Graduate Attributes In Physics

Some of the characteristic attributes of a graduate in Physics are:

(i) **Disciplinary knowledge and skills:** Capable of demonstrating (i) good knowledge and understanding of major concepts, theoretical principles experimental findings in Physics and its different subfields like Astrophysics and Cosmology, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics, Analytical dynamics, and other related fields of study, including broader interdisciplinary subfields like Chemistry, Mathematics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology etc. Ability to use modern instrumentation and laboratory techniques to design and perform experiments is highly desirable in almost all the fields of Physics listed above

(ii) **Skilled communicator:** Ability to transmit complex technical information relating all areas in Physics in a clear and concise manner in writing and oral ability to present complex and technical concepts in a simple language for better understanding

(iii) **Critical thinker and problem solver:** Ability to employ critical thinking and efficient problem solving skills in all the basic areas of Physics.

(iv) **Sense of inquiry:** Capability for asking relevant/appropriate questions relating to the issues and problems in the field of Physics, and planning, executing and reporting the results of a theoretical or experimental investigation.

(v) **Skilled project manager:** Capable of identifying/mobilizing appropriate resources required for a project, and manage a project through to completion, while observing responsible and ethical scientific conduct; and safety and laboratory hygiene regulations and practices.

(vi) **Digitally Efficient:** Capable of using computers for simulation studies in Physics and computation and appropriate software for numerical and statistical analysis of data, and employing modern e-library search tools, various websites of the renowned Physics labs in various countries to locate, retrieve, and evaluate Physics information.

(vii) **Ethical awareness / reasoning:** The graduate should be capable of demonstrating ability to think and analyze rationally with modern and scientific outlook and identify ethical issues related to one's work.

(viii) **National and international perspective:** The graduates should be able to develop a national as well as international perspective for their career in the chosen field of the academic activities. They should prepare themselves during their most formative years for their appropriate role in contributing towards the national development and projecting our national priorities at the international level pertaining to their field of interest and future expertise.

(ix) **Lifelong learners:** Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling in all areas of Physics.

Preamble

The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics.
This is a revised part of the undergraduate programme (Six Semesters) in Physics, to be taught in Semester V & VI from the academic year 2020-21 onwards. Developing Curriculum that is progressive and purposeful to create positive improvement in the education system is the logic behind this revision.
In each Semester, courses are devoted to core Physics, catering to Mechanics, Thermodynamics, Optics, Electrodynamics, Quantum Mechanics, Mathematical Physics and Digital and Analog Electronics. These have been tailored to fit in with the existing F.Y.B.Sc syllabus (Semester I and Semester II) & SYBSC (Semester III & IV) in terms of continuity and to ensure delivery of quality content to the learner.
The elective in first semester offers interdisciplinary application- oriented topics. It will be offered as a choice to all learners across various combinations. This course will seek to foster a spirit of multidisciplinary approach in learning.

Course Objectives:

Upon completion of the course, students should have acquired the following knowledge and skills:

1. A thorough quantitative and conceptual understanding of the core areas of physics, including mechanics, , thermodynamics, quantum mechanics, electronics at a level compatible with graduate programs in physics at peer institutions.
2. The ability to analyse and interpret quantitative results, both in the core areas of physics and interdisciplinary areas.
3. The ability to use contemporary experimental apparatus and analysis tools to acquire, analyse and interpret scientific data.
4. The ability to apply the principles of physics to solve new and unfamiliar problems.
5. The ability to communicate scientific results effectively in presentations or posters.
6. Develop analytical abilities towards real world problems.
7. To familiarize with current and recent scientific and technological developments

Syllabus for Semester V

Course No	Course Title	Course Code	Credits	Hours	Periods (50 min)	No.of lec	Examination		
							Int	Ext	Tot
Core Courses									
1	Stat. Phy.	20US5PHSP1	02	30	36	12	20	30	50
		Unit 1	Description of a system						
		Unit 2	Thermal and Adiabatic Interactions						
		Unit 3	Statistical Mechanics						
2	Solid State Physics	20US5PHSSP2	02	30	36	12	20	30	50
		Unit 1	Electrical properties of metals						
		Unit 2	Modern optics						
		Unit 3	Conduction in semiconductors						
3	Atomic Physics	20US5PHAP3	02	30	36	12	20	30	50
		Unit 1	Hydrogen atom						
		Unit 2	Spin orbit coupling & vector atom model						
		Unit 3	Interaction of atoms with “B”						
4	Electro dynamics	20US5PHED4	02	30	36	12	20	30	50
		Unit 1	Electro statistics						
		Unit 2	Magneto statistics						
		Unit 3	Electromagnetic Waves						
Discipline Specific electives (DSE)									
1	Analog Instr.	20US5PHAI1	02	30	36	12	20	30	50
		Unit 1	Transducers and its applications						
		Unit 2	Display devices and power supplies						
		Unit 3	Measuring instruments						
2	Digital Elect & Instr	20US5PHDEI2	02	30	36	12	20	30	50
		Unit 1	Data Processing Circuits						
		Unit 2	Registers and Counters						
		Unit 3	Digital integrated circuits						
3	Electronics Comm.	20US5PHEC3	02	30	36	12	20	30	50
		Unit 1	Introduction to communication techniques						
		Unit 2	Modulation techniques						
		Unit 3	Introduction to amplitude modulation						

Course No	Course Title	Course Code	Credits	Hours	Periods (50 min)	No.of lec	Examination		
							Int	Ext	Tot
4	Renewable energy harvesting	20US5PHRE4	02	30	36	12	20	30	50
		Unit 1	Introduction						
		Unit 2	Solar and wind energy sources						
		Unit 3	Non-conventional energy technologies						
1	Mathematical methds	20US5PHMMS	01	15	18	09			25
		Unit 1	Matrices						
		Unit 2	Fourier and Laplace transform						
Practical									
Core Courses									
	I &II	20US5PHP1	02						
	III&IV	20US5PHP2	02						
Discipline specific elective									
1	DSE1	20US5PHAE1	01	2	2.4		20	30	50
2	DSE2	20US5PHDEI2	01	2	2.4		20	30	50
3	DSE3	20US5PHEC3	01	2	2.4		20	30	50
4	DSE4	20US5PHRE4	01	2	2.4		20	30	50

Syllabus for Semester VI

Course No	Course Title	Course Code	Credits	Hours	Periods (50 min)	No.of lec	Examination		
							Int	Ext	Tot
Core Courses									
1	Classical Mechanics.	20US6PHCM1	02	30	36	12	20	30	50
		Unit 1	Accelerated Frame						
		Unit 2	Lagrange's Mechanics						
		Unit 3	Kinematics of moving fluid and rigid fluid						
2	Electronics	20US6PHE2	02	30	36	12	20	30	50
		Unit 1	Multivibrators and timer						
		Unit 2	Differential Amplifier						
		Unit 3	Field effect transistors						
3	Nuclear Physics	20US6PHNP3	02	30	36	12	20	30	50
		Unit 1	Nuclear reactions and alpha decay						
		Unit 2	Beta and gamma decay						
		Unit 3	Nuclear models						
4	Special theory of relativity	20US6PHSR4	02	30	36	12	20	30	50
		Unit 1	Experimental Background						
		Unit 2	Relativistic kinematics, relativistic dynamics						
		Unit 3	Relativity and electromagnetism						
Discipline Specific electives (DSE)									
1	µp and interfacing.	20US6PHMI1	02	30	36	12	20	30	50
		Unit 1	Basic concepts of microprocessor						
		Unit 2	8085 assembly language programming						
		Unit 3	Programming techniques						
2	C programming	20US6PHCP2	02	30	36	12	20	30	50
		Unit 1	Introduction to Computers, C Programming						
		Unit 2	Control Structures in C programming						
		Unit 3	Functions and pointers in C programming						
3	Applied Otics	20US6PHAO3	02	30	36	12	20	30	50
		Unit 1	Light transportation system. Geometrical optics						
		Unit 2	Modern Optics						
		Unit 3	Optical techniques for material characterization						

Course No	Course Title	Course Code	Credits	Hours	Periods (50 min)	No.of lec	Examination		
							Int	Ext	Tot
4	SWAYAM	20US6PHSW4	02	30	36	12	20	30	50
		Unit 1	Introduction						
		Unit 2	Solar and wind energy sources						
		Unit 3	Non-conventional energy technologies						
1	Electrical circuits and network skills	20US6PHECNS	01	15	18	09			25
		Unit 1	Introduction to Basic Electricity Principles						
		Unit 2	Application and Protection of Electrical Circuit						
Practical									
Core Courses									
	I &II	20US6PHP1	02	04					
	III&IV	20US6PHP2	02	04					
Discipline specific elective									
1	DSE1	20US6PHMI1	01	2	2.4		20	30	50
2	DSE2	20US6PHCP2	01	2	2.4		20	30	50
3	DSE3	20US6PHAO3	01	2	2.4		20	30	50
4	DSE4	20US6PHSW4	01	2	2.4		20	30	50

SEMESTER V
Course – I
COURSE TITLE: Statistical Physics
COURSE CODE: 20US5PHSP1
[CREDITS - 02]

Course outcome: This course develops concepts in classical laws of thermodynamics and their applications. It postulates statistical mechanics and statistical interpretation of thermodynamics, various canonical ensembles.

Using statistical mechanics development of MB, BE and FD formulae are established and its applications are discussed.

On completion of this course a student should be able to:

1. Define and discuss the concepts of microstate and macro state of a model system.
2. Apply the machinery of statistical mechanics to the calculation of macroscopic properties resulting from microscopic models of magnetic and crystalline systems.

Course Specific Outcome: The course is centred about a thorough understanding of the theory and methods of statistical physics and thermodynamics.

Unit I	**Description of a System**	**Number of lectures :12**
1	**Learning Objective:** (i) To describe elementary statistical Physics to learners (ii) To establish the statistical background of thermodynamics. **Learning Outcomes:** (i) Students understand the need to use statistics to describe systems containing huge numbers of particles. (ii) Students understand the statistical foundations of Equilibrium Thermodynamics	
	(i) Description of a system: Why statistical approach, Particle-states, System-states, Microstates and Macro states of a system. (ii) Equilibrium and Fluctuations, Irreversibility, The equiprobability postulate, Statistical ensemble, Number of states accessible to a system, Phase space. (iii) Reversible processes. Phase space, The probability of a distribution, The most probable distribution	
Unit II	**Thermal and adiabatic interactions**	**Number of lectures :12**
2	**Learning Objective:** (i) To describe statistical interpretations of thermal interactions. (ii) To understand thermodynamically potentials. **Learning Outcomes:** (i) Understand & be able to apply Classical Thermodynamics to simple problems. (ii) Students learn how to solve thermodynamics problems related to thermodynamical relations.	
	(i) Thermal interaction, Canonical distribution, Energy fluctuations, Entropy of a system in a heat bath, Helmholtz free energy. (ii) Adiabatic interaction and enthalpy, General interaction and the first law of thermodynamics, Infinitesimal general interaction, Gibbs free energy, Phase transitions	
Unit III	**Statistical Mechanics**	**Number of lectures :12**
	Learning Objective: (i) To describe concepts of bosons and fermions. (ii) To obtain statistical formulae for BE and FD statistics. **Learning Outcomes:**	

	(i) (ii)	Understand the quantum statistical physics of Fermions & Bosons Students understand the statistical foundations of Equilibrium Thermodynamics Be able to apply Fermion & Boson Statistics to various many particle problems
	(i) (ii)	Statistical Mechanics :, Maxwell-Boltzmann statistics, Quantum Statistics : Bose-Einstein statistics, Black-body radiation, The Rayleigh-Jeans formula, The Planck radiation formula, Fermi-Dirac statistics, Comparison of results, Transition between states

References:

(1) S. Lokanathan and R. S. Gambhir (2008). An introduction to Statistical and Thermal Physics; NewDelhi: Prentice Hall of India.
(2) Arthur Beiser, Perspectives of Modern Physics; (Mc Graw Hill International).
(3) Sinha H P (2005) Thermal and Statistical Physics. Agra: Ram Prasad and Sons.
(4) Seth Publishers Text Book, Mumbai

SEMESTER V
Course – II
COURSE TITLE: Solid State Physics
COURSE CODE: 20US5PH2
[CREDITS - 02]

Course outcome: The course gives an introduction to solid state physics, and wil enable the student to employ classical and quantum mechanical theories needed to understand the physical properties of solids.

Course Specific Outcome: The main objective of this course is to learn about properties and their response to internal and external stimuli. This goal can be achieved by learning crystal structure, crystal binding, lattice dynamics, electron, electron distribution theories and the concept of energy bands.

Unit I	**Electrical Properties of Metals**	**Number of lectures :12**
	Learning Objective: (i) Describe the classical free electron theory. (ii) Derive Ohm's law and Wiedemann Franz Law . (iii) Explain failure of classical free electron theory. (iv) Describe quantum free electron theory. (v) Derive equation for Fermi energy. (vi) Explain Fermi distribution function.	

	(vii) Explain how quantum free electron theory overcomes failures of classical free electron theory **Learning Outcomes:** (i) List various electrical properties of metal. (ii) State assumptions of classical free electron theory and its success in verifying Ohm's law and Wiedemann Franz law. (iii) Explain failures of classical free electron theory. (iv) Define Fermi function and Fermi energy. (v) Derive equation for Energy density states. (vi) Describe electrical conductivity on the basis of Quantum free electron theory. (vii) Explain success of Quantum free electron theory in overcoming failures of classical free electron theory	
1	(i) Electrical properties of metals : Classical free electron theory of metals, Drawbacks of classical theory, Relaxation time, Collision time and mean free path, (ii) Quantum theory of free electrons, FermiDirac statistics and electronic distribution in solids, Density of energy states and Fermi energy, (iii) The Fermi distribution function, Heat capacity of the electron gas, Mean energy of electron gas at 0 K, Electrical conductivity from quantum mechanical considerations, SOP : Ch. 6 Art : I to V, XIV to XX, XXXI	
Unit II	**Modern Optics**	**Number of lectures :12**
2	**Learning Objective:** (i) Students will be able to evaluate and analyze the electrical and optical properties of solids (ii) Students will be able to analyze electron transport and energy related problems by applying quantum mechanical principles **Learning Outcomes:** (i) Students will be able to determine the crystal structure by analysis of XRD data (ii) Students will be able to evaluate and analyze the electrical and optical properties of solids	
	(i) Superconductivity: A survey, Mechanism of Superconductors, Effects of magnetic field, The Meissner effect, the penetration depth, Type I and Type II Superconductors. (ii) Band theory of solids, The Kronig- Penney model (Omit eq. 6.184 to 6.188), Brillouin zones, Number of wave functions in a band, Motion of electrons in a one-dimensional periodic potential, Distinction between metals, insulators and intrinsic semiconductors. SOP: Ch. 8 Art: II, III, IV, VII, XII and XIII. , Ch. 6 Art : XXXVI to XXXXI	

Unit III	Conduction in Semiconductors	Number of lectures :12
3	**Learning Objective:** (i) Have knowledge about the physics of semiconductor materials. (ii) Describe various properties of semiconductor materials using mathematical equations. (iii) Analyse the characteristics and theories in semiconductor materials in terms charge carriers and energy bands. (iv) Able to calculate charge carrier concentration and change due to temperature. (v) Evaluate the charge and electric field distribution in a p-n junction. (vi) Formulate the sequence of events of a p-n junction under forward bias and reverse bias. **Learning Outcomes:** (i) Know the physics of semiconductor, (ii) Able to differentiate intrinsic, extrinsic semiconductor (iii) Able to describe their behaviour in various conditions.	
	(i) Conduction in Semiconductors. Electrons and Holes in an Intrinsic Semiconductor, Conductivity, Carrier concentrations, Donor and Acceptor impurities, Charge densities in a Semiconductor, Fermi level in extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation, The Hall effect. (ii) Semiconductor-diode Characteristics: Qualitative theory of the p-n junction, The p-n junction as a diode, Band structure of an open-circuit p-n junction, The current components in a p-n junction diode, Quantitative theory of p-n diode currents, The Volt-Ampere characteristics, The temperature dependence of p-n characteristics, Diode resistance. Semiconductor nanoparticle: effect on band gap energy MH : Art 4.1 to 4.10 ; Art 5.1 to 5.8 3.	

References:

(1) Pillai S.O (2015): Solid State Physics 7/e New Age International. (SOP)
(2) Millman, Halkias & Satyabrata Jit (2015): Electronic Devices and Circuits 2/e : Tata McGraw Hill.
(3) Pillai S.O(2012): Modern Physics and Solid State Physics : Problems and solutions
(4) T. Pradeep (2007) : Nano: The essentials: Tata McGraw Hill
(5) Solid State Physics: A. J. Dekker, Macmillan India Ltd.

SEMESTER V
Course –III
COURSE TITLE: Atomic Physics

COURSE CODE: 20US5PH3
[CREDITS - 02]

Course outcome:

(1) Explain the application of quantum theory to hydrogen atom.
(2) Understand the physical interpretation of quantum numbers.
(3) Differentiate between the effects of change in the intensity of applied field on spectrum.
(4) Solve problems based on operators and wave functions at atomic level.

Unit I	**Hydrogen Atom**	**Number of lectures :12**
1	**Learning Objective:** (i) Understand use of quantum mechanics at atomic level. (ii) Derive Schrodinger equation for hydrogen atom in spherical polar coordinate. (iii) Estimate the Eigen values of wave functions for different operators. (iv) Draw interference of spin concept from Stern Gerlach experiment. **Learning Outcomes:** (i) Solve Schrodinger equation using spherical polar coordinates by using separation of variables. (ii) Illustrate the physical interpretation of quantum numbers. (iii) Explain the concept of probability density of electron in hydrogen atom for various states. (iv) Describe the construction of Stern Gerlach experiment for demonstrating spin of electron.	
	(i) Hydrogen atom: Schrödinger's equation for Hydrogen atom, Separation of variables, Quantum Numbers: Total quantum number, Orbital quantum number, Magnetic quantum number. Angular momentum, Electron probability density (Radial part). (ii) Electron Spin: The Stern-Gerlach experiment Ref--- 1. B : 9.1 to 9.9. 2. B: 10.1, 10.3	
Unit II	**Spin orbit coupling & Vector atom model**	**Number of lectures :12**
	Learning Objective: (i) Differentiate between the symmetric and anti-symmetric wave functions. (ii) Understand the spin orbit coupling in Hydrogen atom. (iii) Explain the vector atom model with possible schemes. **(iv)** Derive the selection rules in hydrogen spectrum. **Learning Outcomes:** (i) List the type of particles and possible statistics for type of wave functions. (ii) Calculate the shift in wavelength observed in the hydrogen spectrum due to	

2	spin orbit coupling. (iii) Explain the LS coupling and JJ coupling. (iv) Derive the expression for change in the average value of electron and frequency of light emitted in the process (Bohr's Third postulate) (v) Solve problems based on vector atom model	
	(i) Pauli's Exclusion Principle Symmetric and Anti-symmetric wave functions. (ii) Spin orbit coupling, Hund's Rule, Total angular momentum, Vector atom model, L-S and j-j coupling. (iii) Origin of spectral lines, Selection rules Ref. B : 10.2, 10.6, 10.7, 10.8, 10.9. ; B : 11.1 and 11.2.	
Unit III	**Atom interaction with external magnetic field**	**Number of lectures :12**
	Learning Objective: (i) Learn basic interaction an atom with an external magnetic field. (ii) Removal of degeneracy with respect to various angular momentum quantum numbers. (iii) Impact of magnetic field strength on coupling between spin and orbit and accordingly removal of degeneracies. **Learning Outcomes:** (i) At weak external magnetic field degeneracy with respect to J is removed - Anomalous Zeeman effect. (ii) As a special case (S = 0) degeneracy w.r.t. L is removed – Normal Zeeman Effect. (iii) At very high magnetic fields, J loses its importance and degeneracy w.r.t. L and S is simultaneously removed, Paschen Back effect.	
	(i) Effect of Magnetic field on atoms, the normal Zeeman Effect and its explanation (Classical and Quantum), The Lande g factor, Anomalous Zeeman effect. (ii) Paschen-Back effect, Paschen-Back effect of principal series doublet, Selection rules for Paschen-Back effect. Ref--- SA : 9.14, 9.15, 9.16, 9.17; W : 10.7, 10.8, 10.9	

References:

(1) B : Arthur Beiser: Perspectives of Modern Physics, McGraw Hill.
(2) SA : H. Semat & J. R. Albright: Introduction to Atomic & Nuclear Physics,(5th Ed.) Chapman & Hall.
(3) W : H. E. White: Introduction to Atomic Spectra: McGraw Hill.

SEMESTER V

Course –IV
COURSE TITLE: Electrodynamics
COURSE CODE: 20US5PH4
[CREDITS - 02]

Course Objective:
This course revises the basic concept of electrodynamics and establishes the concept of electromagnetic waves and its properties.

Course outcome:
(1) A fundamental understanding of electrostatics, electricity, magnetism, electromagnetic induction and electrodynamics, its application and linkage to the Industry.
(2) Interpret Maxwell's equations in matter and vacuum.
(3) Write the equations for electric and magnetic waves in different situations for problems and solve them.
(4) Show how reflection and transmission can be derived from electromagnetic waves.
(5) Develop analytical and problem solving skills.

Unit I	**Electrostatics**	**Number of lectures :12**
	Learning Objective: (i) State the gauss' law and Amperes law (ii) Apply the laws for finding electric and magnetic fields for various surfaces. (iii) Derive the divergence and curl of electric and magnetic field **Learning Outcomes:** (i) Understand Gauss's and Ampere`s law in matter. (ii) To able to analytically apply Gauss`s to solve different problems. (iii) Understanding and applying divergence and curl to electric and magnetic fields. Drawing of field line for a given charge and current configuration.	
1	(i) Gauss' law, The divergence of E, Applications of Gauss' law, The curl of E. (ii) Introduction to potential, Comments on potential, Poisson's equation and Laplace's equation, The potential of a localized charge distribution. (iii) Dielectrics, Induced Dipoles, Polarization, Bound charges and their physical interpretation, Gauss' law in presence of dielectrics, A deceptive parallel, Susceptibility, Permittivity, Dielectric constant, DG: 2.2, 2.3, 4.1.1, 4.1.4, 4.2, 4.3, 4.4.1	
Unit II	**Magnetostatics**	**Number of lectures :12**
	Learning Objective: (i) To apprise the students regarding the concepts of electrodynamics and Maxwell equations and use them various situations **Learning Outcomes:**	

	(i) To able to analytically apply Ampere`s law to solve different problems. (ii) Interpret Maxwell's equations (iii) Analyze the various boundary conditions (iv) Able to solve problems based on the Maxwell`s equation, boundary conditions.	
2	(i) The Divergence and Curl of B, Applications of Ampere's Law (ii) Dia-magnets Paramagnets Ferro magnets, Magnetization , Bound currents and their physical interpretation, Ampere's law in magnetized materials, A deceptive parallel, Magnetic susceptibility and permeability. (iii) Electrodynamics before Maxwell, Maxwell's correction to Ampere's law, Maxwell's equations, Maxwell's equations in matter, Boundary conditions Electrodynamics before Maxwell, Maxwell's correction to Ampere's law, Maxwell's equations, Maxwell's equations in matter, Boundary conditions DG: 5.3.2, 5.3.3, 6.1.1, 6.1.4, 6.2, 6.3, 6.4.1	
Unit III	**Electromagnetic Waves**	**Number of lectures :12**
	Learning Objective: (i) To acquire the knowledge of Electromagnetic field theory that allows the student to have a solid theoretical foundation to be able in the future to design emission , propagation and reception of electro- magnetic wave systems **Learning Outcomes:** (i) Compare continuity equation and Poynting`s theorem based on energy conservation (ii) Write wave equations for electric and magnetic fields. (iii) Estimate energy and momentum in electromagnetic waves (iv) Solve simple problems on electromagnetic waves in different media. (v) Justify why to do electrodynamics and show the reflection and transmission of electromagnetic waves in different media	
	(i) The continuity equation, Poynting's theorem (ii) Electromagnetic waves in vacuum, electromagnetic waves in matter, the wave equation for E and B, Monochromatic Plane waves, Energy and momentum in electromagnetic waves. (iii) Electromagnetic waves in matter, Reflection and transmission of EM waves at normal incidence. DG:,8.1, 9.1, 9.2, 9.3.1,9.3.2:, 9.1, 9.2, 9.3.1,9.3.2	

References:

(1) DG: David J. Griffiths (3rd Ed) Introduction to Electrodynamics : Prentice Hall of India.
(2) Electricity and magnetism: A S Mahajan, A A Rangwala Mc Graw Hill
(3) Classical Electrodynamics: David Jackson (3rd Edition) John Wiley and Sons
(4) Introduction to Electrodynamics: A. Z. Capria and P. V. Panat., Narosa Publishing

SEMESTER V
Course –DSE-I
COURSE TITLE: Analog Electronics
COURSE CODE: 20US5PHAI1
[CREDITS - 02]

Course Outcome:

(1) Provide basic knowledge about the various sensors and data acquisition systems applied in Wireless sensor network.
(2) To understand the concepts, working principles and key applications of linear integrated circuits.
(3) To perform analysis of circuits based on linear integrated circuits.
(4) To design circuits and systems for particular applications using various types of power supplies

Course Specific outcome:

(1) Explain the basic features of oscilloscope and different types of oscilloscopes
(2) Apply the complete knowledge of various electronics instruments/transducers to measure the physical quantities in the field of science, engineering and technology.

Unit I	**Transducers and its applications**	**Number of lectures :12**
	Learning Objective: (i) To provide basic knowledge about the various sensors and data acquisition systems applied in Wireless sensor network. **Learning Outcomes:** (i) After successful completion of the course student will be able to explain principle of operation for various sensors. (ii) Students will be able to describe functional blocks and applications of sensor in various areas	
1	(i) Introduction to Transducers. (ii) Temperature measurements, Resistance thermometer, thermocouple & thermistor. (iii) Pressure & Displacement Transducers: Strain Gauges (derivation of gauge factor is not expected), LVDT, Capacitive transducers (iv) Optical Transducers Photo –diode, photo transistor, Photo multiplier tube, (v) Transducers Applications :Automotive sensors, Home appliance sensors, Medical diagnostic sensors	
Unit II	**Display devices and Power Supplies**	**Number of lectures :12**
	Learning Objective:	

2	(i) Students will try to learn about Various display device and Various types of power supplies **Learning Outcomes:** (i) Understand the fundamentals and areas of applications for the integrated circuits & Display devices (ii) Analyse important types of power supplies (iii) Demonstrate the ability to design practical circuits that perform the desired operations. (iv) Understand the differences between theoretical, practical & simulated results in integrated circuits.	
	(i) Display devices: LED, LCD, and Seven segment LED display, BCD to seven segment decoder / driver. (ii) Linear and switching regulatorsMonolithic linear IC voltage Regulators. (LM 78XX, LM 79XX, LM 317). (iii) Basic and Monolithic Switching regulators (buck, boost and buck – boost) (Only basic Configurations)	
Unit III	**Measuring Instruments**	**Number of lectures :12**
	Learning Objective: (i) Theoretical background of cathode ray oscilloscope (ii) Conversion of Analog signal to digital signal by various methods **Learning Outcomes:** (i) Analyse the performance characteristics of each instrument (ii) Explain the basic features of oscilloscope and different types of oscilloscopes (iii) Apply the complete knowledge of various electronics instruments/transducers to measure the physical quantities in the field of science, engineering and technology	
	(i) Cathode Ray Oscilloscope: Introduction, CRO block diagram, CRT connection, Vertical amplifier, Basic function of sweep generator, Horizontal deflection system, Triggered sweep, Trigger Pulse, Delay line. Dual trace CRO. (ii) Analog to digital conversion:--Simultaneous Conversion methods , Counter method, successive approximation method	

References:

(1) D.Patranabis Sensors and Transducers 2nd edition .
(2) Albert D. Helfrick& William D. Cooper (PHI) Edition: Modern Electronic Instrumentation & Measurement Techniques.
(3) K: H. S. Kalsi, 2nd Edition Electronic Instrumentation by, Tata McGraw Hill.
(4) T: G. L. Tokheim (6th Editon)Digital electronics (Tata McGraw Hill)

(5) C & D: Coughlin & F. F. Driscoll "OPAMPs and linear integrated circuits 6th Edition), Eastern Economy Education, PHI
(6) G R. A. Gayakwad: OPAMPs & linear integrated circuits,(4th Edition, PHI)

SEMESTER V
Course –DSE-II
COURSE TITLE: Digital Electronics and instrumentation
COURSE CODE: 20US5PHDE
[CREDITS - 02]

Course Outcome:

(1) Develop a digital logic and apply it to solve real life problems.
(2) Analyze, design and implement combinational logic circuits.
(3) Classify different semiconductor memories.
(4) Analyze, design and implement sequential logic circuits.

Unit I	**Data Processing Circuits**	**Number of lectures :12**
	Learning Objective: (i) To understand number representation and conversion between different representation in digital electronic circuits. (ii) To Analyze logic processes and implement logical operations using combinational logic circuits. (iii) To understand characteristics of memory and their classification. (iv) To understand concepts of sequential circuits and to Analyze sequential systems in terms of state machines **Learning Outcomes:** (i) After successful completion of the course student will be able to develop a digital logic and apply it to solve real life problems. (ii) Analyze, design and implement combinational logic circuits. (iii) Study the conversion of digital data.	
1	Data processing circuits (i) Multiplexers, Demultiplexers, 1-of-16 Decoder, BCD-to-decimal Decoders, and Seven segment Decoders, Encoders. (ii) D/A conversion: Variable resistor Networks, binary ladders, D/A converters, D/A accuracy and resolution. ML : Art 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 ML : Art 12.1, 12.2, 12.3, 12.4.	
Unit II	**Registers and Counters**	**Number of lectures :12**
	Learning Objective: (i) Students will try to learn different types of Registers and digital counters. **Learning Outcomes:** (i) Develop a digital counter which will be able to use for real life counting	

2	and (ii) learn how to shift data at appropriate location	
	(i) Registers: Types of registers, Serial In-serial Out, Serial In-Parallel Out, Parallel In – Serial Out, Parallel In –Parallel Out, Applications of Shift Registers (ii) Counters: Ripple Counter, Synchronous Counters, Ring Counters, And Other Counters. ML : Art. 9.1, 9.2, 9.3, 9.4, 9.5, 9. MB : Art. 8.4, 8.5, 8.6, 8.7	
Unit III	**Digital Integrated Circuit**	**Number of lectures :12**
	Learning Objective: (i) Differentiate between sequential logic and combinational logic. (ii) Describe the structure and function of the sequential portion of a circuit. (iii) Distinguish between Small Scale (SSI) Integration and Medium Scale (MSI) Integration designs **Learning Outcomes:** (i) After completion of course student will learn about Design sequential logic circuit based on design specifications.	
	(i) Digital Integrated Circuits: Switching Circuits, Logic families: Standard TTL NAND, TTL NOR, Open collector gates, Three state TTL devices, (ii) MOS inverters, CMOS NAND and NOR gates, CMOS characteristics	

References:

(1) ML: Malvino and Leach (6th Ed) Digital Principles and Applications (TMH).
(2) MB : Malvino and Brown (3rd Ed) Digital Computer Electronics

SEMESTER V
Course –DSE-III
COURSE TITLE: Electronics Communication
COURSE CODE: 20US5PHEC
[CREDITS - 02]

Unit I	**Introduction to Communication System**	**Number of lectures :12**
	Learning Objective: (i) Define communication and explain the different steps in communication & different types of communication system. (ii) Distinguish between information and message. (iii) Explain need for modulation. (iv) Classify electromagnetic spectrum as MF,HF,VHF and UHF. (v) Explain different sources of noise & Calculate noise levels using equations	

1	taught in the text. **Learning Outcomes:** (i) Define the word information as it applies to subject of communication. (ii) Various elements of communication system. (iii) Understand the use of modulation as it applies to transmission. (iv) Know about electromagnetic spectrum and basic terminologies in communication system& different types of communication system. (v) Understand the different sources of noise. (vi) Explain how to measure signal to noise ratio and noise figure and their necessity.	
	(i) Introduction to Communication System: Elements of communication system, need for modulation, electromagnetic spectrum and typical applications, types of communication systems, classification of communication system. (ii) Noise: Introduction, external noise, internal noise, noise figure. KD : 1.1, 1.2, 1.3, 1.4, 1.6, 1.7; 2.1, 2.2, 2.3, 2.4, 2.5	
Unit II	**Amplitude modulation techniques**	**Number of lectures :12**
2	**Learning Objective:** (i) Know the elements of analog communication. (ii) Understand the theory of amplitude modulation techniques. (iii) Explain different approaches for the generation of AM, DSBSC and SSB signals. **Learning Outcomes:** (i) Distinguish between analog and digital communication (ii) List and explain the different elements of analog communication. (iii) Mention different components of AM, DSBSC and SSB wave. (iv) Derive the expression for peak amplitude, instantaneous voltage and total power of AM, DSBSC and SSB wave. (v) Explain the difference between AM, DSBSC and SSB wave. (vi) Describe the AM wave generation process using analog multiplier and diode as non-linear resistor. (vii) Describe the DSBSC wave generation process using analog multiplier and balanced modulator. (viii) Describe the SSB wave generation process using analog multiplier and frequency discrimination methods.	
	(i) Amplitude modulation techniques: Elements of analog communication, Amplitude modulation (AM) techniques, Double side band suppressed carrier (DSBSC) technique, Single sideband (SSB) technique, Generation of AM signal, Generation of DSBSC signal, generation of SSB signal. KD : 3.1, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.3.	

Unit III	Modulation Techniques	Number of lectures :12
	Learning Objective: (i) Describe the theory of amplitude modulation & generation of frequency modulation. (ii) Understand the difference between continuous wave and pulse analog modulation techniques. (iii) Explain the sampling process, PAM, PWM and PPM techniques. (iv) How to demodulate pulse analog modulated techniques. **Learning Outcomes:** (i) Explain what is the effect of modulating signal amplitude and modulating signal frequency on FM wave?. (ii) Give the differences and similarities between FM and PM. (iii) Describe direct and indirect method of FM generation and its limitations. (iv) Describe the sampling process. (v) Describe the generation & demodulation of PAM, PWM and PPM signals. (vi) Make a comparison between PAM, PWM and PPM modulation schemes	
	(i) Angle modulation techniques: Theory of angle modulation techniques, Generation of frequency modulation (FM and Direct methods) (ii) Pulse modulation techniques: Introduction, Pulse analog modulation techniques -Pulse amplitude modulation, Pulse width modulation, Pulse position modulation, Demodulation of pulse analog modulated signals. KD : 4.1, 4.3.1, 4.3.2, 5.1, 5.2	

References:

(1) KD : George Kennedy, Bernard Davis, S R M Prasanna -Electronic communication systems (6th Ed)

SEMESTER V
Course –DSE-IV
COURSE TITLE: Renewable Energy harvesting
COURSE CODE: 20US5PHREH4
[CREDITS - 02]

Course Outcome:

(1) Describe sources and uses renewable and non-renewable energy.
(2) Provide examples of common types of renewable and non-renewable resources.
(3) Understand and explain general ways to save energy at a personal, community and global level.
(4) Understand and explain, in general how passive solar heating, hydropower and wind power work.
(5) Understand the benefits and disadvantages to using renewable resources.

Course Specific outcome:

(1) Although leaders in this field were aware of the importance of non-conventional sources of energy since 1970, the first Earth Summit. Even then, we have hardly achieved around 20% of power generations by renewable sources, worldwide, by today. To accelerate this process, we need to invoke more understanding about technical and social aspects of renewable energy through the education system.

Unit I	**Introduction**	**Number of lectures :12**
	Learning Objective: (i) Outline and brief description, including fundamentals, of the different renewable energy technologies, wind, solar, bioenergy, hydro, and geothermal energy; (ii) Overview of renewable energy technologies and applications; **Learning Outcomes:** (i) Understand the depth and importance of nonconventional energy (ii) Correlate renewable energy with sustainable development	
1	(i) Introduction: Forms of Energy, Present-day energy use Energy devices and Conversions, Energy problem, Environmental impact, Limitations and side effects of conventional sources, Way towards Sustainable Development Environmental impact of renewable energy sources BO Ch 1.1 – 1.3 , AB Ch 7 (ii) Different ways of generating renewable energies, Solar energy, Wind energy, Tidal energy, Wave energy, Ocean thermal energy conversion, MA Ch 18, RAI Ch 1 (iii) Hydroelectricity, Hydrogen energy, Magneto-hydro dynamic (MHD) power generation: Materials, principle and advantages, Piezoelectric Energy generation, Thermoelectric power: Materials, power generation, applications Thermionic generation of power RAI 11.2 – 11.5, 12.2, 12.5, 12.8, 13.2 – 13.5, 14.2 – 14.4	
Unit II	**Widely used non-conventional energy sources**	**Number of lectures :12**
	Learning Objective: (i) Describe Solar energy harvesting in detail	

2	(ii) Give overview of Wind energy **Learning Outcomes:** (i) Identify strengths and weaknesses of different renewable technologies	
	(i) Solar Energy Introduction, Solar energy collectors, Storage of solar energy, Solar pond, Applications of Solar Energy, Solar Green House, Solar Heater and Cooker Solar cell, Absorption Air Conditioning, Solar Photovoltaic, PV models and equivalent circuits Efficiency calculations RAI 3.2, 3.7-3.8 ; ch 4, ch 5 (ii) Wind Energy Introduction and Historical Background, Designs of windmills, Wind Turbines and electrical machines required for their working, power electronic interfaces and grid interconnection topologies, Applications of wind energy RAI ch 6.2, 6.4-5, 6.7, 6.13, AB ch 2	
Unit III	**Additional non-conventional energy technologies**	**Number of lectures :12**
	Learning Objective: (i) Enable understanding of renewable energy in the broadest terms (ii) Show the strengths and weaknesses of renewable energy technologies **Learning Outcomes:** (i) Provide an overview of the different renewable energy technologies and their applications (ii) Explain the need of renewable energy sources in future and its potential in energy requirements of the world.	
	(i) Ocean Energy Ocean thermal electric conversion (OTEC) power generation, Energy and poser from ocean wave, Basic principles of tidal power, Operation methods for tidal power, Advantages and limitations of tidal power generation (ii) Hydro Electric Energy Components of a hydroelectric system, Turbines and generators, protection and control of the system, Advantages and limitations RAI 9.2 – 9.5, AB Ch 3, Ch 4 (iii) Geothermal Energy Geothermal Resources, Geothermal energy conversion, Advantages, disadvantages and applications of geothermal energies AB Ch 5, RAI 8.4, 8.11 – 8.13 (iv) Energy from Biomass Design and maintenance of biogas production, Biomass as source of energy, Advantages and disadvantages of energy from biomass RAI 7.2-7.4, 7.22, 7.25 (v) Chemical energy sources Fuel Cell energy, Design and principle of operation of a fuel cell, types of fuel cells, conversion efficiency and power output, application of fuel cells RAI 10.2	

References:

(1) G. D. Rai, Non-conventional Energy Sources, New Delhi: Khanna Publishers
(2) AB: S. A. Abbasi, (2006), 'Renewable Energy Sources and Their Environmental Impact, 4th Edition, Prentice Hall of India Ref 3 Abbasi
(3) MA: S. E. Manahan, (2007), Environmental Science and Technology: A sustainable Approach to Green Science and Technology, 2nd Edition, Taylor and Francis Group Ref 5 Manahan
(4) BO: Ref 1 Godfrey Boyle, (2012), Renewable Energy, Power for a sustainable future, 3rd edition, Oxford University Press and Open University.
(5) S. P. Sukhatme,(2008), Solar Energy, New York: TMH Publication
(6) Gilbert M. Masters, (2004), Renewable and Efficient Electric Power Systems, Wiley-IEEE Press
(7) Bent Sorensen, (2004), Renewable energy: its physics, engineering, use, environmental impacts, economy, and planning aspects, 3rd Edition, Elsevier Academic Press Andre Brin, (1981), Energy and the Oceans, Ann Arbor Science Publishing Inc.

SEMESTER V
Course –SEC
COURSE TITLE: Mathematical Methods
COURSE CODE: 20US5PHMM7
[CREDITS - 01]

Course Outcome:

(1) Describe sources and uses renewable and non-renewable energy. Students will demonstrate competence with the basic ideas of linear algebra including concepts of linear systems, independence, theory of matrices, linear transformations, bases and dimension, eigenvalues, eigenvectors and Diagonalization.
(2) Use the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients.
(3) Solve a Cauchy problem for the wave or diffusion equations using the Fourier Transform.

Unit I	**Matrices**	**Number of lectures :12**
	Learning Objective: (i) Understand the linear equations, vector spaces, matrices, linear transformations, determinants, Matrices, etc. (ii) Learn to use Laplace transform methods to solve differential equations. (iii) Introduce the Fourier series and its application to the solution of partial differential equations	

1	**Learning Outcomes:** (i) Learn the basic ideas of linear algebra including concepts of linear systems, independence, theory of matrices, linear transformations (ii) Use the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients	
	Matrices: (i) Addition and Multiplication of Matrices. Null Matrices. Diagonal, Scalar and Unit Matrices. Upper Triangular and Lower-Triangular Matrices. (ii) Transpose of a Matrix. Symmetric and Skew-Symmetric Matrices. Conjugate of a Matrix. Hermitian and Skew-Hermitian Matrices. Singular and Non-Singular matrices. (iii) 3. Adjoint of a Matrix. Inverse of a Matrix by Adjoint Method. Orthogonal and Unitary Matrices. Trace of a Matrix. Eigen-values and Eigenvectors. Cayley- Hamilton Theorem. Diagonalization of Matrices	
Unit II	**Fourier and Laplace transforms**	**Number of lectures :12**
2	**Learning Objective:** (i) Describe Solar energy harvesting in detail (ii) Give overview of Wind energy **Learning Outcomes:** (i) Use the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients.	
	(i) Fourier transforms: Introduction, Formal development of the complex Fourier transform, (ii) Cosine and Sine transforms, The transforms of derivatives. (iii) Laplace transforms, Laplace transform of derivatives, Inverse Laplace transform and Convolution theorem.	

References:

(1) Erwin Kreyszig (Wiley Eastern Limited,1985) Advanced Engineering Mathematics
(2) Charlie Harper. (P.H.I., 1995) Introduction to Mathematical Physics
(3) B S Grewal, Khanna Publishers (2000) Higher Engineering Mathematics
(4) H.K.Dass Mathematical Physics.

Evaluation Pattern (Theory):

For each course I, II, III and IV and DSE Course
External Evaluation – Semester End Examination [60 Marks] - Duration : 2 hours
Paper Pattern

Question No.	Module	Marks with Option	Marks without Option
Q.1 (A) Attempt any One/Two	1	08	16
(B) Attempt Three/Four		12	16

Q.2 (A) Attempt any One/Two	2	08	16
(B) Attempt Three/Four		12	16
Q.3 (A) Attempt any One/Two	3	08	16
(B) Attempt Three/Four		12	16

Internal Evaluation: [40 Marks]

Evaluation Type	Marks
Class Test/Online Test	25
Assignment Poster Presentation Field Visit Report Simple Project	15
Project +Presentation + Report writing + Viva OR Chapter Review +Presentation + Report writing + Viva	40

SEMESTER V Practicals
Course-I
COURSE CODE: 20US5PHP1 & 20US5PHP2

Learning Outcomes:

The T. Y. B. Sc. Syllabus integrates the regular practical work with a series of skill experiments. During the teaching and examination of Physics laboratory work, simple modifications of experimental parameters may be attempted. Attention should be given to basic skills of experimentation which include:

(1)Understanding relevant concepts.
(2)Planning of the experiments.
(3)Layout and adjustments of the equipment.
(4)Recording of observations and plotting of graphs.
(5)Calculation of results and estimation of possible errors in the observation of results.

Regular Physics Experiments: A minimum of 8 experiments from each of the course are to be performed and reported in the journal.

Skill Experiments: Minimum 7 skills are compulsory and must be reported in the Journal. Skills will be tested during the examination through viva or Practical.

The certified journal must contain a minimum of 16 regular experiments (8 from each group), & 6 experiments from DSE (any two DSE branch) (Not more than 3experiments/DSE from any group) and 7 Skills in semester V.

A separate index and certificate in journal is must for each semester course.
There will be three turns of three hours each for the examination of practical course

20US5PHP1	20US5PHP2	No.of credits	No.of hours
1) Determination of "g" by Kater's pendulum. 2) Flat spiral spring (Y) 3) Stefan's constant σ 4) Koenig's method 5) R.P. of grating 6) Goniometer 7) Rydberg's constant 8) Edser's A pattern 9) Diameter of lycopodium powder 10) Determination of e/m	1) Mutual inductance by BG. 2) Hysteresis by magnetometer 3) Maxwell's bridge 4) Band gap of energy. 5) Diode as temperature sensor. 6) Log amplifier using OPAMP 7) Wien bridge oscillator 8) Hall effect 9) LM-317 as voltage regulator 10) LM 317 as current regulator 11) M/C using BG 12) Capacitance bridge using series bridge	02	4 periods of 50 minutes

Skills (Minimum 7 experiments)

(1) Estimation of errors.
(2) Soldering advanced circuit.
(3) Bread board circuit using IC's.
(4) Optical Levelling of Spectrometer.
(5) Laser beam profile.
(6) Use of electronic balance: radius of small ball bearing.
(7) Dual trace CRO: Phase shift measurement.
(8) BG: C1 /C2 by comparing θ1 / θ2.
(9) Designing of simple experiments

SEMESTER V Practicals
Course-DSE I
COURSE CODE: 20US5PHP1

1) Thermistor as sensor in temperature to voltage converter using OPAMP (C&D Ch.8)
2) Basic Instrumentation Amplifier using 3 Op Amps coupled to resistance bridge (C&D Ch.8

3) Study of LVDT characteristics (K Ch. 13)
4) Study of Load Cell / Strain Guage (K Ch. 13)
5) UJT Oscillator Circuit.
6) Adjustable Voltage Regulator using LM 317.(C&D Ch 14)
7) Adjustable constant Current Source using LM 317. .(C&D Ch 14)

Course-DSE 2
COURSE CODE: 20US5PHP2

Note: All the experiments should be performed on breadboard

1) Temperature to frequency Conversion using 555 timer. (C &D Ch. 13)
2) OPAMP ---D/A Converter weighted resistor / Ladder network (M & L Ch. 12)
3) Shift Resister
4) Study of 8:1 Multiplexer (74LS151) and its applications.(RPJ)
5) Study of1: 4 De-multiplexer (74LS155) and its applications.(RPJ)

Course-DSE 3
COURSE CODE: 20US5PHP3

1) Amplitude modulation and demodulation by opamps
2) Pulse amplitude Modulation
3) Pulse width modulation
4) Frequency Modulation and demodulation by IC 555
5) Balance modulator
6) Time division multiplexer

Course-DSE 4
COURSE CODE: 20US5PHP4

DSE 3

1) Study of IV characteristics of PV cell
2) Study the effects of series and parallel combination of PV cells with a load
3) Observe the Effects of Power Production from Sun with Different Angles
4) Developing electronic circuit as a sun tracker system
5) Study the effect of coloured filters on the output of PV cell
6) Study of IV characteristics of vertical wind turbine (lab scale)

References:

(1) H & C : Albert D. Helfrick & William D. Cooper Modern Electronic Instrumentation & Measurement Techniques (PHI)

Edition

(2) C & D : Coughlin & F. F. Driscoll :"OPAMPs and linear integrated circuits" (6thedition PHI)

(3) G: R.A. Gayakwad: OPAMPs and linear integrated circuits (4th edition, PHI)

(4) M : A. P. Malvino: "Electronic Principles" (6th edition, PHI)

(5) K : H. S. Kalsi: Electronic Instrumentation (TMH) 2nd Edition

(6) M & L : Malvino and Leach: Digital Principle and Applications" (5th edition, TMH)

(7) 7. RPJ : R .P. Jain: Modern Digital Electronics 3rd edition (TMH)

Evaluation pattern:

(i) No internal evaluation in practical

(ii) External evaluation: ---- practical examination at the end of each semester per course.

SEMESTER VI
Course – I
COURSE TITLE: Classical Mechanics
COURSE CODE: 20US6CM1
[CREDITS - 02]

Course outcome:

This Course Enables the Student

(1) To distinguish between 'inertia frame of reference' and 'non-inertial frame of reference'.
(2) To know how to impose constraints on a system in order to simplify the methods to be used in solving physics problems.
(3) To know what central, conservative and central-conservative forces mathematically understand the conservative theorems of energy, linear momentum and angular Momentum.
(4) To know the importance of concepts such as generalized coordinates and constrained motion.
(5) To establish that Kepler's laws are just consequences Newton's laws of gravitation and that of motion.
(6) To understand Poisson brackets, understand canonical transformations.
(7) To find the linear approximation to any dynamical system near equilibrium and also know how to derive and solve the wave equation for small oscillations.

Unit I	**Accelerated Frames**	**Number of lectures :12**
1	**Learning Objective:** (i) This course enables the student to distinguish between 'inertia frame of reference' and 'non-inertial frame of reference' **Learning Outcomes:** Learners will learn about (i) Central, conservative and central-conservative forces mathematically understand the conservative theorems of energy (ii) Foucault pendulum theory.	
	(i) Motion under a central force, The central force inversely proportional to the square of the distance, Elliptical orbits. The Kepler problem (ii) Moving origin of co-ordinates, Rotating co-ordinate systems, Laws of motion on the rotating earth, Larmor's theorem (with proof), Foucault pendulum (Qualitative discussion and problems. KRS : Art. 3.13 to 3.16 , KRS : Art. 7.1 to 7.5	
Unit II	**Lagrange's Mechanics**	**Number of lectures :12**
2	**Learning Objective:** (i) The course enables the student information about Lagrange's equations & D'Alembert's principle **Learning Outcomes:**	
	(i) Lagrange's equations: D'Alembert's principle, Generalized coordinates, (ii) Lagrange's equations using D'Alembert's principle, Examples, Systems subject to constraints, Examples of systems subject to constraints,	

	Constants of motion and ignorable coordinates. G : Art 1.2 – 1.6	
Unit III	**Kinematics of moving fluids & Rigid Body**	**Number of lectures :12**
	Learning Objective: This course enables the student to (i) Kinematics of moving fluids, ideal fluid (ii) Conservation laws for fluid motion. **Learning Outcomes:** (i)	
	(i) Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow. (ii) The rotation of a Rigid body : Motion of a rigid body in space, Euler's equations of motion for a rigid body, Euler's angles KRS : Art. 8.6 to 8.9 ; KRS : Art. 11.1, 11.2, 11.4, 11.5	

References:

(1) KRS : Keith R. Symon Mechanics :. (Addision Wesely) 3rd Ed.
(2) G, Herbert Goldstein Classical Mechanics : (Narosa 2nd Ed.)
(3) Daniel Kleppner & Robert Kolenkow. An Introduction to Mechanics :, Tata Mc Graw Hill (Indian Ed. 2007) Author, I. N. (Year). Title of book. Location: Publisher.

SEMESTER VI
Course – II
COURSE TITLE: Electronics
COURSE CODE: 20US6PHE2
[CREDITS - 02]

Course outcome:
The course will provide the students about the
(1) Advance electronic Circuits as multivibrators & Timer
(2) An important information about the optoelectronic devices.
(3) Design Non-Sinusoidal oscillations (Square wave and ramp oscillatory circuits)
(4) It will give the knowledge of switching circuit. .

Unit I	**Multivibrators & Timer**	**Number of lectures :12**
	Learning Objective: (i) The study of semiconductor devices makes the base of student in the electronic field. (ii) Understand Timer and multivibrators can be used for many applications	

1	**Learning Outcomes:** (i) Learner will gain basic knowledge about different types of multivibrators. (ii) Timer circuit & its applications	
	(i) Transistor Multivibrators: Transistor as a Switch Astable, Monostable and Bistable Multivibrators, Schmitt trigger. (ii) 555 Timer: Block diagram, Monostable and Astable operation (with VCO), triggered linear ramp generator. MB : Art. 13.1 to 13.9, 14.1, 14.2, 14.4, 14.6, 15.6, 15.7 VKM : Art. 20.1 to 20.10, 21.1 to 21.6, 21.8, 21.9, 21.10. VKM : Art 7.7 to 7.11	
Unit II	**Differential Amplifier**	**Number of lectures :12**
2	**Learning Objective:** (i) Analyse the differential amplifier circuits (ii) Different applications of operational amplifier. **Learning Outcomes:** (i) Understand the external circuit of differential amplifier& its ideal characteristics. (ii) Applications of operational amplifier.	
	(i) Differential Amplifier using transistor: The Differential Amplifier, DC and AC analysis of a differential amplifier, Input characteristic-effect of input bias, offset current and input offset voltage on output, common mode gain, CMRR. (ii) Op Amp Applications Introduction, Log amplifier, First order Active filters, Instrumentation Amplifier ,Band pass Filters, band rejection filter .Square wave &Triangular wave generator using Op-Amp MB : Art 17.1 to 17.5. KVR : Art. 14.5.2.1, 14.5.2.5, 14.5.2.6, 14.5.4.1. MB : Art. 20.5, 20.8, 21.4, 22.7, 22.8, 23.2. MH : 16.14. G: 7.1, 7.2, 7.4, 7.6, 7.7, 7.8, 7.8.1, 7.9.1 & 7.9.2	
Unit III	**Field effect transistors**	**Number of lectures :12**
3	**Learning Objective:** (i) Describe the theory of JFET,MOSFET. (ii) Use the theory to develop various application using FET **Learning Outcomes:** (i) Understand the external circuit of Field effect transistors and their applications.	
	(i) Field effect transistors(JFET): Basic ideas, Drain curve, The transconductance curve, Biasing in the ohmic region and the active region, Transconductance, JFET common source amplifier, JFET analog switch multiplexer, voltage controlled resistor, Current sourcing.	

	(ii) MOSFET : Depletion and enhancement mode, MOSFET operation and characteristics, digital switching MB : Art. 23.7 to 23.9. ML : Art. 6.2, 6.4, 6.6, 6.7, 7.2 to 7.4.

References:

(1) MB : A. P. Malvino and D.J. Bates Electronic Principles (7th Ed.) – (TMH).
(2) VKM : V. K. Mehta and Rohit Mehta Principles of Electronics . (11th Ed.). S. Chand Publications
(3) KVR : K .V. Ramanan Functional Electronics
(4) G: R. A. Gayakwad,(4th Edition, PHI) OPAMPs & linear integrated circuits :
(5) S. Salivahanan, N. Suresh Kumar and A. Vallavaraj. (2nd Ed.)Electronic Devices and Circuits (Tata McGraw Hill)
(6) Millman & Taub Pulse, Digital & Switching Waveforms

SEMESTER VI
Course –III
COURSE TITLE: Nuclear Physics
COURSE CODE: 20US6PHNP3
[CREDITS - 02]

Course outcome:

(1) Explain the different types of nuclear reaction with relevant examples.
(2) Derive the Q value equation of typical scattering type reaction.
(3) Explain the Alpha decay using Gamow theory
(4) Explain the energetic of Beta and Gamma Decay.
(5) Explain various nuclear radiation detection techniques.
(6) Derive Semi Empirical mass formula and will learn its applications.

Unit I	**Nuclear Reactions & Alpha Decay**	**Number of lectures :12**
	Learning Objective: (i) Differentiate between types of nuclear reactions. (ii) Illustrate types of reactions with suitable examples. (iii) Derive energetic of alpha decay based on conservation principals. (iv) Derive Gamow theory of alpha decay. (v) Define range, ionization, stopping power. **Learning Outcomes:** (i) Solve Q values for various nuclear reaction. (ii) Derive Q value for scattering type reaction based on momentum conservation. (iii) Construct decay scheme for long and short range alpha particles.	

1	(iv) Derive expression for tunneling probability using Gamow theory. (v) Explain the alpha decay paradox.	
	(i) Types of Nuclear Reactions, Balance of mass and energy in Nuclear Reaction, the Q-equation and Solution of Q-equation. (ii) Alpha decay: Range of alpha particles, Disintegration energy, Alpha decay paradox: Barrier penetration (Gamow's theory of alpha decay and Geiger-Nuttal law),Absorption of alpha particles: Range, Ionization and stopping power P : 3.1 to 3.5. K : 8.5, 9.5 P : 4. II. 1, 4. II. 2, 4. II. 3, 1.II.3 K : 13. 1, 13.2, 13.5.	
Unit II	**Beta and Gamma decay**	**Number of lectures :12**
2	**Learning Objective:** (i) Explain the continuous nature of beta spectrum & energetic of beta decay. (ii) Explain Pauli's neutrino hypothesis. (iii) Understand types of gamma decay w. (iv) Explain the Mossbauer effect. **Learning Outcomes:** (i) Explain the continues and characteristics beta spectrum and appeared contradiction in it about conservation of energy. (ii) list the properties of neutrino.& construction of assembly in the detection of neutrino. (iii) Solve problems based on the energetic of beta decay. (iv) Explain Gamma decay and internal conversion. (v) Applications of Mossbauer effect.	
	(i) Beta decay: Introduction, Continuous beta ray spectrum-Difficulties encountered in it, Pauli's neutrino hypothesis, Detection of neutrino, Energetic of beta decay. (ii) Gamma decay: Introduction, Internal conversion, Nuclear isomerism, Mossbauer effect. P : 4.I.2, 4.I.3, 4. III. 1, 4. III. 2, 4. III. 3, 4. III. 5 K : 14.1, 14.7 G : 5.5. P : 4. IV. 1, 4. IV. 3, 4. IV. 4, 9.4.	
Unit III	**Nuclear Models**	**Number of lectures :12**
	Learning Objective: (i) Differentiate between types nuclear radiation detectors (ii) Explain principle of operation and construction of nuclear radiation detectors (iii) Derive semi empirical mass formula. (iv) Draw mass parabolas to predict stability against beta decay. (v) Derive stability limits against spontaneous fission.	

	Learning Outcomes: (i) Derive and apply semi-empirical mass formula to find most stable odd A isobar. (ii) Describe mass parabolas to predict stability against beta decay. (iii) Explain the concept of mirror nuclei. (iv) Explain Nuclear radiation detectors. (v) Explain principle of operation of scintillation counter.
	(i) Nuclear radiation detectors: Proportional counter, Scintillation counter, Ionization chamber, Proportional and GM counter. (ii) Liquid drop model, Weizsacher's semi-empirical mass formula, Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. mirror nuclei P : 1. I. 3 K : 2.8. P : 5.1, 5.3, 5.4, 5.5.

References:

(1) AB : Arthur Beiser: Concepts of Modern Physics : (6th Ed.) (TMH).
(2) P : S.B. Patel Nuclear Physics: (Wiley Eastern Ltd.).
(3) K : Irving Kaplan : Nuclear Physics: (2nd Ed.) (Addison Wesley).
(4) G : S. N. Ghoshal : Nuclear Physics : (S. Chand & Co.)
(5) Kenneth Krane (2nd Ed.) John Wiley & Sons. Modern Physics
(6) N Subrahmanyam, Brij Lal. Atomic & Nuclear Physics (Revised by Jivan Seshan.) S. Chand.

SEMESTER VI
Course –IV
COURSE TITLE: Special Theory of Relativity
COURSE CODE: 20US6PHSTR4
[CREDITS - 02]

Course Objective:

This course introduces students to the concepts of special theory of relativity

Course outcome:

(1) Explain the basics of frames of reference and Einstein's concept of space and time.
(2) Appreciate the significance of experimental evidence to establish any theory.
(3) Apply the various transformation equation between frames of reference.
(4) Solve problems based on the various concept s of special theory of relativity.

Unit I	**Experimental background of special theory of relativity**	**Number of lectures :12**
1	**Learning Objective:** **Learning Outcomes:** (i) Understand the significance of frames of reference and Michelson Morley experiment. (ii) State the postulates of special theory of relativity.	
	(i) Galilean transformations, Attempts to locate absolute frame: Michelson-Morley experiment, (ii) Attempts to preserve the concept of a preferred ether frame: Forentz fitzgerald contraction hypothesis and ether drag hypothesis, (iii) Attempt to modify electrodynamics, postulates of the special theory of relativity. RR: 1.1, 1.2, 1.3, 1.5 to 1.9	
Unit II	**Relativistic Kinematics, Relativistic Dynamics**	**Number of lectures :12**
2	**Learning Objective:** **Learning Outcomes:** (i) Derive the Lorentz transformation equations. (ii) Apply the transformation equations to arrive at transformation properties of momentum, energy, mass	
	Relativistic Kinematics: (i) The relativity of Simultaneity, (ii) Derivation of Lorentz transformation equations, length contraction, time dilation and meson experiment, (iii) The relativistic addition of velocities RR: 2.1 to 2.8 Relativistic Dynamics: (iv) Mechanics and Relativity, Relativistic momentum, Alternative views of mass in relativity, (v) The relativistic force law and the dynamics of a single particle, The equivalence of mass and energy, (vi) The transformation properties of momentum, energy and mass.	

	RR: 3.1 to 3.7	
Unit III	**Relativity and Electromagnetism , The Geometric Representation of Space-Tim**	**Number of lectures :12**
	Learning Objective: **Learning Outcomes:** (i) Apply the transformation equations for electric and magnetic fields (ii) Represent the concept of simultaneity, length contraction and time dilation through space time diagrams	
	Relativity and Electromagnetism (i) The interdependence of Electric and Magnetic fields, The Transformation for E and B, The field of a uniformly moving point charge, Force and fields near a current-carrying wire, Force between moving charges, the invariance of Maxwell's equations. RR: 4.1 to 4.7 The Geometric Representation of Space-Time: (ii) Space-Time Diagrams, Simultaneity, Length contraction and time Dilation, twin paradox RR: Supplementary topics A1-2, B1-3	

References:

(1) Robert Resnick (Wiley Student Edition) Introduction to Special Relativity : Reprint 2010, New Delhi
(2) W.W.Nortan and Company First Ed (1968)Special Relativity, A P French, MIT,

SEMESTER VI
Course –DSE-I
COURSE TITLE: 8085 microprocessor architecture, programming and applications
COURSE CODE: 20US5PHMP1
[CREDITS - 02]

Preamble:

The aim of the course is to make students familiar to the 8085 microprocessors. This course also emphasizes on the architecture and designing programs using assembly language programming.

Course Outcome:

(1) Describe the general architecture of a microcomputer system and architecture and organization of 8085.
(2) Understand and classify the instruction set of 8085 microprocessor and distinguish the use of different instructions and apply it in assembly language programming.
(3) Will be able to use advanced programming techniques.

Course Specific outcome:

(1) To familiarize with 8085 microprocessor and learn assembly language programming
(2)

Unit I	**Basic concepts of microprocessor**	**Number of lectures :12**
1	**Learning Objective:** (i) To learn the fundamentals of microprocessor **Learning Outcomes:** (i) Will be able to identify various components of a microprocessor. (ii) Will be able to list the four operations of microprocessor. (iii) Will be able to recognize the functions of various pins of the 8085 microprocessor.	
	(i) Microprocessors, microprocessor instruction set and computer languages. (ii) Microprocessor architecture and its operations, the 8085 microprocessor, microprocessor communication and bus timings, a detailed look at the 8085 MPU and its architecture, 8085 machine cycles and bus timings. (RG: 1.1,1.2,2.1,3.11,3.12,3.15,3.21,3.22,3.23)	
Unit II	**Introduction to 8085 assembly language programming**	**Number of lectures :12**
2	**Learning Objective:** (i) To learn assembly language programming **Learning Outcomes:** (i) Will be able to explain various functions of registers. (ii) Will be able to classify the instructions. (iii) Will be able to recognize the addressing modes of the instructions. (iv) Will be able to draw the flowchart and write simple programs. (v) Understand the differences between theoretical, practical & simulated results in integrated circuits.	
	(i) 8085 programming model, instruction classification, instruction and data format, addressing modes, simple programs. (RG: 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.4, 6.5)	
Unit III	**Programming techniques**	**Number of lectures :12**
	Learning Objective:	

	(i) To learn various programming techniques. **Learning Outcomes:** (i) Will be able to use the technique of looping. (ii) Will be able to write instructions for delay time. (iii) Will be able to use stacks and subroutines
3	(i) Looping, counting and indexing, additional arithmetic and data transfer instructions, arithmetic operations related to memory, logical operation rotate, logical operation compare, counters and delays, stack, subroutine. (RG:7.1,7.2,7.3, 7.4, 7.5, 8.1, 9.1, 9.2)

References:

(1) Gaonkar R.S. (1989), Microprocessor architecture, programming and applications with 8085,4th edition, Penram International Publishing (India) Pvt.Ltd. .
(2) B.Ram (2012), Fundamentals of microprocessors and microcontrollers, Dhanpat Rai Publication
(3) Rafiquzzaman M, (2016), Microprocessors, Theory and applications, Pearson publication

SEMESTER VI
Course –DSE-II
COURSE TITLE: C PROGRAMMING
COURSE CODE: 20US6PHCP2
[CREDITS - 02]

Preamble- The computer is often a very handy tool when solving complex problems in scientific explorations. Programming a computer is a fundamental task in finding solutions to such problems. This course is being offered in order to train the students in the fundamentals of programming.

Course Outcome:

(1) Identify and abstract the programming task involved for a given a computational problem.
(2) Approach the programming tasks using techniques learned and write the pseudo-code.
(3) Write the C code for a given algorithm.
(4) Write the C program on a computer, edit, compile, debug, correct, recompile and run it.

Unit I	**Introduction to Computers, C Programming**	**Number of lectures :12**
	Learning Objective: (i) Student will learn the fundamental of hardware, software, operating	

	systems, programming, problem solving, and software engineering. (ii) Student will also learn the components of programs, such as key words, variables, operators, and punctuation. **Learning Outcomes:** (i) Student will able to create simple programs with the understanding of basic input, processing, and output structure	
1	(i) Fundamentals of Computing, Computer Systems: Hardware and Software Programs and Programming Languages, Pseudo-code and flowcharts. Memory, Variables, Values, Instructions, Programs Input, Processing, and Output. The steps in the Programming Process. (ii) Getting Started with C, The C Character Set, Constants, Variables and Keywords. The First C Program, Compilation and Execution, Receiving Input, C Instructions, Type Declaration Instruction, Arithmetic Instruction, Integer and Float Conversions.	
Unit II	**Control Structures in C programming**	**Number of lectures :12**
2	**Learning Objective:** (i) Student will learn different control structures C programming. **Learning Outcomes:** (i) Student will able to use the different control structures for problem solving.	
	(i) Control Structures :- Decision making structures, If, if-else, switch Loop Control structures (ii) While, do-while, for Nested structures break and continue, Arrays :- Array Initialisation (iii) Strings as array of characters, string Library functions.	
Unit III	**Functions and pointers in C programming**	**Number of lectures :12**
	Learning Objective: (i) Student will understand functions in C , it's declaration and uses and also the concept of pointers. **Learning Outcomes:** (i) Student will able to understand how to write and use functions. Also student will able to use the pointer to implement function calls, and parameter passing options	
	(i) Functions: The prototype declaration, Function definition. (ii) Function call: Passing arguments to a function, by value, by reference. Scope of variable names. Recursive function calls, Tail recursion. Analysing recursion, Tree of recursion, linear recursion. (iii) Pointers : Pointer variables. Declaring and dereferencing pointer variables.	

References:

(1) Tony Gaddis (2015) Starting out with C++ Addison Wesley Publication Company

(2) Yashwant Kanetkar (2016) Let us C INDIA : BPB Publications
(3) E. Balguruswamy (2019) Programming in ANSI C India Tata Mc-Graw Hill

SEMESTER V
Course –DSE-III
COURSE TITLE: Applied Optics
COURSE CODE: 20US6PHAO3
[CREDITS - 02]

Unit I	**Light transportation system. Geometrical optics**	**Number of lectures :12**
	Learning Objective: (i) Determine the path of light using ray tracing method (ii) Design the simple lens system for magnified image. (iii) Design optical system to propagate light beam. **Learning Outcomes:** (i) Know the working principle of optical fiber. (ii) Discuss various application of optical fiber. (iii) Select optical sources and detectors to design fiber optics based system. (iv) Learning Outcome: after compilation of this module student should able to understand and design various light propagation system and image formation for various applications. (v) Introduction to Integrated Optics.	
1	Ray Optics (i) Various components of geometrical optics: mirrors, lenses, prism, polarizer, wave plate, grating. (ii) Image formation using lenses, Combination of lenses, focal and cardinal points of lenses, (iii) Working principal of basic optical instruments: microscope, telescope . Optical fibers (iv) Review of Light transmission through optical fiber, types of optical fiber, (v) Optical sources and detectors used for optical fiber, (vi) Losses in optical fiber, application in commutation, (vii) Optical fiber as sensors, integrated optics	
Unit II	**Modern Optics**	**Number of lectures :12**
	Learning Objective: (i) Able to measure/ calculate various parameters of light sources/ laser source. (ii) Make selection of proper source based on application. (iii) Introduction to nonlinear optics (iv) Various techniques of holography.	

2	(v) Able to design system to record simple hologram **Learning Outcomes:** (i) After compilation of this module student should able to use the laser as a tool for various application.	
	Laser and its application (i) Review of working principle of Laser, Laser beam characteristic. (ii) Types of lasers based on active medium, CW and pulsed laser, laser pulse compression techniques, Selection parameters of lasers for various application, laser material processing/interaction, (iii) Applications in industrial, research and medical field, laser safety. Ref---Hecht:13.1.2; KN:4.7-4.11,4.14, KN: part B ch 1,2.3,2.5,2.6,7.2,7.5 Non linear Optic (iv) Introduction, Photon addition, harmonic generation, frequency mixing (optical parametric oscillator) Hecht:13.4	
Unit III	**Optical techniques for material characterization**	**Number of lectures :12**
	Learning Objective: (i) Know spectroscopy techniques and evaluate some basic samples using these techniques. (ii) Application of interference and diffraction principles. (iii) State and compare properties of various optical sources and detectors (iv) Develop skill to design the spectroscopy system for laboratory application. **Learning Outcomes:** (i)	
	Optical techniques for material characterization (8 lectures) (i) Absorption and transmission spectroscopy, UV-VIS-IR spectrometer, measurement of absorption/ transmission for samples Emission spectroscopy, application of diffraction (XRD) application of interference, interferometer in gravitational wave detection.(LIGO) Opto-electronics: (ii) Optical sources: characteristics of optical sources, gas vapour lamps, flash lamp, led, lasers, and source selection. (iii) Optical sensors: basic principles of semiconductor detectors, thermal detectors, photo diodes, photo transistor photo-multipliers solar cells (PV module), CCD.	

References:

(1) Brij Lal, M N Avadhanulu & N Subrahmanyam(2012): A Text Book of Optics, 25/e: S.Chand Publication
(2) Ghatak Ajoy (2005): Optics 3/e : Ajoy Ghatak: Tata McGraw-Hill Education
(3) Hecht E (2008): Optics 4/e : Pearson Education; 4 edition (2008)

(4) Nambiar K. R. (2004) : Lasers: Principles, Types and Applications: New age Publication
(5) Nagabhushana S (2010) Lasers and Optical Instrumentation: I. K. International Pvt Ltd
(6) Khangaonkar P R (2008) An Introduction to Material Characterization : Penram intl. Publishing

SEMESTER VI
Course –DSE-IV
COURSE TITLE: SWAYAM
COURSE CODE: 20US6PHSW4
[CREDITS - 02]

Available SWAYAM COURSE during semester

SEMESTER VI
Course –SEC
COURSE TITLE: Electrical circuits and Network skills
COURSE CODE: 20US6PHECNS7
[CREDITS - 01]

Course Outcome:
(1) .

Unit I	**Introduction to Basic Electricity Principles**	**Number of lectures :12**
1	**Learning Objective:** (i) Outline and brief description, including fundamentals, of the different type of circuits and respective networks; (ii) Overview of electrical circuits and applications **Learning Outcomes:** (i) Design and analyze the electrical circuits, networks and appliances.	
	Basic Principles (2L) (i) Ohm's law. Series, parallel, and series-parallel combination. AC electricity and DC electricity. Familiarization with Multimeter, voltmeter and ammeter. Description of electrical circuits (3L) (ii) Main electric circuit elements and their combination. Rules to analyze DC source electrical circuits. Current and voltage drop across the DC circuit and elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Electrical Drawing and symbols (2L) (iii) Drawing symbols. Reading of circuit schematics & electrical schematics. Power and control circuits. Tracking the connections of elements and	

	identify current flow and voltage drop. Generators and Transformer (2L) (iv) DC power sources. AC/DC generators, Inductance, Capacitance and Impedance. Introduction of transformer.	
Unit II	**Application and Protection of Electrical Circuits**	**Number of lectures :12**
2	**Learning Objective:** (i) Brief description of the electrical appliances with AC or DC sources; (ii) Fundamental description of active and passive components of electrical circuits. **Learning Outcomes:** (i) Monitor the devices with their specific properties. (ii) Protection of the electrical components and circuits	
	Electric Motors (4L) (i) Single-phase, three-phase and DC motors. Basic design. Interfacing DC or AC sources to control heater & motors. Speed and power of AC motor. Solid- State Devices (3L) (ii) Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of Inductors and capacitors with DC or AC sources. Electrical Protection (2L) (iii) Relays, Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolatin	

References:

(1) B.L. Theraja A text book in electrical technology– S Chand & Co.
(2) A.K. Theraja.A text book of electrical technology –

Evaluation Pattern (Theory):

For each course I, II, III and IV and DSE Course
External Evaluation – Semester End Examination [60 Marks] - Duration : 2 hours
Paper Pattern

Question No.	Module	Marks with Option	Marks without Option
Q.1 (A) Attempt any One/Two	1	08	16
(B) Attempt Three/Four		12	16
Q.2 (A) Attempt any One/Two	2	08	16
(B) Attempt Three/Four		12	16
Q.3 (A) Attempt any One/Two	3	08	16
(B) Attempt Three/Four		12	16

Internal Evaluation: [40 Marks]

Evaluation Type	Marks
Class Test/Online Test	25
Assignment Poster Presentation Field Visit Report Simple Project	15
Project +Presentation + Report writing + Viva OR Chapter Review +Presentation + Report writing + Viva	40

SEMESTER V - Practicals
Course-I
COURSE CODE: 20US5PHP1 & 20US5PHP2

Learning Outcomes:

The T. Y. B. Sc. Syllabus integrates the regular practical work with a series of skill experiments. During the teaching and examination of Physics laboratory work, simple modifications of experimental parameters may be attempted. Attention should be given to basic skills of experimentation which include:

(1)Understanding relevant concepts.
(2)Planning of the experiments.
(3)Layout and adjustments of the equipment.
(4)Recording of observations and plotting of graphs.
(5)Calculation of results and estimation of possible errors in the observation of results.

(i) **Regular Physics Experiments:** A minimum of 8 experiments from each of the course are to be performed and reported in the journal.

(ii) **Demonstration Experiments:** The demonstration experiments are to be performed by the teacher in the laboratory and students should be encouraged to participate and take observation wherever possible. Demonstration experiments are designed to bring about interest and excitement in Physics. Students are required to enter details of these 'demo' experiments in their journal.

(iii) The certified journal must contain a minimum of 16 regular experiments (8 from each group), & 6 experiments from DSE (any two DSE branch) (Not more than 3experiments/DSE from any group) and 7 demonstration experiments in semester VI.

(iv) A separate index and certificate in journal is must for each semester course.

(v) There will be three turns of three hours each for the examination of practical course

20US6PHP1	20US6PHP2	No.of credits	No.of hours
1) Lee's method for thermal conductivity 2) Quincke's method for surface tension of Mercury 3) Flat spiral spring (η) 4) R.P. of prism 5) Lloyd's mirror 6) Double refraction 7) FET characteristics 8) UJT characteristics 9) SCR characteristics 10) Photodiode and phototransistor characteristics 11) Y by flexural method 12) Determination of wavelength of a laser using diffraction grating.	1) M/C using B.G. 2) Capacitance by using series bridge. 3)Transistorized Astable MV 4)Transistorized Bistable MV 5)Transistorized Monostable MV 6) Trigger using OPAMP. 7) IC555 Timer Astable MV 8) IC 555 Timer as Monostable MV 9) IC 55 Timer as ramp generator. 10) Counters mod 2, 5, 10. 11) Square & Triangular wave generator using Op-amp 12)OPAMP as monostable /astable using breadboard 13).Op-Amp Instrumentation amplifier	02	4 periods of 50 minutes

Demonstration (Minimum 7 experiments)

(1) Open CRO, Power Supply, and Signal Generator: Discuss block diagram.

(2) Data sheet reading for diodes, Transistor, Op amp and Optoelectronic devices.

(3) Circuit designing – single stage amplifier, Transistor Multivibrator etc. and testing on breadboard.

(4) Equation solver.

(5) Amplitude Modulation.

(6) Frequency Modulation.

(7) Millikan's oil drop experiment.

(8) Zeeman Effect.

(9) Michelson's interferometer.

(10) Iodine absorption spectra.

(11) Standing waves in liquid using Ultrasonic waves.

(12) PC simulation of 8085.

(13) Use of PC / μP to control real world parameters.

(14) Seven segment display

(15) GM counter

References:

(1) D. Chattopadhya, PC. Rakshit & B. Saha: Advanced course in Practical Physics :

(2) Harnam Singh : BSc Practical Physics: (2001)S. Chand & Co. Ltd.

(3) Samir Kumar Ghosh A Text book of Practical Physics: New Central Book Agency (4rd edition).

(4) C. L. Arora B Sc. Practical Physics : (1st Edition)(2001) S. Chand & Co. Ltd.

(5) C. L. Squires Practical Physics:– (3rd Edition) Cambridge University Press.

(6) D C Tayal University Practical Physics : Himalaya Publication.

SEMESTER VI - Practicals
Course-DSE I
COURSE CODE: 20US6PHPD1

NOTE: The students should be familiar with Keyboard and Display utilities such as READ KEYBOARD, TO DISPLAY ON ADDRESS FIELD, and TO DISPLAY ON DATA FIELD, mentioned in their 8085 μp kit's manual.

1) Write a program using 8085 Microprocessor for Hexadecimal addition and subtraction of two Numbers.
2) Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
3) To perform multiplication of two 8 bit numbers using 8085.
4) To perform division of two 8 bit numbers using 8085.
5) To find the largest / smallest number in an array of data using 8085 instruction set.
6) To write a program to arrange an array of data in ascending and descending order.
7) To write a program to sort the odd/even numbers.
8) To write a program to sort positive/negative numbers.
9) To write a program to transfer a block of data from one memory location to another.
10) To write a program to add series of numbers.

Course-DSE 2
COURSE CODE: 20US5PHPD2

Note: All the experiments should be performed on breadboard

1) Programs based on arithmetic expression,
2) Program based on fixed mode arithmetic.
3) Programs based on conditional statements
4) Programs based on control structures.
5) Programs based on arrays (1-D, 2-D),
6) Programs based on functions
7) Programs based on pointers.

Course-DSE 3
COURSE CODE: 20US5PHPD3

1) Design and study two lens system.
2) Study V-I characteristics of several LEDs / Laser Diode.
3) Study of optical fiber transmission characteristics.
4) Compare diverengence of RED diode and HE-Ne laser.
5) Laser application as Bar code reader.
6) Study of absorption spectrum.

References:

(1) RPJ: R. P. Jain Modern Digital Electronics, 3rd Edition, Tata McGraw Hill.
(2) RG: Ramesh Gaonkar: Microprocessor Architecture, programming and Applications with the 8085, 5th Edition, Prentice Hall of India.
(3) Vibhute and Borole : Microprocessor and Applications, Techmax Publications, Pune.
(4) Gilmore: Microprocessor, Principles & Applications (2nd Ed) TMH
(5) Yashwant Kanetkar (2016) Let us C INDIA : BPB Publication.

Evaluation pattern:

(i) No internal evaluation in practical
(ii) External evaluation: ---- practical examination at the end of each semester per course.

Evaluation pattern for TYBSc. With DSE and Skill enhancement courses

To be implemented from 2020-21

Course	Internal Maximum Marks	Semester End Maximum Marks	Duration of Examination
Core course I	40	60	2 hours
Core course II	40	60	2 hours
Practical course I	--	100	Two sessions
Core course III	40	60	2 hours
Core course IV	40	60	2 hours
Practical course II	--	100	Two sessions
DSE I	40	60	2 hours
DSE II	40	60	2 hours
DSE Practical course	--	100	2 hours
Skill enhancement course	--	100	2 hours