODYNAMICS

And

PROPERTIES OF MATTER & ACOUSTICS

SECTION 1: HEAT AND THERMODYNAMICS I (Theory 2 Credits)

Kinetic theory of gases [8]

Three states of matter, concept of ideal gas, postulates of Kinetic Theory of gases, expression of pressure of a gas, relation between rms velocity and temperature, Average kinetic energy of a gas molecule, heat and temperature, kinetic interpretation of temperature, Degrees of freedom, Law of equipartition of energy and its application to specific heats of gases. Brownian motion and its features, Einstein's equation, Determination of Avogadro's number. Mean free path and derivation to calculate MFP, Transport phenomena, transport of momentum (viscosity).

Behavior of real gases [7]

Deviation from perfect gas behavior, Discussion of results of Andrew's experiments on CO2 and Amagat's experiment, critical constants, Van der Wall's equation of state, expression of Wan der Wall's constants, Reduced equation of state, Law of corresponding state, relation between Boyle temperature and critical temperature, critical coefficient.

Zeroth and First Law of Thermodynamics [4]

Basic concepts of thermodynamics: Thermodynamic system, Thermodynamic variables, Thermodynamic equilibrium, and Thermodynamic processes, Zeroth law of thermodynamics and concept of temperature, Internal energy and First law of thermodynamics, Relation between pressure, volume and temperature in adiabatic process, Work done in isothermal and adiabatic processes, Path dependence of heat and work.

Second Law of Thermodynamics [7]

Process-reversible and irreversible, condition of reversibility, Second law of thermodynamics, Carnot's cycle, efficiency of Carnot's cycle, reversibility of Carnot's cycle, Carnot's theorem, coefficient of performance of a refrigerator, Thermodynamic scale of temperature, its identity with perfect gas scale, Clapeyron latent heat equation and its applications.

Entropy [4]

Entropy as a Thermodynamic variable, Entropy change in reversible and irreversible processes, Temperature–Entropy diagram of Carnot's Cycle, Entropy of a perfect gas, Physical significance of Entropy: Entropy and Unavailable Energy, Entropy and molecular disorder, Entropy and Second Law of Thermodynamics. Impossibility of attaining Absolute Zero (Third law of Thermodynamics).

Text Books & Reference Books:

1. Treatise on heat, M. N. Saha and B. N. Shrivastava, The Indian Press(1965).
2. Thermal Physics, S.C . Garg, R.M. Bansal and C. K. Ghosh, TMH (1993).
3. Thermodynamics J.K. Roberts and A.R Miller , E.L.B.S. (1960).
4. Text Book of Heat, G.R. Noakes, Mcmilan& Co(1960).
5. Thermodynamics, William C .Reynolds (1968).
6. Heat and Thermodynamics M.W. Zemansky and R.H. Ditman, McGraw Hill (1997).

7. Heat, Thermodynamics and Statistical Physics, BrijLal, N. Subrahmanyam and P. S. Hemne, S. Chand.

PYC102

SECTION 1: HEAT AND THERMODYNAMICS I

Practical (any four) (1 credit)

1. Determination of Stefan's constant.
2. Resistance Thermometry (Cu wire and Pt 100).
3. Study of thermocouples for temperature measurement
4. Constant volume air thermometer.
5. Constant pressure air thermometer.
6. Calibration of Si diode as a temperature sensor.

PYC102

SECTION 2: PROPERTIES OF MATTER AND ACOUSTICS

(Theory 2 Credits)

Elasticity: [10]

Brief review of moment of Inertia. Modulii of elasticity, Strain energy, equivalence of shear to compression and extension at right angles to each other, Poisson's ratio and its limiting values, Relationship between the elastic constants. Torsion in a string-couple per unit twist, Torsional Pendulum. Bending of beams-bending moment, flexural rigidity. Cantilever (rectangular bar). Depression of a beam supported at the ends and loaded at the center. Theory of Loaded pillars, Critical load for pillars.

Surface Tension: [4]

Brief review of molecular theory of surface tension. Relation between surface tension and surface energy. Pressure difference across curved surfaces. Angle of contact. Capillarity, experimental determination of surface tension and angle of contact.

Flow of liquids and Viscosity: [3]

Streamline flow, Turbulent flow, Critical velocity. Coefficient of viscosity, Poiseuille's formula for flow of liquid through a capillary tube. Viscosity of gases – Mayer's formula.

Acoustics: [10]

Differential equation for harmonic oscillator, Velocity of longitudinal waves in fluids. Newton's formula for velocity of sound, vibrations in stretched strings. (transverse and longitudinal modes). Vibration in rods. Superposition of two simple harmonic motions, standing waves and beats, Helmholtz resonator.

Doppler effect. Intensity level - Bel and Decibel.

Production and detection of Ultrasonic waves and its applications.

Reverberation of sound [3]

Reverberation of Sound, Reverberation time, Absorption coefficient, Sabine's formula for reverberation time, Acoustic requirements of an auditorium.

Text Books and References

1. Elements of Properties of Matter, by D. S. Mathur, S. Chand and Sons, (2013).
2. Lectures in elementary fluid dynamics, by J. M. McDonough (Lecture Notes available on Net, free download).
3. Fluid Mechanics by R K Bansal, Firewall Media, (2005).
4. Fluid Mechanics by Merle Potter, David Wiggert, Schaum Outline Series, (2008).
5. Continuum Mechanics by George Mase, Schaum Outline Series. (1969).
6. Text book of Sound by Khanna and Bedi, Atma Ram, New Delhi, 1969.

PYC102

SECTION 2: PROPERTIES OF MATTER AND ACOUSTICS

Practical (any four) (1 credit)

1. Bending of beams-single cantilever: determination of Young's modulus.
2. Bending of beams-double cantilever: determination of Young's modulus.
3. Young's modulus by transverse vibrations of rods /strips.
4. Capillarity: determination of Surface tension.
5. Viscosity of a liquid by Poiseuilles method.
6. Verification of Bernoulli's theorem.
7. To measure the velocity of flow using Pitot tube.
8. To determine the viscosity of fluid by viscometer.
9. Frequency of AC cycle using amplitude resonance
10. Kundt's tube experiment

SEMESTER III

PYC103: WAVES & OSCILLATIONS

And

ELECTRONICS

SECTION 1: WAVES AND OSCILLATIONS

(Theory 2 Credits)

Waves and Oscillations: [10]

Periodic oscillations and potential well, differential equation for harmonic oscillator and its solutions (case of harmonic oscillations), kinetic and potential energy. Examples of simple harmonic oscillations: spring and mass system, simple and compound pendulum, Helmholtz resonator, bifilar oscillations.

Superposition of Waves: [8]

Wave equation and solutions, Superposition of two simple harmonic motions of the same frequency along the same line, interference, superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures, case of different frequencies.

Oscillatory Motion in a Resistive Medium: [12]

Damped harmonic oscillator, Damped forced harmonic oscillator. Displacement and velocity Resonance, Sharpness of resonance, Phase relationships, Energy consideration in a forced harmonic oscillator. Harmonic oscillator with an arbitrary applied force.

Text Books and References:

1. Takawale R. G. and Puranik P S. Introduction to Classical Mechanics, TMH, 1997
2. D. R. Khanna and R.S. Bedi, Text book of Sound,Atma Ram, New Delhi (1994).
3. N. K. Bajaj, Physics of Waves and Oscillations, TMH, 2006.
4. A P French, Waves and Oscillations, CBS Publishers, 2003
5. H. J. Pain, Physics of Vibrations and waves, 6th Ed, Wiley, India, 2005
6. Brijlal and Subrahmanyam, Waves and Oscillations and Accoustics, S Chand & Co Ltd.(2009)
7. D. Chattopadhyay and P.C. Rakshit, Waves and Oscillations, Books and Allied Pvt Ltd (2009)
8. M Ghosh and B Bhattacharya, Oscillations and Accoustics, S Chand & Co Ltd. (1976).
9. S.P.Puri, Text book of Vibrations and Waves, Macmillan India ltd, 2nd edition, 2004

PYC103

SECTION 1: WAVES AND OSCILLATIONS

Practical (any 4) (1 credit)

1. Frequency of AC mains using resonant vibrations of string.
2. Determination of η using Flat spiral spring.
3. Determination of Y using Flat spiral spring.
4. Y by vibrations of cantilever.
5. Superposition of two mutually perpendicular simple harmonic oscillations -Lissajous figures using CRO.
6. Helmholtz resonator.
7. Simulation of Waves
8. Falling plate experiment
9. Double pendulum

PYC103
SECTION 2: ELECTRONICS
(Theory 2 Credits)

Rectifiers and Regulators **[6]**

Volt-ampere characteristics of Junction diode, Half wave, Full wave and Bridge rectifiers using Junction diodes without and with capacitive filters. Percentage regulation, Ripple factor and Rectification efficiency. Zener diode characteristics and its use as a simple voltage regulator. Thermistor characteristics and its use in A.C. voltage regulation.

Transistors **[3]**

Basic configurations of transistors, Transistor characteristic in CE and CB mode, Current gains α and β and their interrelation, Leakage current in transistors.

Basic Amplifier Characteristics **[3]**

Current gain, Voltage gain, Power gain, Input resistance, Output resistance, Conversion efficiency, Classes of amplifier operations, Decibel, Frequency response, Amplifier bandwidth.

C-E amplifier: Class A **[4]**

Graphical analysis, Effect of adding A.C. load, Input and Output resistance, Conversion efficiency, Phase relationship between input and output.

Transistor Biasing **[4]**

Bias stability, Stability factor, Different methods of biasing, biasing compensation.

Feedback **[5]**

Positive and negative feedback, Voltage and current feedback, series and shunt feedback.
Effect on negative feedback on gain, frequency response, input and output resistance and distortion. **Positive feedback,** Barkhausen criterion for oscillations, Phase shift oscillator, Wein bridge oscillator, LC tank circuit, Hartley oscillator and Colpitts oscillator.

Linear IC's and Operation Amplifiers **[5]**

The Differential Amplifier, OP-Amp characteristics, Input and Output impedance, Input bias and offset currents, Input and output offset voltages. Differential and Common mode gains, CMRR, Slew rate, OP-Amp as inverting , Non Inverting amplifier and Difference amplifier.

Text Books and References

1. A.P.Malvino, Electronic Principles –TMH 5th edition (1996).
2. Allen Mottershed, Electronics Devices and Circuits an Introduction- 3rd edition PHI (1997).
3. Millman and Halkias, Intergrated electronics- TMH (1972).
4. Bhargava, Kulshrestha and Gupta, Basic Electronics and Linear Circuits-. TMH (1984).
5. Ramakant Gayakwad, Op-amp and Linear Intergrated Circuits, PHI (2002).

PYC103
SECTION 2: ELECTRONICS
Practical (any four) (1 credit)

1. Half wave and Full wave rectifier using Junction Diode, Load regulation characteristics.
2. Bridge rectifier with capacitor filter- Ripple factor using CRO.
3. Zener Diode Regulation.
4. Colpitts / Hartley oscillator
5. Wein's Bridge /Phase shift Oscillator.
6. Transistor characteristics- Input and Output (C E mode)
7. C.E. Amplifier. Fequency response with and without negative feedback. Calculation of Gain Bandwidth product.
8. C.E. Amplifier -Determination of Input and Output Impedance, Variation of Gain with load
9. OP-Amp: Inverting and Non-inverting amplifier.

SEMESTER IV

PYC104: OPTICS

And

MODERN PHYSICS

SECTION 1: OPTICS

Interference **[9]**

Introduction: Interference by division of wave front & division of amplitude. Fresnel's biprism and Lloyd's mirror.

Formation of colors in thin film- reflected system, Transmitted system, wedge shaped film, Newton's Rings and its application to determine refractive index of liquids (Normal Incidence only).

Interferometry:- Michelson interferometer-its principle, working and its application to determine wavelength and difference between two wavelengths. Fabri Perot Interferometer.

Diffraction **[12]**

Concept of Diffraction, Fresnel and Fraunhoffer Diffraction. Division of cylindrical wave-front into half period strips, Fresnel's diffraction at straight edge and cylindrical wire. Fraunhoffer diffraction at single, double and N slits. Diffraction grating, width of principal maxima of plane diffraction grating. Resolving power of optical instruments- Rayleigh's criterion, Resolving power of telescope, Prism and grating.

Polarization **[9]**

Concept of polarization, Plane of polarization, Polarization by reflection, Brewster's law, Polarization by refraction, Double refraction, uniaxial and biaxial crystals, positive and negative crystals, Nichol's Prism, Circularly and Elliptically polarized light - Theory and analysis, Polaroid, Retardation plates - Quarter wave plate and Half wave plate, Optical activity, specific rotation, simple polarimeter, Laurent's half shade polarimeter.

Text Books and References

1. N Subrahmayam and N.Brijlal, Text Book of Optics, S. Chand & Company Ltd,(1991).
2. Optics, AjoyGhatak, Tata McGraw-Hill Publicashing Company Limited. (1977).
3. Ghatak And Tyagrajan, Contenprary Optics, Mc Millan (2003).
4. R. S Longhurst, Geometrical and Physical Optics, Orient Longman (1976 Indian edition).
5. Francis A Jenkins and Harvey E White, Fundamentals of Optics, (1976).
6. D N VasudevaA textbook of light for B. Sc. students (1962).
7. B.K. Mathur and T P Pandya,Principles of Optics, New Global Printing Press, Kanpur. (1980).

PYC104
SECTION 1: OPTICS
Practical (any four) (1 credit)

1. Spectrometer: Determination of refractive index.
2. Spectrometer: Determination of dispersive power.
3. Cardinals points of two lenses.
4. Wedge shaped film
5. Newton's rings.
6. Single slit Diffraction.
7. Diffraction Grating.
8. Resolving power of telescope using striped sheets.
9. Brewster's law.
10. Determination of specific rotation of optically active substances.

PYC104
SECTION 2: MODERN PHYSICS
(Theory 2 Credits)

Motion of charged particles in electric and magnetic fields [6]
Lorentz force , Motion in a uniform electric field, magnetic field, parallel and crossed fields. Electric discharge through gases, Determination of e/m for cathode rays, Charge and mass of an electron, Atomic masses, Energy and mass units.

Particle Accelerators [3]
Linear accelerator and Cyclotron.

Atomic Physics [6]
Measurement of Mass: Thomson's positive ray analysis, Dempster's Mass spectrometer, Bainbridge Mass spectrograph. Review of Bohr's Hydrogen atom, Correction due to finite nuclear mass. Frank-Hertz experiment and atomic energy levels.

Properties of electromagnetic radiation [7]
Black Body Radiation, Kirchoff's radiation law, Stefan's law, Wien' law, Raleigh - Jean's law, Planck's law. Photoelectric effect and Compton Effect – observation, description, derivations of relevant equations and failure of classical physics to explain the same. Experimental verification of the Photoelectric and Compton effects.

Crystal Structure [3]
Crystal lattice,crystal planes and Miller indices, unit cells, typical crystal structures.

X-rays [5]
Coolidge tube generator, Continuous X-ray spectra and its dependence on voltage, Duane and Hunt's law, Wave nature of X-rays – Laue's pattern, Diffraction of X-rays by crystal, Bragg's law, Bragg single crystal spectrometer, Analysis of crystal structure - simple cubic crystal.

Text Books and References

1. Arthur Beiser, Concepts of Modern Physics, 5th Edition, McGraw Hill (1985).
2. S.B. Patel, Nuclear Physics, TMH (1991).
3. Irving Kaplan, Nuclear Physics, Narosa Publishing House,(1997).
4. F.K. Richtmyer, E.H. Kennord, J.N. Cooper Introduction to Modern Physics, McGraw Hill (1997).
5. H.Semat and J.R.Albright, Introduction to Atomic and nuclear Physics, Chapman and Hall (1973).
6. J.B.Rajam, Atomic Physics, S.Chand and Co. Ltd.(1950).
7. K. Thyagrajan and A. Ghatak Laser: Theory and Applications, McMillan (2009).
8. K.Thyagarajan and A.Ghatak, Optical Electronics, Cambridge University Press (1997).
9. B.B.Laud, LASERs and Non-linear optics, Wiley Eastern (1991)

PYC104

SECTION 2: MODERN PHYSICS

Practical (any four) 1 credit

1. X-ray emission (characteristic lines of copper target) – calculation of wavelength and energy and assigning transitions.
2. Calculation of lattice constant by of Copper – x-ray diffraction pattern is given and student calculates, d-spacing, miller indices and lattice constant.
3. Frank Hertz Experiment.
4. Characteristics of photo cell.
5. Measurement of Boltzmann constant using transistor.
6. Photocell (verification of Photoelectric effect).
7. *e/m* by Thomson method.

GENERIC ELECTIVE PAPERS OF B.Sc. PROGRAMME

PYG101: BASIC PHYSICS
(4 credits theory paper)

Measurement of Physical quantities, standards and units. [5]

Length: radius of proton to size to astronomical distances.
Mass: atomic mass unit to mass of earth.
Time: time for fast elementary particle to pass through nucleus to age of earth.
Units in electricity: volts, Amperes, ohms.
Units of Temperature: Celsius scale, Kelvin scale.
International systems and units: Units used to measure physical quantities and their inter-conversion.

Properties of matter [12]

Elasticity: Hook's law, modulii of elasticity.

Surface tension: Brief review of molecular theory of surface tension. Relation between surface tension and surface energy. Pressure difference across curved surfaces. Angle of contact. Capillarity. **Application of the phenomenon to life sciences**.

Fluid Statics and fluid dynamics**:** Pascal's Principle, Measurement of pressure. Various units of pressure and their inter-conversion, Concept of pressure energy. Bernoulli's theorem and its applications- Venturi meter and Pitot's tube. Viscosity, Viscosity estimation by Oswald's viscometer. Relevance to life sciences.

Acoustics [12]

Loudness, units of intensity and loudness, Weber Fechner law and sound absorbers.

Production and detection of Ultrasonic waves and its applications. Doppler effect. Calculation of apparent frequency, (Normal incidence only), application to life sciences.

Acoustics of Building : Growth and decay of intensity, Reverberation of Sound, Reverberation time, Absorption coefficient, Sabine's formula for reverberation time (discussions only) , Acoustic requirements of a good auditorium.

Basics of Electrostatics and Electricity: [10]

Electric charge. Coulomb's law. Applications of electrostatics in life sciences.

Basics of electricity: Current, voltage and resistance and their units, Ohm's law, Conductor, Semiconductor and Insulator.

Transducers: characteristics, classification of transducers-electrical, mechanical, optical. Applications in chemical and biological instruments.

Magnetism **[5]**

The magnetic field, The definition of B, magnetic dipoles, Units of magnetism, Electromagnetic induction, Faraday's law, Lenz's law.

Basic Electronics **[16]**

Voltage and current sources, Inductance coils, capacitors and transformers. Rectifiers and voltage regulators: Volt-ampere characteristics of Junction diode, Half wave, Full wave and Bridge rectifiers using Junction diodes, Percentage regulation, Ripple factor and Rectification efficiency. ripple filters, Zener diode characteristics and its use as a simple voltage regulator. Thermistor characteristics and its use in A.C. voltage regulation. Junction Transistor and its characteristics in CE mode, Current gain, Voltage gain, Light Emitting Diodes, Photoiodes and Phototransistors.

Text Books & References

1. Haliday, Resnik and Walker, Fundamentals of Physics, 10e, John Wiley and Sons.
2. Elements of Properties of Matter, by D. S. Mathur, S. Chand and Sons, (2013).
3. Text book of Sound by D.R. Khanna and R.S. Bedi, Delhi : Atma Ram, 1962.
4. H.S. Kalsi, Electronic Instrumentation,Tata McGraw Hill Publication.
5. A course in Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney, Dhanpat Rai & Sons,
6. V.K.Metha, Principles of Electronics, S.Chand & Company (2009).
7. A.P.Malvino, Electronic Principles –TMH 5th edition

PYG102 :OPTICS and INSTRUMENTATION
(4 credits theory paper)

Image Formation [8]

Luminous intensity and its units, reflection, refraction. Introduction to lenses, optical properties of lenses, thin lenses & thick lenses, cardinal points of an optical system.

Aberrations: Spherical & chromatic aberrations in lenses (only conceptual), methods of minimizing spherical & chromatic aberrations.

Eyepieces: Kellner's, Ramsden And Huygens eyepiece. Construction and image formation with optical ray diagrams.

Interference: [3]

Interference by division of wave front & division of amplitude. One example of each kind.

Diffraction: [5]

Concept of diffraction, Fresnel and Fraunhoffer class of diffraction. Concept of Fraunhoffer diffraction at single slit. Application of Fraunhoffer diffraction to resolving power of optical instruments, Raleygh's criterian for resolution, resolving power of telescope and microscope.

Polarization: [5]

Concept of polarization, plane of polarization, polarization by reflection, Brewster's law, polarization by refraction, double refraction. Nicol prism, simple Polarimeter.

Lasers: [7]

Stimulated and spontaneous emission, population inversion, Lasers, properties of Lasers, different kinds of Lasers, applications of Lasers in Medicine and Science. Optical fibers: Basic principle and applications.

X-Rays [5]

Coolidge tube generator, continuous X-ray spectra and its dependence on voltage, Duane and Hunt's law, wave nature of X-rays – Laue's pattern, diffraction of X-rays by crystal, Bragg's law, Bragg single crystal spectrometer, analysis of crystal structure - simple cubic crystal.

LCD And LED Displays: [5]

Types of liquid crystals, principle of liquid crystal displays, applications, LED's, LED displays and their advantages.

Instrumentation [7]

Simple microscope, compound microscope, phase cantrast microscope, electron microscope, XRD, UV and IR spectroscopy.

MEDICAL IMAGING PHYSICS: [12]

Magnetic field, diamagnetism, paramagnetism and ferromagnetism, X-ray diagnostics and imaging, Physics of nuclearmagnetic resonance (NMR) – NMR imaging – MRI Radiological imaging – Radiography –X-ray film – fluoroscopy –computed tomography scanner – principle function – display – generations –mammography. Ultrasound imaging – magnetic resonance imaging.

Demonstration in class/ laboratory. (Any four) [4]

1. Luxmeter/Photometer .
2. Construction and image formation of Ramsden /Huygens eyepiece.

3. Interference patters using Fresnel's biprism, Lloyds mirror in Physics Laboratory.
4. Fresnel and Fraunhoffer class of Diffraction, Resolving power of telescope and microscope in Physics Laboratory
5. Polarization using Polaroid, Double refraction. Nicol prism, simple polarimeter in Physics Laboratory
6. Some properties of lasers in class
7. Analysis of x-ray diffraction data for crystal structure determination

Text Books & References

1. N Subrahmayam and N.Brijlal, Text Book of Optics, S. Chand & Company Ltd,(1991).
2. Arthur Beiser, Concepts of Modern Physics, 5th Edition, McGraw Hill (1985).
3. Banwell, Fundamentals of Molecular Spectroscopy, TMH (2012).
4. K. Thyagrajan and A. Ghatak Laser: Theory and Applications, McMillan (2009).
5. R. S. Khandpur, Handbook of Biomedical Instrumentation, Second Edition. Front Cover. . Tata Mcgraw-hill Pub, 1992 Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978).

PYG103: ACOUSTICS AND NOISE CONTROL

(4 credits theory paper)

1. **Fundamentals** (12)
   Introduction to Acoustics; Brief History of Acoustics; Frequency, Wavelength, Simple harmonic motion & Superposition of waves; Sound waves; Acoustical properties; Levels; Source Characterization; Human hearing mechanisms; Pitch, Loudness, Intelligibility & Annoyance; Other Effects (Precedence Effect, Perception of Echoes and Direction, Binaural Sound).
2. **Acoustics of Rooms for Speech, Music & Worship** (16)
   Energy Build-up in a Room; Room Impulse Response; Subjective & Objective Room Acoustical Parameters for Music; Speech-Intelligibility Tests & Metrics; Rooms for Speech Intelligibility; Speech Privacy Calculations; Speech Reduction Rating & Privacy; Open-Plan Ceilings & private offices; Masking Sound; Acoustical Characterization of a Worship Space, Church Acoustics; Temple Acoustics; Mosque Acoustics; Acoustics of other Worship Spaces; Sound Reinforcement & Electro-acoustics.

3. **Ultrasonics: Biological & Medical Acoustics** (16)
   Ultrasonics (Relaxation processes, Cavitation, Phonons, Transducers, Transducers Arrays, Ultrasound Imaging); Forest & Ocean Bioacoustics (Optimized Communication; Insects; Land Vertebrates; Birds; Bats; Aquatic Animals; Generalities; Quantitative System Analysis**;** Hearing in Cetaceans; Echolocation Signals; Odontocete Acoustic Communication; Acoustic Signals of Mysticetes); Medical Acoustics (Basic Physics of Ultrasound Propagation in Tissue; Methods of Medical Ultrasound Examination; High-Intensity Focused Ultrasound (HIFU) in Surgery; Thrombolysis; Lower-Frequency Therapies) .
4. **Environmental Noise: Sources, Effects, & Control** (16)
   Environmental Noise: Characterization, Prediction, Assessment & Control (Specification & measurement of sound isolation, Design of partitions & barriers, Railroad noise, Aircraft and Airport noise, Industrial Noise, Building site noise), Noise in buildings & communities (criteria, isolation of air-borne & structure-borne noise in buildings, community noise ordinances); Effects of Noise on People (Sleep disturbance due to transportation noise exposure; Effects of infrasound, low-frequency noise & ultrasound on people; Auditory hazards of impulse & impact noise; Noise induced annoyance & stress; Effect of Noise on Behaviour & Work Efficiency; Hearing protectors; Hearing conservation programs; Rating measures, descriptors, criteria & procedures for determining human response to noise).

Text Books & References:

1. Springer Handbook of Acoustics, Rossing, 2007.
2. Architectural Acoustics, M. Long, 1st Ed., 2005.
3. The Master Handbook of Acoustics, Everest, 4th Ed., 2000.
4. Worship, Acoustics & Architecture, Cirillo & Martellotta, 2006.
5. Acoustics of Worship Spaces, Lubman & Wetherill, 1985.
6. Engineering Noise Control, C. Hansen, 4rd Ed. 2009.
7. Fundamentals of Acoustics, Bruneau, 2006.
8. The Science and Applications of Acoustics, Daniel Raichel, 2000.
9. Fundamentals of Acoustics, Kinsler et al., 4th Ed, 2000.
10. Handbook of Noise and Vibration Control - Crocker, 2007.

11. Noise and Vibration Control Engineering - Principles and Applications, Ver & Beranek, 2nd Ed. 2006.
12. Acoustical designing in Architecture, Knudsen, Harris, 1988.

PYG104: BIOPHYSICS and BIOMEDICAL INSTRUMENTATION
(4 credits theory paper)

Basic Transducer Principles **[2]**

Transducer and transduction principle, active transducer, passive transducer, transducers for biomedical applications.

Sources of Bioelectric Potentials: **[5]**

Resting and acting potentials, bio electric potentials Electrodes: Biopotential electrodes, measurement of biopotentials with two electrodes.

PHYSICS OF THE BODY-I **[15]**

Mechanics of the body: Skeleton, forces, and body stability. Muscles and the dynamics of body movement, physics of body crashing.

Energy in the body: Energy balance in the body, energy consumption of the body, heat losses of the body.

Pressure system of the body: Physics of breathing, instrumentation for measuring the mechanics of breathing, measurement of blood pressure, working principle of the manual Hg Blood Pressure monitor.

Physics of the cardiovascular system, Cardio vascular measurements: Electrcardiography.

PHYSICS OF THE BODY-II **[12]**

Acoustics of the body: Nature and characteristics of sound, Production of speech,

Physics of the ear,

Diagnostics with sound and ultrasound

Optical system of the body: Physics of the eye, Understanding the working of a manual optical eye-testing machine and to learn eye-testing procedure.

Electrical system of the body: Basic Physics of the nervous system, Electrical signals and information transfer.

PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-I **[7]**

X-RAYS: Electromagnetic spectrum – production of x-rays – x-ray spectra-Brehmsstrahlung-Characteristic x-ray – X-ray tubes – Coolidge tube – x-ray tube design– tube cooling stationary mode – Rotating anode x-ray tube – Tube rating – quality andintensity of X-ray.

RADIATION PHYSICS: **[6]**

Radiation types and units - exposure - absorbed dose – units: rad, gray -relative biological effectiveness - effective dose - inverse square law - interaction ofradiation with matter - linear attenuation coefficient. Radiation Detectors –Thimblechamber- condenser chambers – Geiger counter – Scintillation counter – ionization chamber, semiconductor detectors.

MEDICAL IMAGING PHYSICS: **[11]**

X-ray diagnostics and imaging, Physics of nuclearmagnetic resonance (NMR) – NMR imaging – MRI Radiological imaging –Radiography –X-ray film – fluoroscopy –computed tomography scanner – principle function – display – generations –mammography. Ultrasound imaging – magnetic resonance imaging

BASIC ELEMENTS OF NUCLEAR MEDICINE [3]

Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging, Single photon and positron emission tomography.

Test Books & References:

1. ***R. S. Khandpur,*** Handbook of ***Biomedical Instrumentation***, Second Edition. Front Cover. . Tata Mcgraw-hill Pub, 1992.
2. Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978).
3. Lessley Cromwell Biomedical Instrumentsand Measurements 3rd Ed, Peranon Education, 2004.
4. P. Narayanan, Essentials of Biophysics, New age Publisher, 2000.
5. Dr. K. Thayalan, Basic Radiological Physics - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003).
6. Curry, Dowdey and Murry, Christensen's Physics of Diagnostic Radiology , Lippincot Williams and Wilkins (1990).
7. Irving P. Herman, Physics of the human body, Springer (2007).
8. F M Khan, Physics of Radiation Therapy : - Williams and Wilkins, 3rd edition (2003).
9. Bushberg, Seibert, Leidholdt and Boone, The essential physics of Medical Imaging, Lippincot Williams and Wilkins, Second Edition (2002).
10. H. E. Johns and J. R. Cunningham, The Physics of Radiology, 1984.

SKILL ENCHANCED COURSES OF B.Sc. PROGRAMME

PYS101: NETWORK ANALYSIS
(3 credits theory and one credit practical)

Review of BASIC CONCEPTS: [5]

Voltage, Current, Power and Energy, Constant voltage and constant current source, The sine wave, RMS value and average value of a sine wave, The Resistance, Inductance and Capacitance, Kirchhoff's Voltage Law, Kirchhoff's Current Law, Principle of non-inductive resistance coils, Mutual inductance, Coefficient of coupling. Self Inductance of co-axial cables, Inductance in series and parallel. Capacitances in series and parallel.

CIRCUIT ANALYSIS AND NETWORK THEOREMS: [10]

Mesh analysis, Super Mesh analysis, Nodal analysis, Super Node analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer Theorem, Impedance matching.

RESPONSE OF RL, RC and RLC circuits to DC and AC [11]

Transient Response of RL, RC and RLC circuits. Sinusoidal response of RL, RC, RLC circuits, Impedance diagram, Phase angle, series and parallel complex impedance circuits.

POWER AND POWER FACTOR: [3]

Instantaneous power, Average power, Apparent power and Power factor, Reactive power, Power triangle.

COUPLED CIRCUITS: [3]

AC applied to mutually coupled L-R circuits. Reflected impedance, Transformers, Effect of loading the secondary of a transformer, Ideal transformer.

RESONANCE: [3]

Series resonance, quality factor (Q) and its effect on Bandwidth, parallel resonance, Q factor of parallel resonance.

TWO-PORT NETWORK: [7]

Two-port networks, open circuit impedance (Z) parameters, Short circuit admittance (Y) parameter, Hybrid (h) parameter, Interrelationship of different parameters, T & II networks, Lattice networks.

AC BRIDGES [3]

General AC bridges, Maxwell's bridge, Maxwell's L/C bridge, De-Sauty's bridge. Wein's frequency bridge.

Text Books & References

7. Sudhakar and Shammohan, Circuits and Networks Analysis and Synthesis, TMH, (2006).

8. J. Yarwood and J. H. Fewkes, Electricity and Magnetism. University Tutorial Press (1991).
9. D. N. Vasudeva,Fundamentals of Electricity and Magnetism.S. Chand and Company Ltd. New Delhi.(2012).
10. Brijlal and Subramaniam, Electicity and Magnetism, Ratan Prakashan, New Delhi. (1966).
11. Thereja B.L. Text Book of Electrical Technology, S. Chand and Co Ltd. New Delhi (1990).
12. Mahmood Nahvi, Joseph Edminister, Electrical Circuits, Schaum outline Series, (2002).

Practical:
Minimum of 4 experiments.

1. Design of 1 mH inductor.
2. Study of High pass, Low Pass filters using passive components.
3. Band pass and Band stop filters using passive components.
4. Study of passive integrator and differentiator.
5. Thevenin's Theorem and Norton's Theorem.
6. Varification of Superposition Theorem.
7. Impedance Matching.
8. Response of LR, circuit to DC and AC.
9. Response of CR circuit to DC and AC.

PYS102: COMPUTATIONAL PHYSICS using FORTRAN
(3 credits theory and one credit practical)

Introduction: **[5]**

Importance of computers in Physics, paradigm for solving physics problems for solutions**.**
Installation and introduction to Linux.

Algorithms and Flowcharts: **[10]**

Algorithm: Definition, properties and development.
Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum and product of two matrices, Sum and Product of a finite series, calculation of Factorial, calculation of Sin(x), Cos(x) as a series, Integration.

Scientific Programming: **[30]**

Some fundamental Linux Commands (Internal and External commands).

Development of FORTRAN.

Basic elements of FORTRAN: Character Set, FORTRAN Constants and their types, FORTRAN Variables and their types, Keywords, Variable Declaration and concept of instruction and program.

Operators: Arithmetic, Relational, Logical and Assignment Operators.

Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions.

Fortran Statements, Layout of FORTRAN Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from Physics.

Control Statements
Types of Logic: Sequential, Selection, Repetition

Branching Statements: Logical **IF**, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements

Looping Statements: DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO Loops
Jumping Statements: Unconditional GOTO, Computed GOTO, Assigned GOTO
Subscripted Variables

Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays.

Functions and Subroutines
Arithmetic Statement Function, Function Subprogram and Subroutine, RETURN, CALL, COMMON and EQUIVALENCE Statements, Structure, Disk I/O Statements, Open a file, writing in a file, reading from a file. Examples from Physics.

Practical:
Minimum of 4 practical

1. Installation of Linux
2. Exercises on syntax on usage of FORTRAN
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. To compile a frequency distribution and evaluate mean, standard deviation etc.
6. To evaluate sum of finite series and the area under a curve.
7. To find the product of two matrices
8. Numerical Integration
9. Method of Least Squares : Linear Regression for two variables
10. Solving Linear Equations
11. To find a set of prime numbers and Fibonacci series.

PYS103: COMPUTATIONAL PHYSICS using C
(3 credits theory and one credit practical)

Introduction: **[5]**

Importance of computers in Physics, paradigm for solving physics problems for solutions**.**
Installation and introduction to Linux.

Algorithms and Flowcharts: **[10]**

Algorithm: Definition, properties and development.
Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum and product of two matrices, Sum and Product of a finite series, calculation of Factorial, calculation of Sin(x), Cos(x) as a series, Integration.

Scientific Programming: **[30]**

Some fundamental Linux Commands (Internal and External commands).

Basic elements of C: The C character Set, Identifiers and Keywords, Data types, Constants, variable and Arrays, Declarations, Expressions, Statements, Symbolic Constants.

Operators and Expressions: Arithmetic Operators, Unary Operators, Relational Logical Operators, Assignment Operators, the Conditional Operators, Library Functions.

Data Input and Output: Preliminaries, Single character input and output, entering Input data, writing output data, Opening and closing data file, format statements.

Branching Statements: Preliminaries, Branching statements, Looping statements, nested control structure, switch, break, continue, go to statements.

Arrays: Defining an array, processing an array, passing arrays to functions, multidimensional arrays.

Functions: Defining functions, accessing functions, Passing arguments to a function.

Practical:

Minimum of 4 practical

1. Installation of Linux
2. Exercises on syntax on usage of C
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. To compile a frequency distribution and evaluate mean, standard deviation etc.
6. To evaluate sum of finite series and the area under a curve.
7. To find the product of two matrices
8. Numerical Integration
9. Method of Least Squares : Linear Regression for two variables
10. Solving Linear Equations
11. To find a set of prime numbers and Fibonacci series.

PYS104: DOCUMENTATION AND VISUALIZATION
(3 credits theory and one credit practical)

Scientific word processing using LaTex **[30]**

LaTeX on Windows/Linux using TeXworks

Installing LaTex on Windows/Linux, Writing basic LaTeX document using TeXworks editor. Configuring LaTeX to download missing packages.

Report Writing

Report style having chapter, section and subsection, article style having section, subsection and subsubsection. Automatic generation of table of contents. Automatic numbering of section numbers. Appendix; its appearance in report and article style exiting from LaTeX when a compilation error occurs.

Letter Writing

Letter document class, From address, Automatic generation and format of date, Starting a new line with double slash, To address, Starting a new paragraph with a blank line, itemize environment for bullet points, enumerate environment for numbered points, Closing statement, Signature, Carbon copy.

Mathematical Typesetting

$ sign to begin and end mathematical expressions, Creating alpha, beta, gamma and delta, Space being used as a terminator of symbols, Creating spaces in mathematical formulae, Difference in font of text and formula, Difference in the minus sign in text and in formula, frac command to create fractions, Subscripts and superscripts, Use of braces {} to demarcate arguments, Not equal to, greater than or equal to, less than or equal to, much less than, Right arrow, left arrow, left right arrow, up arrow, Integral sign, limits of an integral, Matrices of different rows and columns

Equations

amsmath package and align and align* environments to create equations, Matrix differential equation, aligning two equations using &, with and without intervening text, Automatic numbering of equations using align, Labeling equations with the label command, Cross referencing equation numbers through the ref command, Inserting text between two aligned equations through the intertext command, Automatic generation of equation numbers at run time allows insertion and removal of an equation from a set of equations, Labeling sections and subsections for easy and fool-proof cross referencing, Breaking an equation into more than one line, Suppression of equation numbers in the align environment using the nonumber command, Use of backslash (\) to make braces appear as braces left[, right] and also left[. (i.e. left bracking fullstop), Blank lines in the align environment is not permissible.

Tables and Figures: Creating tables and figures in LaTeX, Inserting figures into documents.

Beamer: Creating a presentation using Beamer

Bibliography: Creating Bibliography in LaTeX

Practical [30 hours]
(All three)

1. Hands on learning of gnuplot/Qtiplot

Visualization using gnuplot or QtiPlot :

Introduction to graphical analysis and its limitations. Introduction to Gnuplot/QtiPlot. Importance of visualization of computational data, basic commands, simple plots, plotting data from a file, saving and exporting, multiple data sets per file, equations, building functions, user defined variables and functions.

2. Hands on learning of LaTex

Reproduce a given journal report which contain tables, figures, equations etc. in LaTex

3. Hands on learning of PowerPoint presentation using Beamer.

Reproduce a given presentation in Beamer.

PYS105: ELECTRICAL AND ELECTRONIC INSTRUMENTATION
(3 credits theory and one credit practical)

D.C Indicating Instruments: (6)

PMMC Galvanometer (D'Arsonval movement) - Principle, construction and working, current sensitivity, voltage sensitivity and megohm sensitivity, advantages and disadvantages, conversion of Galvanometer into Ammeter, Voltmeter and Ohmmeter (series and shunt type), Aryton shunt, Loading effect of voltmeter.

A.C Indicating Instruments: (6)

Electrodynamometer-principle, construction and working, merits and demerits, Rectifier type Instruments, thermocouple Instrument (Ammeter), electrostatic voltmeter-principle, construction and working, watt-hour meter.

D.C and A.C Bridges: (6)

Wheat stone bridge-determination of resistance, Kelvin double bridge-determination of resistance, Maxwell's L/C bridge-determination of self inductance, Wien's bridge-determination of frequency, Schering bridge-determination of capacitance.

Power Supplies: (9)

Unregulated D.C power supplies(using full wave, bridge rectifier with C and L-C filter), transistor series and shunt voltage regulators, OP-AMP series and shunt voltage regulators, voltage regulators using IC 78xx series and ICLM317, Switching regulator(step down type).

Oscilloscopes: (9)

Block diagram of basic oscilloscope, CRT, deflection sensitivity, electrostatic deflection, electrostatic focusing (explanation only –no mathematical treatment), vertical amplifier, delay line circuit, sweep generator, measurement of voltage, period, frequency and phase difference, sampling oscilloscope, Digital storage oscilloscope – block diagram and working principle.

Instrumentation Amplifiers and Signal Analyzers: (9)

Instrumentation amplifier, Electronic voltmeters - d.c voltmeter with direct coupled amplifier, a.c voltmeter using rectifiers, ramp type digital voltmeter, digital multimeter, function generator, wave analyzers- audio range wave analyzer, heterodyne wave analyzer.

Books:

1. W. D. Cooper and A. D. Helfrik Electronic Instrumentation and Measurement Techniques - PHI Publication
2. H.S. Kalsi, Electronic Instrumentation,Tata McGraw Hill Publication
3. A course in Electrical and Electronic Measurements and Instrumentation by A. K. Sawhney, Dhanpat Rai & Sons
4. Robert Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory - PHI Publication
5. Ramakant Gayakwad, Op-amps and Linear Integrated Circuits, Pentice Hall, 2000.

Practical:
Minimum of 4 practical

1. Use of Analog and Digital Multimeter for components testing and measurements(voltage, current and resistance)
2. Design and construction of multi range Voltmeter
3. Design and construction of series type Ohmmeter
4. Study of Maxwell's L/C bridge for determination of inductance
5. Study of Schering bridge for determination of capacitance
6. Design and construction of Wien bridge oscillator using OP-AMP
7. Design and construction of Instrumentation amplifier using OP-AMP
8. Series voltage regulator using transistor/OP-AMP.
9. Shunt voltage regulator using transistor/OP-AMP.
10. Design and construction of Function Generator using IC XR2206.
11. Measurement of frequency and phase on a CRO using Lissajous figures
12. Study of SMPS.

PYS106-MICROPROCESSOR ARCHITECTURE AND PROGRAMMING
(3 credits theory and one credit practical)

1. Basics of Digital Electronics (8)

Number Systems: Binary and hexadecimal number system. Conversion: binary↔decimal, binary↔hexadecimal. Positive, negative logic and tri state. Binary addition. 1's and 2's complement number. 2's complement addition and subtraction. Logic gates: AND, OR, NOT, NOR,NAND, XOR. Half adder and full adder. RS FF, D FF, JK FF, T FF, Shift registers(shift left and shift right), Ripple counters, MOD 2, MOD 5 and MOD 10 counter. Memories: RAM, ROM, PROM, EPROM. Buses: address, data and control bus, Example of a simple microprogram illustrating the use of CONTROL WORD for data storage in memory and fetch from memory.

2. Introduction to microprocessor: (4)

Block diagram of a microprocessor based system and its description,memory (Gaonkar 2.1 – 2.4)

3. 8085 Microprocessor Architecture: (7)

8085 pin configuration & function of each pin. Buses and its organization, registers, flags, Instruction Format, Fetch, decode and execute operations. Op -code Fetch, execute cycle, T state, Machine cycle. Memory and I/O read and write cycles. Examples for Timing diagram for MOV and MVI instruction. (Gaonkar 3.1 – 3.3)

4. Interfacing I/O Devices: (5)

IN and OUT instruction(no timing diagram), Device selection and data transfer, interfacing o/p displays, Memory mapped I/O(no timing diagram) (Gaonkar 4.1-4.4)

5. Introduction to 8085 Assembly Language Programming (8)

8085 programming model, instruction classification, instruction format, writting, assembling and executing a simple program, overview of 8085 instruction set, Data transfer operations, arithmetic operations, logic operations, branch operations, (Gaonkar 5.1- 5.5 ,6.1-6.4)

6. Advanced 8085 Programming: (5)

Looping, counting and indexing, Additional data transfer and 16 bit arithmetic instruction, Arithmetic operations related to memory, logic rotate instructions, compare instructions. (Gaonkar 7.1-7.5)

7. Time Delays (4)

Counters and time delays, Programs: hexadecimal counter, Mod 10 counter (Gaonkar 8.1-8.3)

8. Stack and Subroutines: (4)

stack, subroutine, conditional call and return instructions. (Gaonkar 9.1-9.3)

Books:

1. Malvino and Leach, Digital Principles and Applications, TMH (1986).
2. R. P. Jain, Modern Digital Electronics, TMH (2003).
3. Ramesh S Gaonkar - Microprocessor Architecture, Programming and application with 8085, 4th Edition, Penram International Publishing, New Delhi
4. Microprocessor 8085 and its Interfacing, By Sunil Mathur, Second Edition, PHI Learning Pvt. Ltd.
5. 0000 to 8085 Introduction to Microprocessors for Engineers and Scientists by P.K. Ghosh, P.R. Sridhar Prentice Hall India.

Practicals: (programs can be on 8085 kit or using 8085 simulation software)
Minimum of four practical

1. Addition of one byte numbers
2. Addition of 2 byte numbers with ADC

3. Addition of 2 byte numbers with DAD instruction
4. Subtraction using 2's complement subtraction
5. Block transfer of data
6. Multiplication of two one byte numbers using rotate instruction
7. Multiplication of two one byte numbers using repetitive addition
8. Division of two 16 bit numbers
9. Division of two 2 byte numbers
10. Multi byte BCD addition
11. conversion of hexadecimal to decimal numbers
12. sorting number in ascending and descending order
13. Finding the greatest or least of a group of numbers

PYS107-MICROCONTROLLER ARCHITECTURE AND PROGRAMMING
(3 credits theory and one credit practical)

1. Introduction: (2)
Microprocessors and Microcontrollers, microcontroller types.

2. 8051 Architecture: (8)
Hardware, I/O pins, ports and circuits, memories, counters and timers, serial data I/O, interrupts.

3. 8051 Instruction set: (10)
Addressing modes, data movement, Instruction- external data move, code memory read-only-data moves, push and pop opcodes, data exchanges, programs.

4. Logical operations: (4)
bit and byte level, rotate and swap, jump instructions, call and return instructions, programs.

5. Arithmetic operations: (5)
Flags, incrementing, decrementing, addition, subtraction, multiplication, division, interrupt priority in 8051.

6. Interrupt programming: (8)
8051 interrupts, programming timer interrupts, external hardware interrupts, interrupt priority in 8051.

7. Interfacing 8051 & programming: (6)
LED, 7 segment display, LCD, keyboard, stepper motor, DAC and ADC.

8. Embedded system software tools: (2)
IDE, simulators, debuggers, compilers and cross compilers, software monitors, watch dog timers (basic working only- no programs).

Books:
1. Muhammad Ali Mazidi & Janice Mazidi – The 8051 microcontroller and Embedded systems – Pearson Education.
2. Kenneth J Ayala – The 8051 Microcontroller, Architecture, Programming & applications - 2nd edition – Penram international.
3. David Simon – An Embedded Software Primer - Pearson Education.
4. Myke Predco – Programming and customizing 8051 microcontroller.

Practical: (use kit or simulation software and programming in assembly or C/C++)
Minimum of four practical

1. Programs to illustrate the types of Addressing Modes: Immediate, Direct, Register, Indirect, External, Stack, Data Exchanges – At least 3 programs
(a) Write a program to copy the value 55H (use any other value) into RAM memory locations 40H to 41H (use any other value) using (i) direct addressing mode, (ii) register indirect addressing mode without a loop, and (iii) with a loop,
Any other example programs

2. Data Transfer Programs: at least 3 programs
(a) Write a program to clear 16 RAM locations starting at RAM address 60H (Data transfer program)
(b) Write a program to copy a block of 10 bytes of data from 35H to 60H
Any other example programs

3. Port programming: At least 3 programs
(a) Write a program to get the x value from P1 and send x2 to P2, continuously
Any other example programs
4. Timer programming: At least 3 programs
(a) Copy a byte from TCON register using at least 4 different methods
(b) Setting timer T0 to 1234H using direct and indirect addressing
Any other example programs

5. Logical operations: at least 3 programs
6. Serial data transfer programs: at least 2 programs
7. Programs to perform arithmetic operations (including BCD addition) with data in internal/external RAMs and use of Register Banks. - at least 3 programs
8. Programs to illustrate loop, jump and call instructions. - at least 3 programs
9. Programs to illustrate Timer Interrupts and External Interrupts (with wavefrom generation). - at least 3 programs
10. Interface LCD to 8051 and display messages.
11 Interface Keypad to 8051 and program to accept the key input and display it on LCD.
12. Interface LEDs and 7-segment displays to 8051 and program to activate the devices.
13. program to illustrate traffic lights
14. Program to illustrate ADC / DAC conversion

PYS108-PHOTOGRAPHY
(3 credits theory and one credit practical)

1. Introduction to photography [3]
   Definition of photography, Physics of photography, History and developments in photography, Types of photography, Digital photography.
2. Camera Basics [3]
   Types of cameras, introduction to common brands of cameras, Camera Controls, basic camera settings, Basic camera operations.
3. DSLR Camera [3]
   Detailed operational procedure of a DSLR Camera and shooting modes
4. Exposure [2]
5. Aperture & Shutter Speeds [2]
6. ISO, Exposure compensation, Concept of high- and low key photographs [3]
7. Light Meter, TTL concept [2]
8. Depth of Field [3]
9. White balance and colour compensation [3]
10. Lenses [4]
    Importance of lens in a camera, focal length of camera lenses and its effects on photographs. Types of lenses. (Prime lens, zoom lens & tilt lens) Categorization of lenses (kit lenses, micro, macro, wide angle & telephoto lenses).
11. Lighting [4]
    Natural lighting, artificial lighting. speed lights, studio strobes, light modifiers, colour gels.
12. Effect of lighting on photographs [4]
    Fill light, back light, Rembrandt lighting; butterfly lighting, golden hour and sun set photography
13. Flash Photography [3]
    TTL, high speed sink, Composition tips and Shooting at Night
14. Filters, Tripod, & Camera Accessories [3]
15. Introduction to a photo editing soft ware (adobe light room) [3]

References

1. Scott Kelby's Digital Photography Boxed Set, Volumes 1, 2, and 3 1st Edition
   Author: Scott Kelby, Publisher: Peachpit Press ©2007, 2009
2. Understanding Exposure, 3rd Edition: How to Shoot Great Photographs with Any Camera
   Author: Bryan Peterson, Publisher: Random House India Edition: 3rd Edition, 2010

3. The Photographer's Eye: Composition and Design for Better Digital Photos 1st Edition
   Author: Michael Freeman, Publisher: Focal Press; 1st edition (May 23, 2007);
4. Extraordinary Everyday Photography: Awaken Your Vision to Create Stunning Images Wherever You Are
   Author: Brenda Tharp, Publisher Amphoto books 2012
5. Better Photo Basics: The Absolute Beginner's Guide to Taking Photos Like a Pro 1st Edition
   Author: Jim Miotke, Publisher: Amphoto Books 2010
6. The Art of Photography: An Approach to Personal Expression
   Author: Bruce Barnbaum, Publisher: Photographic Arts Editions in cooperation with Rocky Nook Inc 2010
7. David Busch's Mastering Digital SLR Photography (David Busch's Digital Photography Guides) 3rd Edition
   Author: David D. Busch, Publisher: course technology PTR 2012
8. Basic 35mm Photo Guide: For Beginning Photographers 5th Edition
   Author: Craig Alesse, Publisher: Amherat Media Inc. 2001
9. How to Photograph Absolutely Everything: Successful Pictures From Your Digital Camera
   Author: Tom Ang, Publisher: DK; Reprint edition 2009
10. 50 Photo Projects - Ideas to Kickstart Your Photography
    Author: Lee Frost, Publisher: David & Charles; 2009

Practical (All the following) (One Credit)

1. Photograph a subject of interest using different shooting modes to see how that affects the images. Bring 10 images on external media (flash or hard drive).
2. Practice exposure compensation with the camera. Bring 10 high and low-key images on external media (flash or hard drive).
3. Practice shooting portraits and try different lighting techniques. Bring 10 portraits on external media (flash or hard drive).
4. Experiment with night photography and low light shooting. Create 5 best photographs in each category on external media (flash or hard drive).
5. Find a subject of your choice and spend time working with the subject. Practice rules of composition. Bring 10 (5 night or low light) images you are proud of on an external media (flash or hard drive).
6. Shoot 4-8 images that are conceptually driven, based on your own interests or inspired by the lecture. Bring it on external media (flash or hard drive).
7. Practice photo editing and enhance the best 10 images of your choice. Bring it on external media (flash or hard drive).
8. Print the best 10 photographs and present it at the photo exhibition arranged in college at the end of semester.