VIDYASAGAR UNIVERSITY

Paschim Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN PHYSICS

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS) MAJOR IN PHYSICS
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	1st	I	**SEMESTER-I**							
			Major-1	PHSHMJ101	**T: Foundation of Physics -1**	4	3-1-0	15	60	75
			SEC	PHSSEC01	**P: Introduction to Python programming and Graph Plotting**	3	0-0-3	10	40	50
			AEC	AEC01	Communicative English -1 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC01	Multidisciplinary Course -1 (***to be chosen from the list***)	3	3-0-0	10	40	50
			VAC	VAC01	ENVS (***common for all programmes***)	4	2-0-2	50	50	100
			Minor (Disc.-I)	PHSMI01	**T: Mathematical Physics and Mechanics; P: Practical** ***(To be taken by students of other Disciplines)***	4	3-0-1	15	60	75
			Semester-I Total			20				400
		II	**SEMESTER-II**							
			Major-2	PHSHMJ102	**T: Foundation of Physics -2**	4	3-1-0	15	60	75
			SEC	PHSSEC02	**P: Basic Instrumentation**	3	0-0-3	10	40	50
			AEC	AEC02	MIL-1 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC02	Multi Disciplinary Course-02 (***to be chosen from the list***)	3	3-0-0	10	40	50
			VAC	VAC02	Value Added Course-02 (***to be chosen from the list***)	4	4-0-0	10	40	50
			Minor (Disc.-II)	PHSMI01	**T: Thermal Physics and Statistical Mechanics; P: Practical** ***(To be taken by students of other Disciplines)***	4	3-0-1	15	60	75
			Summer Intern.	CS	Community Service	4	0-0-4	-	-	50
			Semester-II Total			24				400
			TOTAL of YEAR-1			44				800

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, VAC = Value Added Course; CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language, ENVS = Environmental Studies

MAJOR (MJ)

MJ-1: Foundation of Physics -1 **Credits 04 (Full Marks: 75)**

MJ-1T: Foundation of Physics -1 **Credits 04**

Course contents:

UNIT – I: Preliminary Math. Methods **Credits 02** **[30L]**

1. Vector Analysis: Definition of vector by rotational transformation of Cartesian axes. Definition of scalar, pseudoscalar, polar and axial vector, Fundamentals of vector algebra. Vector identities. Gradient of a scalar field, divergence and curl of a vector field and their physical significance, solenoidal and irrotational vector, conservative vector field and scalar potential, concept of vector potential, identities involving gradient, divergence & curl. **[5L]**

2. Vector Integration: Line integral, path independence, exact differential, surface integral, flux, volume integral, Gauss divergence theorem, continuity equation, Stoke's theorem, Green's theorem for simply connected region, verification of integral theorems in simple cases. Change of variables and the Jacobian& its use in the evaluation of surface and volume integrals. **[8L]**

3. Orthogonal Curvilinear Coordinates: Covariant and contravariant components, unit vectors and unitary base vectors. Length, area and volume element, general expression of gradient, divergence, Laplacian and curl, their expressions in spherical and cylindrical polar, coordinates. Square of the element of arc length and volume element in general coordinates. **[5L]**

4. Analytic functions: Analytic functions of real variables, Taylor's series and Maclaurin's Series for functions of single variable, illustrations with simple problems. **[3L]**

5. Differential Equation: Exact and inexact differentials, Classification of differential equations with some examples, First order linear differential equations and integrating Factor, Second order (linear) ODEs with constant coefficients, Particular integral. **[5L]**

6. Partial Differential Equation: Solution of Laplace's equation in 2D and 3D by the method of separation of variables in Cartesiancoordinates. **[4L**]

Suggested Readings:

1. Mathematical Methods in the Physical Sciences, M. L. Boas, 2005, Wiley
2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier
3. Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley, M. P. Hobson, S. J. Bence, Cambridge Univ. Press, 3rd Eds., 2006
4. Vector Analysis and an introduction to Tensor Analysis, S. Lipschutz, D. Spellman, M. R. Spiegel, Schaum's Outline Series, Tata McGraw Hill Education Private Limited, edition 2009
5. Mathematical Physics, A. K. Ghatak, I. C. Goyal, S. J. Chua, Macmillan India Ltd., 2016
6. Fundamentals of Mathematical Physics, A. B. Gupta, Books and Allied (P) Ltd. 2022

UNIT – II: Introduction to Thermodynamics **Credits 02** **[30L]**

1. Basics of Kinetic Theory: Macroscopic and microscopic description of matter, Postulates of molecular kinetic theory of an ideal gas, Relation between microscopic and macroscopic state variables, Ideal gas equation and Van-der-Waal's equation. **[2L]**

2. Thermodynamic Description of system: Thermodynamic systems, intensive and extensive thermodynamic variables, thermodynamic equilibrium, Zeroth law of thermodynamics and concept of temperature, concept of work, heat and internal energy, state functions & path functions. **[3L]**

3. First law of thermodynamics: Statement and explanation, its differential form & significance, quasi-static process, various thermodynamic processes, applications of first law - general relation between CP and CV, work done during isothermal and adiabatic processes, compressibility and expansion co-efficient, free expansion. **[5L]**

4. Second Law of Thermodynamics: Reversible and irreversible process with examples, conversion of work into heat and heat into work, heat reservoirs, heat engines, Carnot's cycle, Carnot engine & its efficiency, refrigerator and heat pump, coefficient of performance, statement of second law of thermodynamics, Kelvin-Planck and Clausius Statements and their equivalence, Carnot's theorem, applications of Second law of thermodynamics - thermodynamic scale of temperature and its equivalence to perfect gas scale. **[7L]**

5. Entropy: Concept of entropy, Clausius theorem, Clausius inequality, second law of thermodynamics in terms of entropy, entropy of a perfect gas, entropy of gas mixture, increase of entropy due to diffusion, principle of increase of entropy, entropy changes in reversible and irreversible processes with examples, entropy of the universe, temperature - entropy diagrams for Carnot cycle. **[5L]**

6. Third law of thermodynamics: Third law, unattainability of absolute zero temperature. **[1L]**

7. Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of energy density, derivation of Planck's law, deduction of Wien's distribution law, Rayleigh Jeans law, Stefan-Boltzmann law and Wien's displacement law from Planck's law. **[7L]**

Suggested Readings:

1. Heat and Thermodynamics, M. W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988,Narosa.
3. Thermodynamics, E. Fermi, 2007, Sarat Book House.
4. Basic Thermodynamics, E. Guha, 2010, Narosa.
5. Kinetic theory of gases, Loeb, Radha Publishing House.
6. A Treatise on Heat, MeghnadSaha and B. N. Srivastava, 1958, Indian Press.
7. Thermal Physics, Charles Kittel, Herbert Kroemer - W. H. Freeman, 1980.
8. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 2nd Edition, 1993, Tata McGraw-Hill.
9. Concepts in Thermal Physics, S. J. Blundell and K. M. Blundell, 2nd Ed., 2012, Oxford University Press.
10. Thermodynamics and an introduction to thermostatistics, H. B. Callen, 1985, Wiley.
11. গ্যাসের আনবিক তত্ব, প্রতীপ চৌধুরী, পশ্চিমবঙ্গ রাজ্য পুস্তক পর্ষদ ।
12. তাপ গতি তত্ব, অশোক ঘোষ, পশ্চিমবঙ্গ রাজ্য পুস্তক পর্ষদ ।

MJ-2: Foundation of Physics -2 Credits 04 (Full Marks: 75)

MJ-2T: Foundation of Physics -2 **Credits 04**

Course contents:

UNIT – I: Preliminary Classical Mechanics **Credits 02** **[30L]**

1. Introduction: What is classical mechanics? A brief history of the development of mechanics up to Newton; Newton's laws of motion; Some examples of force laws and the corresponding motions; Newton's second law to a system of particles; Galilean invariance; path integral of force: Work, Power, Kinetic and Potential energies, conservative and dissipative force, conservations of linear and angular momentum, torque etc.; Limitations of Newton's laws. **[5L]**

2. Dynamics of a system of particles: Centre of mass (c.m.), calculation of position of c.m. in simple symmetrical cases; idea of laboratory and centre of mass frames of reference; external force and forces of interaction between particles; motion of centre of mass under external force; kinetic energy and angular momentum about centre of mass and laboratory frames; torque-angular momentum relation; potential energy, conservation of mechanical energy. **[5L]**

3. Rotating frame of reference: Non-inertial frames and fictitious forces; rotating frames of reference - Coriolis and centrifugal forces, Coriolis deflection of vertically thrown or falling particles and particles moving originally in straight lines horizontally. Effect of Coriolis force on nature: sense of rotation of cyclones. **[4L]**

4. Motion under central forces: Two-body problem, reduction to one-body problem, reduced mass; definition and nature (conservative nature, spherically symmetric potential) of central force, features of motion under central force field, differential equation of orbit; energy expression, simple derivations of nature of force from equation of orbit and vice versa; motion under inverse square attractive force: polar equation of conics, dependence of nature of orbits on energy, Kepler's laws, Newton's law of gravitation from Kepler's law; Laplace-Runge-Lenz vector; nature of orbit under inverse square repulsive force; equivalent one dimensional motion, stability of orbit. **[10L]**

5. Scattering: Two-body collision and scattering. **[2L]**

6. Mechanics of Continuum*:* Kinematics of Moving Fluids: Idea of compressible and incompressible fluids, Equation of continuity; streamline and turbulent flow, Reynold's number, Stokes' law from dimensional analysis, Poiseuille's equation; Euler's Equation and the special case of fluid statics;Simple applications (e.g.: Pascal's law and Archimedes principle); Bernoulli's Theorem. **[6L]**

Suggested Readings:

1. Classical Mechanics, N. C. Rana and P. S. Joag, McGraw-Hill Education
2. Classical Mechanics, H. Goldstein, C. P. Poole, and J. Safko, Pearson Education, India, Third Edition.
3. Classical Mechanics, A. K. Raychaudhuri, Oxford University Press, 1984
4. An Introduction to Mechanics, D. Kleppner, R. J. Kolenkow, 1973, McGraw- HillEducation
5. Feynman Lectures, Vol. I, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education

6. Classical Mechanics and General Properties of Matter. S. N. Maiti and D. P. Raychaudhuri, New Age International.
7. Introduction to Classical Mechanics, R. G. Takwale and P.S.Puranik, Tata McGraw-Hill Publishing Company Ltd.
8. Theory and Problems of Theoretical Mechanics, M. R. Spiegel, Mc Grow Hill Education
9. Classical Mechanics, R.D. Gregory, 2006, Cambridge University Press
10. Introduction to Classical Mechanics with problems and solutions, D. Morin, Cambridge University Press
11. Mechanics through problems, D. Roy and A. Dasgupta, Techno World, Kolkata, 2022
12. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill, Physics
13. Mechanics, Resnick, Halliday and Walker 8/e. 2008, Wiley
14. Analytical Mechanics, G.R. Fowles and G.L. Cassiday, 2005, Cengage Learning
15. Mechanics , K. Symon, 2016, Pearson Education India
16. Classical Mechanics, Kibble and Berkshire, Imperial College Press
17. Classical Mechanics, J.M. Finn, 2010, Laxmi Publications
18. Mechanics, D. S. Mathur, S. Chand and Company Limited, 2000
19. University Physics. F.W. Sears, M.W.Zemansky, H.D Young 13/e, 1986, Addison Wesley
20. Classical Mechanics, J. C.Upadhyay, Himalaya Publishing.
21. Fundamentals of Classical Mechanics, A. B. Gupta, Books & Allied (P) Ltd.

UNIT – II: Basic Electricity & Magnetism **Credits 02** **[30L]**

1. Electric Field and Electric Potential: Electric field, Coulomb's law, Electric field lines. Electric flux, Conservative nature of Electrostatic Field, Electrostatic Potential, Potential and Electric Field of a dipole, Force and Torque on a dipole, Calculation of potential for linear, surface and volume charge distributions (uniform line charge, disc, spherical shell, sphere etc.),Equipotential surfaces, Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry, Laplace's and Poisson equations. **[8L]**

2. Electrostatic energy& Capacitor: Electrostatic energy of system of charges, Electrostatic energy of a charged sphere, Conductors and dielectrics in an electrostatic Field, Surface charge and force on a conductor, Capacitance of a system of charged conductors, Parallel-plate capacitor, Capacitance of spherical and cylindrical capacitors. **[4L]**

3. Method of Images: Method of Images and its application to a point charge near (a) an earthed plane infinite sheet, and (b) an earthed spherical conductor. **[3L]**

4. Dielectric Properties of Matter: Electric Field in matter, Polarization, Polarization Charges, Electrical Susceptibility and Dielectric Constant, Displacement vector D, Relations between E, P, and D, Gauss' Law in dielectrics, Boundary conditions for D and E. **[4L]**

5. Lorentz force: Force on a moving charge in simultaneous electric and magnetic fields, force on a current carrying conductor in a magnetic field, Trajectory of charged particles in uniform electric field, crossed uniform electric and magnetic fields, Basic principle of cyclotron. **[4L]**

6. Magnetic Field: Magnetic force between current elements and definition of Magnetic Field B, Biot-Savart's Law and its simple applications: straight wire and circular loop, Current Loop as a magnetic dipole and its dipole moment (Analogy with Electric Dipole). **[3L]**
Ampere's Circuital Law and its application to (a) infinite straight wire, (b) infinite planar surface current, and (c) solenoid. Properties of B: curl and divergence. Axial vector property of B and its consequences,

Vector Potential, Magnetic Force on (a) point charge, (b) current carrying wire, (c) between current elements, Torque on a current loop in a uniform magnetic field. **[6L]**

7. Magnetic Properties of Matter: Magnetization (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H, M. Ideas (qualitative) of Diamagnetism, Paramagnetism, and Ferromagnetism, B-H loop and calculation of hysteresis loss. **[3L]**

Suggested Readings:

1. Feynman Lectures Vol.2, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education
2. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings
3. Electricity and Magnetism, D. Chattopadhyay and P.C.Rakshit, New Central Book Agency, 2011
4. Fundamentals of Electricity and Magnetism, B. Ghosh, Books and Allied (P) Ltd., 4th edition, 2015.
5. Electricity, Magnetism and Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGrawHill
6. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
7. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press
8. Classical Electromagnetism, Jerrold Franklin, Pearson Education
9. Electricity and Magnetism, J.H.Fewkes& J.Yarwood. Vol. I, 1991, Oxford Univ. Press
10. Electricity and Magnetism, D. C. Tayal, Himalayan Publisher

MINOR (MI)

MI – 1: Mathematical Physics and Mechanics **Credits 04 (Full Marks: 75)**

MI – 1T: Mathematical Physics and Mechanics **Credits 03** **[45L]**

Course contents:

1. Differential equations: Exact and inexact differential, First order Linear differential equations with integrating factor, Second order Linear differential equations with constant coefficients, Particular Integral. **[5L]**

2. Vector Calculus: Properties of vectors under rotations. scalar product and its invariance under rotations, Scalar triple product and their interpretation in terms of area and volume, respectively, Scalar and Vector fields, Vector differentiation: Gradient of a scalar field and its geometrical interpretation. Divergence and Curl of a vector field. Only statements of Gauss' divergence theorem, Green's theorem and Stokes theorem. **[8L]**

3. Fundamentals of Dynamics: Reference frames, inertial frames. Galilean transformations. Galilean, invariance, review of Newton's laws of motion, dynamics of a system of particles, centre of mass, concept of centre of mass frame, Non-inertial frames and fictitious forces.
[5L]

4. Gravitation and central force motion: Gravitational potential Energy, potential and field due to a spherical shell and solid sphere, Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). **[6L]**

5. Rotational Dynamics: Perpendicular and parallel axes theorems, radius of gyration, calculation of moment of inertia for rectangular, cylindrical, and spherical bodies, pure rolling of a body on an inclined plane. **[6L]**

6.Motion under central forces: Two-body problem, reduction to one-body problem, reduced mass; definition and nature (conservative nature, spherically symmetric potential) of central force, features of motion under central force field, differential equation of orbit; energy expression, simple derivations of nature of force from equation of orbit and vice versa. **[5L]**

7. General properties of matter: Relation between Elastic constants, Torsion of a cylinder or wire, surface tension and surface energy, angle of contact, capillarity and Jurin's law, excess pressure and application to soap bubble, molecular theory of surface tension, ripple method, Viscosity, Reynold's number, Poiseuille's Equation for flow of a liquid through a Capillary Tube, Stoke's law in a high viscous liquid. **[10L]**

Suggested Readings:

Math. Methods-

1. Mathematical Methods in the Physical Sciences, M. L. Boas, 2005, Wiley
2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier
3. Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley, M. P. Hobson, S. J. Bence, Cambridge Univ. Press, 3rd Eds., 2006
4. Vector Analysis and an introduction to Tensor Analysis, S. Lipschutz, D. Spellman, M. R. Spiegel, Schaum's Outline Series, Tata McGraw Hill Education Private Limited, edition 2009
5. Mathematical Physics, A. K. Ghatak, I. C. Goyal, S. J. Chua, Macmillan India Ltd., 2016
6. Fundamentals of Mathematical Physics, A. B. Gupta, Books and Allied (P) Ltd. 2022

Classical Mechanics-

1. Classical Mechanics, N. C. Rana and P. S. Joag, McGraw-Hill Education
2. Classical Mechanics, A. K. Raychaudhuri, Oxford University Press, 1984
3. Feynman Lectures, Vol. I, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education
4. Classical Mechanics and General Properties of Matter. S. N. Maiti and D. P. Raychaudhuri, New Age International.
5. Introduction to Classical Mechanics, R. G. Takwale and P.S.Puranik, Tata McGraw-Hill PublishingCompany Ltd.
6. Theory and Problems of Theoretical Mechanics, M. R. Spiegel, Mc Grow Hill Education
7. Introduction to Classical Mechanics with problems and solutions, D. Morin, Cambridge University Press
8. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill, Physics
9. Mechanics, Resnick, Halliday and Walker 8/e. 2008, Wiley
10. Mechanics, D. S. Mathur, S. Chand and Company Limited, 2000
11. University Physics. F.W. Sears, M.W.Zemansky, H.D Young 13/e, 1986, Addison Wesley
12. Classical Mechanics, J. C.Upadhyay, Himalaya Publishing.
13. Fundamentals of Classical Mechanics, A. B. Gupta, Books & Allied (P) Ltd.

MI – 1P: Mathematical Physics and Mechanics (Practical) **Credits 01**

Course Outline:

1. Measurements of length (or diameter) using vernier callipers, screw gauge and travelling microscope.
2. To determine g and velocity for a freely falling body using Digital Timing Technique
3. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g
4. To determine g by Bar Pendulum.
5. To determine g by Kater's Pendulum.
6. To determine the Moment of Inertia of a Flywheel.
7. To determine the Modulus of Rigidity of a Wire by Maxwell's needle / To determine the Elastic Constants of a Wire by Searle's method.

Suggested Readings:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. Laboratory Manual of Physics, Madhusudan Jana, Books & Allied (P) Ltd., 2022, Kolkata.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press
6. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited
7. Physics in Laboratory, Mandal, Chowdhury, Das, Das, Santra Publication
8. Advanced Practical Physics Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publisher
9. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited
10. B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited

MI-2: Thermal Physics and Statistical Mechanics — Credits 04 (Full Marks: 75)

MI-2: Thermal Physics and Statistical Mechanics — Credits 03 — [45L]

Course contents:

1. Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law, General Relation between CP & CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. **[15L]**

2. Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations. **[10L]**

3. Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases. **[7L]**

4. Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. **[6L]**

5. Statistical Mechanics: Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law, Distribution of velocities.
Quantum statistics - Fermi-Dirac distribution law, Electron gas, Bose-Einstein distribution law, Photon gas, Comparison of three statistics. **[7L]**

Suggested Readings:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. 1988, Narosa
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

MI-2: Thermal Physics and Statistical Mechanics (Practical) Credits 01

Course Outline:

1. Measurement of Planck's constant using black body radiation.
2. To estimate the Temperature of a Torch bulb filament from resistance measurement and to verify of Stefan's law.
3. To study the variation of thermo-emf across two junctions of a thermo couple with temperature.
4. To determine the coefficient of thermal conductivity of copper by Searle's apparatus.
5. To determine the coefficient of thermal conductivity of a bad conductor by Lees and Chorlton's disc method.
6. To determine the mechanical equivalent of heat (J) by the method of Callendar and Barne.

Suggested Readings:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. Laboratory Manual of Physics, Madhusudan Jana, Books & Allied (P) Ltd., 2022, Kolkata.
5. Practical Physics, G. L. Squires, 2015, 4th Edition, Cambridge University Press
6. B. Sc. Practical Physics, C. L. Arora, S Chand and Company Limited
7. Physics in Laboratory, Mandal, Chowdhury, Das, Das, Santra Publication
8. Advanced Practical Physics Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publisher
9. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited
10. B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited

SKILL ENHANCEMENT COURSE (SEC)

SEC 1: Introduction to Python programming and Graph Plotting **Credits 03**

SEC1P: Introduction to Python programming and Graph Plotting **Full Marks: 50**

Course Outline:

1. **Introduction to programming in python(Version**-3):

(a) Introduction **[11P]**

1. Python interpreter as a calculator
2. Variable and data types (int, float, complex, list, tuple, set, string),the type()function)
3. Basic mathematical operations
4. Compound statements in python
   Logical Conditions (if, elif, else)
   Loops (for, while)
   User defined functions def: (return statement, default values for arguments, key word arguments), lambda function.
5. Importing modules with math, c math, random as examples
6. Using help and dir command to use the inbuilt manual
7. Basic idea of name spaces-local and global
8. Python scripts, I/O operations (including opening and writing to files)

(b) The python data types [12P]

1. List: defining lists, reading and changing elements from lists, slicing, concatenation, list comprehension. 2D list as matrix
2. built in functions involving lists: range(), len(), sum(), min(), max() – list methods: append(),extend(),count(), index(), sort(), insert(), pop(),remove(), reverse()
3. Tuples: Contrast and compare with lists, packing/unpacking using tuples (including a,b=b,a to swap variables)
4. Sets: set methods: update(), pop(), remove(), Set Theoretic operations: union, intersection, difference and symmetric difference of two sets.
5. Strings: Defining strings, the use of single, double or triple quotes as string delimiters, len(), indexing, slicing, string concatenation, some string methods: strip(), split(), join(), find(), count(), replace(), string for matting in python (using the % operator)
6. Dictionary: Make a dictionary, Built-in functions on dict and dictionary methods

2. Problems and Applications **[12P]**

1. Find odd, even numbers
2. Finding factors of an integer
3. Generate list of various random numbers. Find mean, var., std. dev.
4. Roots of a quadratic equation
5. Area of triangle by Heron's formula

6. Check strong number, Armstrong number
7. Determining whether an integer is prime or not. Define a python function and use this to find out all prime numbers within a given range. Finding out prime number greater than or lesser than a given value.
8. Sorting of lists (algorithm and code) using Bubble, insertion or Selection sort
9. Sum of series correct upto given decimal places (Sine, Cosine, Exponential etc.)
10. Motion of a particle under a given force F(x, t, v) with given initial condition and plotting (x,t), (x, v),(t, v). (Matplotlib to be used to plot graphs), using Euler's method only. [Examples: Nuclear Decay equation, projectile motion, damped harmonic motion etc.]
11. Matrix Addition, Multiplication and Transpose directly and using List Comprehension.
12. Curve fitting, Least square fit, Goodness of fit, standard deviation.
13. Plot a polynomial (or any transcendental) function. Indentify the real roots by plotting. Write a Python code to fine tune a possible root.

3. Introduction of graph plotting: [10P]

Matplotlib as a plotting Module: Basics of XY-plotting of function (i) power laws and exponential functions, (ii) trigonometric functions, (iii) Hyperbolic functions. (iv) Define a Python function and plot in a domain. Bar chart plots, histograms, polar plots, pie plots, Plot from data file, saving the figures, subplots, multiple plots.

Suggested Readings:

1. Scientific Computing in Python. Abhijit Kar Gupta, Techno World
2. Computational Physics, Mark Newman, Amazon Digital.
3. Introduction to Numerical Analysis, S.S. Sastry, 5thEdn. , 2012, PHI Learning Pvt. Ltd
4. Numerical Methods, Arun Kr Jalan, Utpal Sarkar, University Press
5. Numerical Mathematical Analysis, J. B. Scarborough, OXFORD and IBH Co. Pvt. Ltd.
6. Elementary Numerical Analysis, K.E. Atkinson, 3rdEdn., 2007, Wiley India Edition
7. Python Programming, Satyanarayana, Radhika Mani, Jagdesh, University Press
8. Python 2.1 Bible Dave Brueck, Stephen Tanner, Hungry Minds Inc, New York
9. Learning with Python-how to think like a computer scientist, J.Elkner, C.Meyer, and A Downey, 2015, Dreamtech Press.
10. Introduction to computation and programming using Python, J.Guttag, 2013, Prentice Hall India.
11. Effective Computation in Physics-Field guide to research with Python, A. Scopatz and K.D.Huff,2015, O'Rielly
12. An Introduction to Computational Physics, T. Pang, 2nd Edn., 2006, Cambridge Univ. Press Computational Physics, DarrenWalker,1stEdn.,2015, Scientific International Pvt.Ltd.

SEC 2: Basic Instrumentation **Credits 03**

SEC 2P: Basic Instrumentation **Full Marks: 50**

Course Outline:

1. **Basic ideas of measurement:** accuracy and precision of data sensitivity and range of resolution of instruments, uncertainties / errors in measurements and loading effects. **[1L + 2P]**

2. Resistances: Use of carbon resistances, electronic potentiometers, electrical rheostats, use of potentiometer in a potential divider circuit. **[1L + 2P]**

3. Analog and digital voltmeter and ammeter: Basic construction (block diagram), Principles of voltage and current measurements, ideas of resistances of voltmeters and ammeters in different ranges, principle of working of digital meters (voltmeters and ammeters), specifications of an electronic meter, advantages of digital meter over analog meters, ideas on range change of meters. **[3L + 7P]**

4. Digital multimeter: Block diagram and working principle of a digital multimeter, Measurements of resistance, current (dc & ac), voltage (dc & ac), inductance, diode and transistor checking. **[1L + 3P]**

5. Introduction to electrical household wiring:

(a) Concept of basic Electricity: Power rating, Idea on Transformer action, Measurement of Electrical quantities like Voltage, Currents, Resistance, Impedance, power factor and energy, Familiarisation with PVC wires with SWG, PVC conduit pipes, sockets and plugs, clips, switches, fuse, holder, ceiling rose, Miniature Circuit Breaker (MCB), Residual Current Circuit Breaker (RCCB), Earth Leakage Circuit Breaker (ELCB), Double Pole (DP) or Single Pole and Neutral Miniature Circuit Board (SPN MCB), DP Isolator, live line, neutral and earth connections, consequences of faulty earth connection. **[2L + 3P]**

(b) Circuit connection and wiring: Two-way switching in stairs, bed switch connection, fluorescent / LED tube circuit, connection from lamp post on road to main distribution board (home), assessment of total load with circuit, sub-circuits, and components with specifications, connections for refrigerator / microwave oven, concept of Single phase and three phase circuits. **[4L + 8P]**

(c) Safety and security: Fires in electrical Circuits & Precautions, Safely handling Tools &Equipment /Fire Fighting and use of fire extinguishers. **[2L + 1P]**

(d) One short project: To be submitted on plan and estimation of power, points with circuit connection in real case. **[5P]**

Suggested Readings:

1. A Textbook of Electrical Technology, Vol – I, B. L. Theraja and A. K. Theraja, S. Chand, 23rd Ed., Delhi
2. Electronic Devices and Circuits, S. Salivahanan and N. S. Kumar, Tata Mc-Graw Hill, 3rd Ed., 2012
3. Digital Circuits and Systems, Venugopal, Tata Mc-Graw Hill, 3rd Ed., 2011
4. Electrical Wiring: An Introduction, Satheesh Kumar, Ane Books Pvt. Ltd, 2011
5. Electrical Wiring Estimating And Costing, S. L. Uppal, G. C. Garg, 6th Eds., Khanna Publishers, Delhi
6. ইলেকট্রিকওয়্যারিং, সম্মাদার ও গঙ্গোপাধ্যায়, New Central Book Agency (P) Ltd.