HSNC UNIVERSITY, MUMBAI

SYLLABUS FOR SEM - V & VI

Program: B.Sc

Subject: Physics (Core Course)

(Under the Choice Based Credit System (CBCS) w. e. f the Academic Year 2022-2023)

Preamble:

This syllabus is a part of the B. Sc Program of the Hyderabad and Sind National Collegiate University to be taught in Semesters 5 and 6 in the subject of Physics from the academic year 2022-23 onwards.

Continuing with the tradition of the previous semesters 1, 2, 3 and 4, this syllabus too aims to impart skills, training and knowledge which will enhance the thinking and application capabilities of the Learner.

Also, the detailed syllabus in each theory course is designed as a continuum to the existing First and Second Year syllabi of the Program.

The theory courses of semesters 5 and 6 - Elements of Modern Physics, Thermodynamics, Electrodynamics, Solid State Physics, Electronics, Statistical Mechanics and Quantum Mechanics are designed to provide a strong foundation in core areas of the subject.

A theory course in the programming language – Python is included in semester 6 with the aim to provide a sound knowledge of the language primarily directed towards its applications in Physics.

As with the Practical courses of the earlier semesters this syllabus too maintains a corelation with the theory courses thus giving the learner an immediate exposure to experiential learning.

Objectives:

1. The primary objective of the syllabus is to impart skills, training and knowledge to enhance the thinking and application capabilities of the Learner.
2. The design of the syllabus maintains a continuum with the courses taught in the lower semesters so as to provide a strong foundation in core areas of the subject.
3. Since digital technology has permeated every aspect of life it became imperative to include a related course closely associated with Physics and with this aim the programming language Python is included among the theory courses.
4. The syllabus also introduces the Learner to the software – SciLab which will enable him to simulate many phenomena of Physics which are not easily experienced.
5. Some topics are earmarked for self-learning which will encourage the Learner to become an independent thinker and the evaluation method for this component will enable him to learn to deftly use technology as well strengthen the soft skills of effective communication and team building.

The Scheme of Teaching and Examination is as under:

Third Year - Semester – V

Summary

Sr. No.	Choice Based Credit System	Course Codes	Remarks
1	Core Course	US-TPH-501, US-TPH-502, US-TPH-503, US-TPH-504 US-TPH-P5, US-TPH-P6	

Detail Scheme

Sr. No.	Course Code	Course Title	Periods Per Week					Credit	Seasonal Evaluation Scheme					Total Marks
			Units	S. L.	L	T	P		SLE	CT	TA	Attendance	SEE	
1	US-TPH-501	Elements of Modern Physics	4	20% *	3	1	0	2.5	10	15	10	05	60	100
2	US-TPH-502	Thermodynamics	4	20% *	3	1	0	2.5	10	15	10	05	60	100
3	US-TPH-503	Electrodynamics	4	20% *	3	1	0	2.5	10	15	10	05	60	100
4	US-TPH-504	Solid State Physics	4	20% *	3	1	0	2.5	10	15	10	05	60	100
5	US-TPH-P5	Physics Practical Course 5	-	-	0	0	8	3	-	-	-	-	100	100
6	US-TPH-P6	Physics Practical Course 6	-	-	0	0	8	3	-	-	-	-	100	100
Total Hours / Credit								16	Total Marks					600

***One to two lectures to be taken for CONTINUOUS self –learning Evaluation.**

III Year - Semester – V - Units – Topics – Teaching Hours

S. No	Course Code	Course Unit: Unit No	Course Unit: Topics	Lectures /periods per week	Total No. of lectures/ periods	Credit	Total Marks
1	US-TPH-501	I	Black Body Radiation & Matter Waves	15	60	2.5	100 (60 +40)
		II	Uncertainty Principle & Schrodinger Equation	15			
		III	Energy Eigenvalues and Eigenfunctions & Atomic Nucleus	15			
		IV	Radioactivity, Fission and Fusion Particle Physics	15			
2	US-TPH-502	I	Heat Engines and Refrigerators	15	60	2.5	100 (60 +40)
		II	Entropy, Thermodynamic Potentials	15			
		III	Application of Thermodynamic Potentials, Maxwell's Thermodynamic Relations	15			
		IV	Classical Theory of Radiation, Quantum Theory of Radiation	15			
3	US-TPH-503	I	Dielectric and Magnetic Properties of Matter, Maxwell's Equations, Wave Equation, Poynting Theorem	15	60	2.5	100 (60 +40)
		II	Electromagnetic Waves in Unbounded Media	15			
		III	Electromagnetic Waves in Bounded Media	15			
		IV	Rotatory Polarization, Wave Guides and Optical Fibers	15			
4	US-TPH-504	I	Crystal Structure of Solids	15	60	2.5	100 (60 +40)
		II	Electrical Conduction in Metals	15			
		III	Band Theory of Solids and Superconductors	15			
		IV	Conduction in Semiconductors, Theory of p-n Junctions	15			
5	US-TPH-P5	Practical Course of US-TPH-501 + Practical Course of US-TPH-502		8 lectures per week	72	3	100 (60 + 20 + 20)
	US-TPH-P6	Practical Course of US-TPH-503 + Practical Course of US-TPH-504		8 lectures	72	3	100

			per week			(60 + 20 + 20)

- **Lecture Duration = 50 mins**
- **1 credit = 24 lectures**

- **Curriculum topics with Self-Learning topics** - to be covered through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT.

Course Name: Elements of Modern Physics
Course Code: US-TPH-501

Learning Outcomes:

- Learner will be introduced to quantum theory of light, energy eigenvalues and eigenfunctions, learn about wave particle duality and about radioactive decay, fusion and fission.

Unit	Content	No. of Lectures
I	**Black Body Radiation & Matter Waves:** 1.1 Planck's quantum, Planck's constant and light as a collection of photons, Black body radiation: Quantum theory of light. 1.2 Photo-electric effect and Compton Scattering 1.3 De-Broglie wavelength and matter waves, Davisson-Germer experiment 1.4 Wave packets, Group and phase velocities and relation between them 1.5 Two slit experiments with electrons, probability, wave amplitude, wave functions	**15**
II	**Uncertainty Principle & Schrodinger Equation:** 2.1 Wave-particle duality, Heisenberg's uncertainty principle: Derivation from wave packets impossibility of particles following a trajectory 2.2 Estimating minimum energy of a particle using uncertainty principle, Energy-time uncertainty principle 2.3 Two slit interference experiments with photons, atoms and particles, Linear superposition principle as a consequence. 2.4 Momentum and energy operators, Matter waves and wave amplitude, Born interpretation of the wave function, normalization of the wave function.	**15**

	2.5 Schrodinger equation for nonrelativistic particles, Stationary states, Expectation values of physical observables, probability current densities in one dimension.	
III	**Energy Eigenvalues and Eigenfunctions & Atomic Nucleus:** 3.1 One dimensional infinitely rigid box – energy eigenvalues and eigen functions and normalization 3.2 Finite potential barrier of height V_0, Solutions to Schrodinger equation for $E > V_0$ and $E < V_0$, the concept of tunnelling – the step potential barrier. 3.3 Size and structure of atomic nucleus and its relation with atomic mass number, Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle 3.4 Nature of nuclear force, NZ graph, Liquid drop model: semiempirical mass formula and binding energy, Nuclear shell model and magic numbers	**15**
IV	**Radioactivity, Fission and Fusion & Particle Physics:** 4.1 Radioactivity: stability of nucleus, Law of radioactive decay, Mean life and half life 4.2 Alpha decay, Beta decay: Q-value / energy released, spectrum and Pauli's prediction of neutrino 4.3 Gamma ray emission, Energy-momentum conservation: electron positron pair creation by gamma photons in the vicinity of a nucleus 4.4 Fission and fusion: mass deficit, generation of energy, energy – mass equivalence, Fission: nature of fragments and emission of neutrons, fission yield curves, Nuclear reactor: neutrons interacting with Uranium isotopes, four factor formula. 4.5 Classification of elementary particles and fundamental interactions, conservation laws, symmetries, brief qualitative introduction of Feynman diagram	**15**

Self-Learning topics (Unit wise)

Unit	**Topics**

I	Photo-electric effect and Compton Scattering
II	Wave-particle duality, Heisenberg's uncertainty principle: Derivation from wave packets impossibility of particles following a trajectory
III	Nature of nuclear force, NZ graph
IV	Radioactivity: stability of nucleus, Law of radioactive decay, Mean life and half life

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, Mc-Graw Hill
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata Mc-Graw Hill
3. Introduction to Quantum Mechanics, David J Griffiths, 2005, Pearson Education
4. Quantum Mechanics: Theory and Applications, A K Ghatak and S Lokanathan, 2004, Macmillan
5. Nuclear Physics, Irving Kaplan, 2^{nd} edition, 1954, Addision- Wesley Publishing Company
6. Introduction to Elementary Particles, David Griffiths, 1987, John Wiley and Sons, Inc.
7. Source Book on Atomic Energy, Samuel Glasston, Kieger 1979, Publishing Company

Additional Reference Books:

1. Theory and Problems of Modern Physics, Schaum's Outline, R Gautreau and W Savin, 2^{nd} edition, Tata Mc-Graw Hill Publishing Company Limited
2. Quantum Physics, Berkley Physics, Vol 4, E H Wichman, 1971, Tata Mc-Graw Hill Co

Course Name: Thermodynamics
Course Code: US-TPH-502

Learning Outcomes:

- Learner will learn about heat engines, refrigerators and low-temperature physics, comprehend the basic concepts of thermodynamics, concept of entropy and the associated theorems, thermodynamic potentials and their physical interpretations, Maxwell's thermodynamic relations and classical and quantum theory of radiation.

Unit	Content	No. of Lectures
I	1.1 **Heat Engines and Refrigerators**: Steam Engine: Carnot Cycle with Steam, Rankine Cycle, Otto Cycle, Efficiency of Otto Cycle, Diesel Cycle, Efficiency of Diesel Cycle, Comparison of Otto and Diesel Cycles, Refrigeration and Air Conditioning, Refrigerator: General Principles, Refrigerating Machines – Compression machine: Frigidaire, Working cycle of a vapor compression machine, Absorption Machine, general principle of refrigeration and gas cooling of different gases, Cooling due to adiabatic demagnetization.	**15**

II	2.1 **Entropy:** Concept of Entropy, Clausius Theorem, Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Reversible and Irreversible Cycles. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero. 2.2 **Thermodynamic Potentials:** Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their definitions and properties.	**15**
III	**3.1 Application of Thermodynamic Potentials:** Surface films, Variation of surface tension with temperature. Magnetic work, First and second order phase transitions with examples, Clausius Clapeyron equation and Ehrenfest equations. 3.2 **Maxwell's Thermodynamic Relations**: Derivations and applications of Maxwell's relations, Maxwell's relations: (1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS equations, (4) Joule-Kelvin coefficient for ideal and Van der Waal Gases, (5) Energy equations, (6) Change of temperature during adiabatic process.	**15**
IV	**4.1 Classical Theory of Radiation:** Properties of Thermal Radiation, Prevost's theory of exchange, Detection and measurement of thermal radiation, Blackbody radiation, Pure temperature dependence, Kirchhoff's law, Stefan-Boltzmann law: Thermodynamic proof, Radiation pressure, Wien's Displacement law, Wien's distribution Law, Rayleigh-Jean's law, Ultraviolet catastrophe. **4.2 Quantum Theory of Radiation:**	**15**

	Planck's quantum postulates. Planck's law of blackbody radiation: Experimental verification. Deduction of (1) Wien's distribution law, (2) Rayleigh-Jeans law, (3) Stefan-Boltzmann law, (4) Wien's displacement law from Planck's law.	

Self-Learning topics (Unit wise)

Unit	Topics
I	Diesel cycle, Efficiency of Diesel Cycle, Comparison of Otto and Diesel Cycles
II	Unattainability of Absolute Zero.
III	Surface tension and Variation of surface tension with temperature.
IV	Prevost's theory of exchange, detection and measurement of thermal radiation.

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press.
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill.
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
7. Fundamentals of Statistical and Thermal Physics, Waveland Press, 2009, F. Reif
8. Thermal Physics, B.K. Agrawal, Lok Bharti Publications.

Additional Reference Books:

1. Thermal Physics, A.B. Gupta & H.P. Roy, 2016, Books and Allied (P) Ltd.

Course Name: Electrodynamics
Course Code: US-TPH-503

Learning Outcomes:

- Learner will learn about Maxwell's Equations, Wave propagation in unbounded and bounded media, Rotatory polarization, Wave guides and Optical fibers

Unit	Content	No. of Lectures

I	**Dielectric and Magnetic Properties of Matter, Maxwell's Equations, Wave Equation, Poynting Theorem:** 1.1 Electric field in matter, Polarization, Polarization charges, Electric susceptibility and dielectric constant 1.2 Displacement vector $\vec{D}$, Relations between $\vec{E}$, $\vec{P}$ and $\vec{D}$, Gauss' law in dielectrics 1.3 Magnetization vector $\vec{M}$, Magnetic intensity $\vec{H}$, Magnetic susceptibility and permeability, Relation between $\vec{B}$, $\vec{H}$ and $\vec{M}$ 1.4 Ampere's circuital law, Maxwell's equations, Displacement current, Boundary conditions at interface between different media 1.5 Wave equation, Plane waves in dielectric media, Poynting theorem and Poynting vector, Electromagnetic field energy density and its physical significance, Momentum density and angular momentum density	**15**
II	**Electromagnetic Waves in Unbounded Media:** 2.1 Plane electromagnetic waves in vacuum and in isotropic dielectric medium, Transverse nature of plane electromagnetic waves, Refractive index and dielectric constant, Wave impedance 2.2 Wave propagation through conducting media, relaxation time, skin depth 2.3 Wave propagation through dilute plasma, Electrical conductivity of ionized gases, Plasma frequency, Refractive index, Skin depth, Application to propagation through ionosphere	**15**
III	**Electromagnetic Waves in Bounded Media:** 3.1 Boundary conditions at a plane interface between two media, Reflection and refraction of plane waves at plane interface between two dielectric media – laws of reflection and refraction 3.2 Fresnel's formulae for perpendicular and parallel polarization cases, Brewster's law. 3.3 Reflection and transmission coefficients, Total internal reflection, Evanescent waves, Metallic reflection (normal incidence).	**15**

IV	**Rotatory Polarization, Wave Guides and Optical Fibers:** 4.1 **Rotatory Polarization:** Optical rotation, Biot's law for rotatory polarization, Fresnel's theory of optical rotation, Calculation of angle of rotation, Specific rotation, Lorentz half-shade polarimeter 4.2 **Wave Guides:** Planar optical wave guides, Planar dielectric wave guide, Condition of continuity at interface, Phase shift on total reflection, Eigenvalue equations, Phase and group velocity of guided waves, Field energy and power transmission 4.3 **Optical fibers:** numerical aperture, Step and graded indices (definition only), Single and multiple mode fibers (concept and definition only).	**15**

Self-Learning topics (Unit wise)

Unit	Topics
I	Wave equation, Plane waves in dielectric media
II	Wave propagation through dilute plasma, Electrical conductivity of ionized gases, Plasma frequency, Refractive index, Skin depth
III	Reflection and transmission coefficients, Total internal reflection, Evanescent waves, Metallic reflection (normal incidence)
IV	Single and multiple mode fibers (concept and definition only)

Reference Books:

1. Introduction to Electrodynamics, D J Griffiths, 3rd edition, 1998, Benjamin Cummings
2. Elements of Electromagnetics, M N O Sadiku, 2001, Oxford University Press
3. Introduction to Electromagnetic Theory, T L Chow, 2006, Jones and Bartlett Learning
4. Fundamentals of Electromagnetics, M A W Miah, 1982, Tata McGraw Hill
5. Electromagnetic Field Theory, R S Kshetrimayun, 2012, Cengage Learning
6. Engineering Electromagnetic, William H Hayt, 8th edition, 2012, McGraw Hill
7. Electromagnetic Field Theory for Engineers and Physicists, G Lehner, 2010, Springer

Additional Reference Books:

1. Electromagnetic Fields & Waves, P.Lorrain & D.Corson, 1970, W.H.Freeman & Co.

2. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
3. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press

Course Name: Solid State Physics
Course Code: US-TPH-504

Learning Outcomes:

- Learner will learn about the basics of crystallography, electrical conduction in metals, about band theory of solids, about superconductors, semiconductors and p-n junctions.

Unit	Content	No. of Lectures

I	**Crystal Structure of Solids:** The crystalline state and amorphous state, Basic definitions of crystalline state, basis vectors, lattice points, basis, Unit cell, primitive and non-primitive cells, The fourteen Bravais lattices and seven crystal systems, elements of symmetry, nomenclature of crystal structure and crystal directions, Miller indices and crystal planes, spacing between the planes of the Miller Indices, Examples of simple crystal structures (Sodium chloride, Cesium chloride, Diamond, Zink Sulphide, hexagonal closed packed structure), APF, coordination number, Linear density, planner density, volume density, The reciprocal lattice and X-ray diffraction.	**15**
II	**Electrical Conduction in Metals:** Classical free electron theory of metals, Drawbacks of classical theory, Relaxation time, Collision time, mean free path Quantum theory of free electron, Fermi Dirac statistics, electronic distribution in solids, Density of energy states, Fermi energy, The Fermi distribution function, Heat capacity of electronic gas, Mean energy of electronic gas at 0K, Electrical conductivity from quantum mechanical consideration, Failure of Sommerfeld’s free electron theory, Thermionic emission.	**15**

III	**Band Theory of Solids and Superconductors:** **3.1 Band Theory of Solids:** Bloch theorem, The Kronig-Penney model, 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 **3.2 Superconductors:** Superconductivity, Experimental results of superconductors, critical temperature, critical magnetic field, Meissner effect, Type I and Type II superconductors, London's equation and penetration depth, Isotope effect, Idea of BCS Theory (no derivation)	**15**
IV	**Conduction in Semiconductors, Theory of p-n Junctions:** **4.1 Conduction in Semiconductors:** Electrons and holes in an intrinsic semiconductor, conductivity of a semiconductor, carrier concentrations in an intrinsic semiconductor, Donor and acceptor impurities, charge densities in a semiconductor, Fermi-level in an extrinsic semiconductor, Diffusion, Carrier lifetime, The continuity equation, Hall effect **4.2 Theory of p-n Junctions:** Qualitative theory of p-n junction, p-n junction as a diode, Band structure of open circuit p-n junction, The current component in a p-n junction diode, Quantitative theory of p-n diode current, The Volt-ampere characteristics, Temperature dependance of p-n characteristics, Diode resistance, Space-charge capacitance, Diffusion capacitance	**15**

Self-Learning topics (Unit wise)

Unit	Topics
I	Examples of simple crystal structures (Sodium chloride, Cesium chloride, Diamond, Zink Sulphide, hexagonal closed packed structure)
II	Thermionic emission

III	Distinction between metals, insulators and intrinsic semiconductors, Type I and Type II superconductors
IV	Donor and acceptor impurities, the p-n junction as a diode

Reference Books:

1. Elementary Solid State Physics :Principles and Applications, M. Ali Omer, Pearson, Education 2012
2. Solid State Physics, S.O.Pillai, New Age International Publisher, 6th edition
3. Introduction to Solid state Physics, Charles Kittle, 7th Ed., John Wiley and Sons
4. Solid State Physics, A.J. Dekker, Prentice Hall
5. Material Science, S.L.Kakani and Amit Kakani, New Age International Publisher
6. Electronic Devices and circuitsDevices and circuits, Jacob Millman, Christos C. Halkias and Satyabrata Jit, International Student Edition, Tata McGraw Hill Book , 3rd edition.
7. Electronic Properties of Material, Rolf Hummel, 3rd Ed. Springer

Additional Reference Books:

1. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed. , John Wiley and Sons
2. Physics of Semiconductor Devices, S.M. Sze and Kwok K.Ng., John Wiley and Sons
3. Solid State Electronic Devices, Ben G. Streetman and Sanjay Kumar Banerjee, 7th Ed. Pearson

Course Name: Physics Practical Course 5
Course Code: US-TPH- P5

Learning Outcomes:

- Learner will learn practical aspects of photoelectric effect, correlation between color and wavelength, experimentally determine the values of e/m, specific heat capacity of a liquid, study variation of thermo-emf and surface tension with temperature and about phase transitions and interpretation of cooling curves

CONTENTS **(Practical based on US-TPH-501 and US-TPH-502)**	**No. of Lectures**
1. To study variation of photo current with intensity and wavelength of light 2. To study variation of maximum energy of photoelectrons with frequency of light 3. To determine Planck's constant using LEDs of at least four different colors 4. To determine the value of e/m 5. To study variation of thermo-emf with temperature. 6. To determine specific heat capacity of a liquid using the method of cooling. 7. To study temperature variation of surface tension of a liquid. 8. To study phase transitions and interpretation of cooling curves. 9. To determine specific heat of a liquid using a calorimeter.	4 lectures per Experiment

Reference Books:

1. Engineering Practical Physics, S Panigrahi and B Mallick, 2015, Cengage Learning India Pvt. Ltd
2. Practical Physics, G L Squires, 2015, 4^{th} edition, Cambridge University Press.

3. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Milller (1994), Mc-Graw Hill
4. Electronic devices and circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009,Pearson
5. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
6. Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
7. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
8. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

Note:

1. Minimum 8 experiments are to be performed by the Learner in the Practical Course
2. A record of experiments performed by the Learner must be maintained and it should be regularly checked by the Teacher-in-Charge.

Course Name: Physics Practical Course 6
Course Code: US-TPH- P6

Learning Outcomes:

- Learner will verify Malu's law, determine specific rotation of sugar solution using polarimeter, refractive index of a liquid and glass by various methods, bandgap energy of Germanium, resistivity of a semiconductor with temperature by four probe method and its bandgap energy, Hall coefficient of a semiconductor sample, carrier lifetime of minority carriers, saturation current and ideality factor of a diode and study dependence of radiation on angle using dipole antenna, reflection and refraction of microwaves.

CONTENTS **(Practical based on US-TPH-503 and US-TPH 504)**	No. of Lectures
1. To verify Malu's law for plane polarized light 2. To determine specific rotation of sugar solution using polarimeter 3. To study dependence of radiation on angle using dipole antenna 4. To study reflection and refraction of microwaves 5. To determine refractive index of a liquid by total internal reflection using Wollaston's air film 6. To determine refractive index of (1) a glass and (2) a liquid by total internal reflection using gaussian eyepiece 7. Determination of the bandgap energy of Germanium. 8. To measure the resistivity of a semiconductor with temperature by four probe method (room temperature to 150^{o}C) and its bandgap energy. 9. To determine Hall coefficient of a semiconductor sample. 10. Determination of carrier lifetime of minority carriers	4 lectures per Experiment

11. Determination of saturation current and ideality factor of a diode.	

Reference Books:

1. Advanced Practical Physics for Students, B L Flint and H T Worsnop, 1971, Asia Publishing House
2. Advanced Level Physics Practical, Michael Nelson & Jon M Ogborn, 4th Edition, Reprinted 1985, Heinemann Educational Publishers
3. A Textbook of Practical Physics, I Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal
4. Electromagnetic Field Theory for Engineers and Physicists, G Lehner, 2010, Springer
5. BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001.
6. A Text book of Practical Physics: Samir Kumar Ghosh New Central Book Agency (4th edition).
7. B Sc. Practical Physics: C. L. Arora (1st Edition) – 2001 S. Chand & Co. Ltd..
8. University Practical Physics: D C Tayal. Himalaya Publication.
9. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Milller (1994), Mc-Graw Hill
10. Electronic devices and circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson
11. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House

Note:

1. Minimum 8 experiments are to be performed by the Learner in the Practical Course
2. A record of experiments performed by the Learner must be maintained and be regularly checked by the Teacher-in-Charge.

The Scheme of Teaching and Examination is as under:

Third Year - Semester – VI
Summary

Sr. No.	Choice Based Credit System	Course Code	Remarks
1	Core Course	US-TPH-601, US-TPH-602, US-TPH-603, US-TPH-604 US-TPH-P8, US-TPH-P9	

Detail Scheme

Sr. No.	Course Code	Course Title	Periods Per Week					Credit	Seasonal Evaluation Scheme					Total Marks
			Units	S. L.	L	T	P		SLE	CT	TA	Attendance	SEE	
1	US-TPH-601	Electronics 3	4	20% *	3	1	0	2.5	10	15	10	05	60	100
2	US-TPH-602	Statistical Mechanics	4	20% *	3	1	0	2.5	10	15	10	05	60	100
3	US-TPH-603	Quantum Mechanics	4	20% *	3	1	0	2.5	10	15	10	05	60	100
4	US-TPH-604	Programming Language – Python	4	20% *	3	1	0	2.5	10	15	10	05	60	100
5	US-TPH-P7	Physics Practical Course 7	-	-	0	0	8	3	-	-	-	-	100	100
6	US-TPH-P8	Physics Practical Course 8	-	-	0	0	8	3	-	-	-	-	100	100
Total Hours / Credit								16	Total Marks					600

***One to two lectures to be taken for CONTINUOUS self -learning Evaluation.**

III Year - Semester – VI - Units – Topics – Teaching Hours

S. No	Course Code	Course Unit No	Course Unit Title	Hours/ Lectures	Total No. of hours/ lectures	Credit	Total Marks
1	US-TPH-601	I	JFET & MOSFET	15	60	2.5	100 (60 +40)
		II	Integrated Circuits, Data Processing Circuits, Shift Registers & Counters	15			
		III	Computer Organization, Microprocessor Architecture, introduction to Assembly Language	15			
		IV	Introduction to Electronic Communication Systems	15			
2	US-TPH-602	I	Classical Statistics	15	60	2.5	100 (60 +40)
		II	Bose-Einstein Statistics	15			
		III	Fermi-Dirac Statistics	15			
		IV	Application of Statistics to Gases & Specific Heat of Solids	15			
3	US-TPH-603	I	Schrodinger Equation – Time Dependent and Time Independent	15	60	2.5	100 (60 +40)
		II	Bound States in an Arbitrary Potential	15			
		III	Atoms in Electric and Magnetic Fields	15			
		IV	Many-Electron Atoms	15			
4	US-TPH-604	I	Introduction to Python Programming	15	60	2.5	100 (60 +40)
		II	Functions and Modules, Data Structures, Class, Objects	15			
		III	numpy, scipy, matplotlib	15			
		IV	VPython	15			
5	US-TPH-P7	Practical Course of US-TPH-601 + Practical Course of US-TPH-602		8 lectures per week	72	3	100 (60 + 20 + 20)

6	US-TPH-P8	Practical Course of US-TPH-603 + Practical Course of US-TPH-604	8 lectures per week	72	3	100 (60 + 20 + 20)

- **Lecture Duration = 50 mins**
- **1 credit = 24 lectures**
- **Curriculum topics with Self-Learning topics** - to be covered through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT.

Course Name: Electronics 3
Course Code: US-TPH-601

Learning Outcomes:

- Learner will learn about JFET and MOSFET, integrated circuits and a few digital circuits, will be introduced to computers and microprocessors and introduced to assembly language and electronic communication.

Unit	Content	No. of Lectures
I	**JFET & MOSFET:** 1.1 JFET: Basic ideas, Drain curve, Transconductance curve, Biasing in the ohmic and active regions, Transconductance 1.2 JFET common source amplifier, JFET analog switch, Voltage controlled resistor, Current source 1.3 MOSFET: Depletion and enhancement mode, MOSFET operation and characteristics, Digital switching	**15**

II	**Integrated Circuits, Data Processing Circuits, Shift Registers & Counters:** 2.1 **Integrated Circuits (Qualitative treatment only):** Active and passive components, Discrete components, Wafer, Chip, Advantages and drawbacks of ICs, Scale of integration (basic idea and definitions only) SSI, MSI, LSI, VLSI, Classification of ICs, Examples of linear and digital ICs. 2.2 Multiplexers, De-multiplexers, Decoders and Encoders 2.3 Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out, Parallel-in-Parallel-out Shift Registers (up to 4 bits only) 2.4 Ring Counter, Asynchronous counters, Decade Counter, Synchronous counters	**15**
III	**Computer Organization, Microprocessor Architecture, introduction to Assembly Language:** 3.1 Input/Output devices, Data storage (idea of ROM and RAM), Computer memory, Memory organization and addressing, Memory interfacing, Memory map 3.2 Main features of Intel 8085 – Block diagram, Components, Pin-out diagrams, Buses, Registers, ALU, Memory, Stack memory, Timing and control circuits, Timing states, Instruction cycle, Timing diagram of MOV and MVI 3.3 Instructions set and basic programming	**15**
IV	**Introduction to Electronic Communication Systems:** 4.1 Means and modes of communication, Block diagram of electronic communication system, Need for modulation 4.2 Amplitude modulation, modulation index and frequency spectrum, Generation of AM (emitter modulation), Demodulation of AM wave (diode detector), Concept of single side band generation and detection 4.3 Frequency and phase modulation, modulation index and frequency spectrum, Generation of FM using VCO 4.4 Basic principles of PAM, PPM and PWM	**15**

	4.5 Need for digital transmission, Pulse code modulation, Digital carrier modulation techniques, Sampling, quantization and encoding	

Self-Learning topics (Unit wise)

Unit	Topics
I	JFET analog switch, Voltage controlled resistor, Current source
II	Scale of integration (basic idea and definitions only) SSI, MSI, LSI, VLSI
III	Input/Output devices, Data storage (idea of ROM and RAM)
IV	Means and modes of communication, Block diagram of electronic communication system, Need for modulation

Reference Books:

1. Digital Principles and Applications, A P Malvino, D P Leach and Saha, 7th edition, 2011, Tata McGraw Hill
2. Fundamentals of Digital Circuits, Anand Kumar, 2nd edition, 2009, PHI Learning Pvt. Ltd.
3. Digital Circuits and Systems, Venugopal, 2011, Tata McGraw Hill
4. Digital Electronics, G K Kharate, 2010, Oxford University Press
5. Digital Systems: Principles and Applications, R J Tocci, N S Widmer, 2001, PHI Learning
6. Logic Circuit Design, Shimon P Vingron, 2012, Springer
7. Digital Electronics, Shubrata Ghosal, 2012, Cengage Learning
8. Digital Electronics, S K Mandal, 2010, 1st edition, McGraw Hill
9. Microprocessor Architecture, Programming and Applications with 8085, 2002, R S Goankar, Prentice Hall
10. Electronic Devices and Circuits, A Mottershead, 1998, PHI Learning Pvt. Ltd.
11. Electronic Communication Systems, G Kennedy, 1999, Tata McGraw Hill
12. Electronic Communications, D Roddy and J Coolen, Pearson Education India
13. Advanced Electronic Communication Systems, Tomasi, 6th edition, Prentice Hall
14. Principles of Electronic Communication Systems, Frenzel, 3rd edition, McGraw Hill
15. Communication Systems, S Haykin, 20006, Wiley India

16. Electronic Communication System, Blake, Cengage, 5th edition

Course Name: Statistical Mechanics
Course Code: US-TPH-602

Learning Outcomes:

- Learner will be introduced to concepts in classical statistics, study Bose-Einstein statistics, Fermi-Dirac statistics, application of statistics to gases and about classical theory of specific heat

Unit	Content	No. of Lectures
I	**Classical Statistics:** 1.1 Macrostate & Microstate, Elementary Concept of Ensemble, PhaseSpace, Estimation of number of accessible microstates, Entropy and thermodynamic probability, Entropy of ideal gas, Maxwell-Boltzmann distribution law, Partition function of canonical ensemble, Thermodynamic functions of an ideal gas, Classical entropy expression, Gibbs Paradox.	**15**

II	**Bose-Einstein Statistics:** 2.1 Indistinguishable particles and distinguishable particles, Bose-Einstein distribution law, Thermodynamic functions of a strongly degenerate Bose gas, Radiation as a photon gas and thermodynamic functions of photon gas, Bose derivation of Planck's law.	**15**
III	**Fermi-Dirac Statistics:** 3.1 Fermi-Dirac distribution law, Pauli's exclusion principle and spin 1/2 particles, Thermodynamic functions of a completely and strongly degenerate Fermi gas, Fermi energy, Electron gas in a metal, Specific heat of metals.	**15**
IV	**Application of Statistics to Gases & Specific Heat of Solids:** 4.1 Ideal gas in a gravitational field, the principle of equipartition of energy, the quantized linear oscillator, Specific heat capacity of a diatomic gas. 4.2 Classical Theory of Specific Heat (Dulong Petit Law), Einstein model of specific Heat, Debye model of specific Heat, Born's modification of Debye's theory, Specific heat of 1d and 2d solids in Debye model, Measurement of specific heat at low temperatures.	**15**

Self-Learning topics (Unit wise)

Unit	**Topics**
I	Macrostate & Microstate.
II	Indistinguishable particles and distinguishable particles.
III	Pauli's exclusion principle and spin 1/2 particles.
IV	Classical theory of specific heat of solid (Dulong Petit Law).

Reference Books:

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
2. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
3. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall

4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
6. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press.

Additional Reference Books:

1. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press.

Course Name: Quantum Mechanics
Course Code: US-TPH-603

Learning Outcomes:

- Learner will learn about time independent and time dependent Schrodinger equations, bound states in an arbitrary potential, about atoms in electric and magnetic field and about the energy spectrum of many-electron atoms

Unit	Content	No. of Lectures
I	**Schrodinger Equation – Time Dependent and Time Independent:** 1.1 Time dependent Schrodinger equation, Derivation of time independent equation for potentials which are not time dependent, dynamical evolution of a quantum state 1.2 Properties of wave function, Interpretation of wave function probability and probability current densities in three dimensions, Conditions for physical acceptance of wavefunctions	**15**

	1.3 Normalization, Linearity and superposition principle, Eigenvalues and eigenfunctions, position, momentum and energy operators, Commutator of momentum and energy operators, Expectation values of position and momentum, Wave function of a free particle 1.4 Time independent Schrodinger equation -Hamiltonian, Stationary states and energy eigenvalues, expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions 1.5 General solution of the time dependent Schrodinger equation in terms of linear combination of stationary states, Application to spread of Gaussian wave packet for a free particle in one dimension, wave packets, Position-momentum uncertainty principle	
II	**Bound States in an Arbitrary Potential:** 2.1 Continuity of wave function, Boundary condition and emergence of discrete energy levels, Application to one dimensional problem – finite square well potential, step potential 2.2 Quantum mechanics of simple harmonic oscillator – energy levels and energy eigen functions using Frobenius method 2.3 Parity of wave functions, Hermite polynomials, Ground state, Zero-point energy and uncertainty principle	**15**
III	**Atoms in Electric and Magnetic Fields:** 3.1 Electron angular momentum, Space quantization 3.2 Electron spin and spin angular momentum, Larmor's theorem, Spin magnetic moment, Stern-Gerlach experiment 3.3 Zeeman effect: electron magnetic moment and magnetic energy, Gyromagnetic ratio and Bohr magneton 3.4 Normal and Anomalous Zeeman effect 3.5 Stark effect	**15**
IV	**Many Electrons Atoms:** 4.1 Pauli exclusion principle, Symmetric and antisymmetric wave functions 4.2 Fine structure, Spin-Orbit coupling, Spectral notations for atomic states, Total angular momentum, Vector model	**15**

	4.3 Spin-Orbit coupling in atoms – L-S and J-J couplings, Hund's rule, term symbols, Spectra of hydrogen and alkali atoms (Na).	

Self-Learning topics (Unit wise)

Unit	Topics
I	Normalization, Linearity and superposition principle, Eigenvalues and eigenfunctions, position, momentum and energy operators
II	Application to one dimensional problem – step potential
III	Stern-Gerlach experiment
IV	Pauli exclusion principle, Symmetric and antisymmetric wave functions

Reference Books:

1. A Textbook of Quantum Mechanics, P M Mathews and K Venkatesan, 2^{nd} edition, 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2^{nd} edition, 2002, Wiley
3. Quantum Mechanics, Leonard I Schiff, 3^{rd} edition, 2010, Tata McGraw Hill
4. Quantum Mechanics, G Aruldhas, 2^{nd} edition, 2002, PHI Learning of India
5. Introductory Quantum Mechanics, Richard L. Liboff, Fourth Edition, 2007, Pearson Education

Additional Reference Books:

1. Introduction to Quantum Mechanics, David J Griffiths, 2005, Pearson Education

Course Name: Programming Language-Python
Course Code: US-TPH-604

Learning Outcomes:

- Learner will learn the programming language Python and its applications especially in Physics experiments.

Unit	Content	No. of Lectures
I	**Introduction to Python Programming:** 1.1 Software, Development Tools, Learning Programming with Python, Writing Python statements 1.2 Keywords, Variables and values, Arithmetic and Boolean operators, Expressions, string, string operations, Different types of errors 1.3 Conditional Statements, simple if statement, if-else statement, Nested conditional statements, Errors in conditional statements 1.4 Iterations, while statement, for statement, Nested loops, abnormal loop termination, Applications of loops 1.5 Programs using conditional statements and iteration statements	**15**

II	**Functions and modules, Data structures, Class, Objects:** 2.1 Advantages of functions, Introduction to using function, Mathematical Functions, time function, random numbers, main function, defining functions, parameter passing, standard function vs custom functions, modules 2.2 List assignment and equivalence, List bounds, slicing, List and functions, List sorting, Searching, List permutations, Reversing List, Introduction to tuple, dictionary and set 2.3 OOP, Class and objects, constructors, destructors, inheritance, polymorphism, encapsulation, overloading, overriding, class variables, class methods and static methods 2.4 Programs using functions, lists, class and objects	**15**
III	**numpy, scipy, matplotlib:** 1.1 Introduction to numpy, data types, ndarray, array attributes, array creation, array from existing data, array from numerical ranges, indexing and slicing, Advanced indexing, iterating over array, manipulation, binary functions, string functions, mathematical function, arithmetic functions, statistical function, sort, search counting functions, byte swapping copies and views, matrix library, I/O with numpy 1.2 Introduction to scipy, Basic functionality, cluster, constants, FFTpack, integrate, interpolate, input and output, linalg, optimize, CSgraph, spatial,ODR, Special package **1.3** Introduction to matplotlib, pyplot API, simple plot, PyLab module, Figure class, Axes class, Subplots(), Subplot2grid(), Grids, Formatting axis, setting limits, Ticks and Ticks labels, twin axes, Bar plots, Histogram, 2D plots, 3D plots, Mathematical expressions, Transforms	**15**

IV	**VPython:** 4.1Introduction, variable assignment, vector assignment and manipulation, scalar assignment and manipulation, canvas, VPython entities names and attributes, loops, Displaying multiple objects, events, Animation, scaling objects. Programs using VPython Application of Python to Physics experiments	**15**

Self-Learning topics (Unit wise)

Unit	**Topics**
I	Keywords, Variables and values, Arithmetic and Boolean operators, Expressions, string, string operations, Different types of errors
II	Programs using functions, lists, class and objects
III	Data types, ndarray, array attributes, array creation, array from existing data, array from numerical ranges
IV	Vector assignment and manipulation, scalar assignment and manipulation

Reference Books:

1. Beginning Python, Using Python 2.6 and Python 3.1, James Payane, Wiley
2. Practical Programming , An Introduction to Computer Science Using Python3, second edition, Paul Gries, Jennifer Campbell, Jason Montojo
3. Data structure and Algorithmic Thinking with Python, Narasimha Karumanchi, , CareerMonk Publications
4. Learning Python, Mark Lutz
5. Python Tutorials for beginners, Telusko
6. Python Crash Course, Eric Matthews

Additional Reference Books:

1. Python for Data Analysis, Wes MCKinney
2. Python Tricks, Dan Bader
3. Python Distilled, David M. Bcazley

Course Name: Physics Practical Course 7
Course Code: US-TPH- P7

Learning Outcomes:

- Learner will be introduced to Sci-Lab, also design and study circuits studied in the theory course on Electronics and do basic programming on 8085 microprocessor

CONTENTS **(Practical based on US-TPH-601 and US-TPH-602)**	**No. of Lectures**
1. To build a 4-bit counter using D type/ JK flip flop ICs and study timing diagram 2. To build a 4-bit shift register (serial and parallel) using D type/ JK flip flop ICs 3. Write the following programs using 8085 microprocessor:	

- Addition and subtraction of numbers using direct addressing mode - Addition and subtraction of numbers using indirect addressing mode - Multiplication by repeated addition - Division by repeated subtraction - Handling of 16-bit numbers - Use of CALL and RETURN instruction - Block data handling - Other programs (eg. Parity checks, using interrupts) 4. To study the output and transfer characteristics of a JFET 5. To design a common source JFET amplifier and to study its frequency response 6. To study the output characteristics of a MOSFET 7. To design an amplitude modulator using transistor 8. To study pulse width modulation (PWM) 9. To study pulse position modulation (PPM) 10. To study pulse amplitude modulation (PAM) 11. To study ASK, FSK, PSK modulators 12. Computational analysis of the behavior of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions: a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations b) Study of transient behavior of the system (approach to equilibrium) c) Relationship of large N and the arrow of time d) Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution e) Computation and study of mean molecular speed and its dependence on particle mass f) Computation of fraction of molecules in an ideal gas having speed near the most probable speed (Use C/C++/Scilab/other numerical simulations)	4 lectures per Experiment

13. Computation of the partition function $Z(\beta)$ for examples of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics: a) Study of how $Z(\beta)$, average energy , energy fluctuation ΔE, specific heat at constant volume Cv, depend upon the temperature, total number of particles N and the spectrum of single particle states. b) Ratios of occupation numbers of various states for the systems considered above c) Computation of physical quantities at large and small temperature T and comparison of various statistics at large and small temperature T. (Use C/C++/Scilab/other numerical simulations) 14. Plot Planck's law for Black Body radiation and compare it with Raleigh-Jeans Law at high temperature and low temperature. (Use C/C++/Scilab/other numerical simulations) 15. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature and compare them for these two cases. (Use C/C++/Scilab/other numerical simulations) 16. Plot the following functions with energy at different temperatures a) Maxwell-Boltzmann distribution b) Fermi-Dirac distribution c) Bose-Einstein distribution. (Use C/C++/Scilab/other numerical simulation)	

Note:

1. Minimum 8 experiments are to be performed by the Learner in the Practical Course
2. A record of experiments performed by the Learner must be maintained and be regularly checked by the Teacher-in-Charge.

Course Name: Physics Practical Course 8
Course Code: US-TPH- P8

Learning Outcomes:

- Learner will be introduced to Scilab – a free software to Matlab and also develop programs using Python programming language.

CONTENTS **(Practical based on US-TPH-603 and US-TPH-604)**	**No. of Lectures**
1. Use Scilab to solve problem based on Quantum Mechanics 2. Use Scilab to solve problem based on Quantum Mechanics 3. Study of Zeeman effect	

4. To show tunneling effect in tunnel diodes using I-V characteristics 5. Programs on decision statements 6. Programs on iterations 7. Programs using functions 8. Programs on Lists 9. Programs using class and objects 10. Programs on Arrays 11. Programs using numpy 12. Programs using scipy and matplotlib 13. Programs using VPython	4 lectures per Experiment

References:

1. Modern Digital Electronics, R P Jain, 4^{th} edition, 2010, Tata McGraw Hill
2. A Text Lab Manual, P B Zbar, A P Malvino, M A Miller, 1994, McGraw Hill
3. Microprocessor Architecture, Programming and Applications with 8085, 2002, R S Goankar, Prentice Hall
4. Microprocessor 8085 Architecture, Programming and Interfacing, A Wadhwa, 2010, Prentice Hall
5. Integrated Electronics, J Millman and C Halkias, 1991, Tata McGraw Hill
6. Electronics: Fundamentals and Applications, J D Ryder, 2004, Prentice Hall
7. Electronic Communication Systems, G Kennedy, 1999, Tata McGraw Hill
8. Electronic Communication System, Blake, Cengage, 5^{th} edition
9. Beginning Python, Using Python 2.6 and Python 3.1, James Payane, Wiley
10. Practical Programming , An Introduction to Computer Science Using Python3, second edition, Paul Gries, Jennifer Campbell, Jason Montojo
11. Data structure and Algorithmic Thinking with Python, Narasimha Karumanchi, ,
12. Elementary Numerical Analysis, K.E.Atkinson, 3^{rd} edn, 2007, Wiley India Edition.
13. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
14. Introduction to Modern Statistical Mechanics, D. Chandler, Oxford University Press, 1987.

15. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
16. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
17. Statistical and Thermal Physics with computer applications, Harvey Gould and Jan Tobochnik, Princeton University Press, 2010.
18. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896.
19. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444.
20. Scilab Image Processing: L.M. Surhone. 2010, Betascript Pub., ISBN: 978-6133459274.

Note:

1. Minimum 8 experiments are to be performed by the Learner in the Practical Course
2. A record of experiments performed by the Learner must be maintained and regularly checked by the Teacher-in-Charge.

Scheme of Examination:

A) Internal Assessment:

Theory Assessment:

1. **Self-Learning Evaluation (10 marks)** – Learner will be evaluated on the self-learning component on the basis of either a PowerPoint or Video Presentation made by the Learner of the topics earmarked for self – study in each unit.

2. **Class Test (15 marks)** – A Test containing 15 Multiple Choice Questions covering first two units of each theory course

3. **Term Assignment (10 marks)** – An assignment about all the SLE components for the given course

4. **Class Attendance (05 marks)** – On the basis of participation of the learner in the classroom

B) <u>Semester End Examination:</u>

i) Theory Assessment:

1. A Question Paper consisting of 5 questions as per the following pattern:

Q1 – (On Unit 1)

Attempt ANY ONE:

(a) …. (8 marks)

Or

(b)

Attempt ANY ONE:

(c) … (4 marks)

Or

(d)

Q2 – (On Unit 2)

Attempt ANY ONE:

(a) …. (8 marks)

Or

(b)

Attempt ANY ONE:

(c) … (4 marks)

Or

(d)

Q3 – (On Unit 3)

Attempt ANY ONE:

(a) …. (8 marks)

Or

(b)

Attempt ANY ONE:

(c) … (4 marks)

Or

(d)

Q4 – (On Unit 4)

Attempt ANY ONE:

(a) …. (8 marks)

Or

(b)

Attempt ANY ONE:

(c) … (4 marks)

Or

(d)

Q5 – (On Units 1, 2, 3, 4)

Attempt ANY FOUR: (12 marks)

(a) – (unit 1)

(b) – (unit 1)

(c) – (unit 2)

(d) – (unit 2)

(e) – (unit 3)

(f) – (unit 3)

(g) – (unit 4)

(h) – (unit 4)

ii) Practical Assessment:

The following rules shall apply to each Practical Course of the Semester:

1. A Learner will be allowed to appear for the Practical Examination of the Semester only if he submits a certified journal or a certificate from the Head of Department to the effect that he has completed the Practical Course with the minimum required experiments.

2. The Learner will have to appear for Practical Examination in each Practical Course of the Semester as per the below particulars:

Particulars	Max Marks Allotted
Experiment	60
Journal	20
Viva	20
Total	100