

Deccan Education Society's
Kirti M. Doongursee College
of Arts, Science and
Commerce (AUTONOMOUS)



Affiliated to

UNIVERSITY OF MUMBAI

T.Y.B.Sc. Physics

Syllabus for

Program: Bachelor of Science Course

Subject: Physics

with effect from

Academic Year 2024-2025

Semester	Course Code	Course Title	Credit
V	KUSPHY24501	Mathematical and Statistical Physics	2.5
	KUSPHY24502	Solid State Physics	2.5
	KUSPHY24503	Atomic and Molecular Physics	2.5
	KUSPHY24504	Electrodynamics	2.5
	KUSPHY245P1	Practical	2.5
VI	KUSPHY24601	Classical Mechanics	2.5
	KUSPHY24602	Electronics	2.5
	KUSPHY24603	Nuclear Physics	2.5
	KUSPHY24604	Special Theory of Relativity	2.5
	KUSPHY246P1	Practical	2.5

Course Code	Course Title	Credits	Lectures / Week
KUSPHY24501	Paper I- Mathematical and Statistical Physics SEM V	2.5	4
About the Course: The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics.			
Course Objectives: 1. To understand the physical phenomena at the undergraduate level and get exposure to important ideas of statistical mechanics. 2. Students are expected to be able to solve simple problems in probability, understand the concept of independent events and work with standard continuous distributions. 3. To understand the functions of complex variables; solve nonhomogeneous differential equations and partial differential equations using simple methods. 4. To analyze and understand the difference between different statistics, classical as well as quantum.			
Unit	Topics	No of Lectures	
I	Probability Review of basic concepts, introduction, sample space, events, independent events, conditional probability, probability theorems, methods of counting (derivation of formulae not expected), random variables, continuous distributions (omit joint distributions), binomial distribution, the normal distribution, the Poisson distribution. Ref: MB – 15.1-15.9 section 2: 1-5, 11-15, section 3: 1, 3, 4, 5, section 4: 1, 3, 5, 13, 21, section 5: 1, 10, 13, section 6: 1 to 9, section 8: 1 and 3, section 9: 2, 3, 4, 9.	15	
II	Complex functions and differential equations 1. Functions of complex variables: The exponential and trigonometric functions, hyperbolic functions, logarithms, complex roots and powers, inverse trigonometric and hyperbolic functions, some applications. Ref.: MB: 2.11 to 2.16 , section 2: 16 – 2, 3, 8, 9, 10. 2. Second-order nonhomogeneous equations with constant coefficients, partial differential equations, some important partial differential equations in physics, method of separation	15	

	of variables. Ref : CH :5.2.4, 5.3.1 to 5.3.4 Expected to cover all solved problems. In addition, solve the following problems: 5.17 a to e, 5.23, 5.26, 5.29 to 5.35.	
III	Statistical Thermodynamics Microstates and configurations, derivation of Boltzmann distribution, dominance of Boltzmann distribution, physical meaning of the Boltzmann distribution law, definition of , the canonical ensemble, relating Q to q for an ideal gas, translational partition function, equipartition theorem, energy, entropy ER: 13.1 to 13.5, 14.1, 14.2, 14.4, 14.8, 15.1, 15.4	15
IV	Classical and Quantum Statistics The probability of a distribution, The most probable distribution, Maxwell Boltzmann statistics, Molecular speeds. Bose-Einstein statistics, Black-body radiation, The Rayleigh-Jeans formula, The Planck radiation formula, Fermi-Dirac statistics, Comparison of results. AB : 15.2 to 15.5, 16.1 to 16.6	15

References:

1. MB: Mathematical Methods in the Physical sciences: Mary L. Boas Wiley India, 3rd ed.
2. ER: Thermodynamics, Statistical Thermodynamics and Kinetics: T. Engel and P. Reid (Pearson).
3. AB: Perspectives of Modern Physics: Arthur Beiser, (Mc Graw Hill International).
4. CH: Introduction to Mathematical Methods: Charlie Harper (PHI Learning).

Additional References:

1. Mathematical Physics: A K Ghatak, Chua – 1995 Macmillian India Ltd.
2. Mathematical Method of Physics: Riley, Hobson and Bence, Cambridge (Indian edition).
3. Mathematical Physics: H. K. Das, S. Chand & Co.
4. Mathematical Methods of Physics: Jon Mathews & R. L. Walker, W A Benjamin inc.
5. A Treatise on heat: Saha and Srivastava (Indian press, Allahabad)
6. Statistical Physics: F. Reif (Berkeley Physics Course, McGraw Hill)
7. Introductory Statistical Mechanics: R. Bowley and M. Sanchez (Oxford Science Publications).
8. An Introduction to Thermal Physics: D. V. Schroeder (Pearson).
9. PROBABILITY: Schaum's Outlines Series by S. Lipschutz and M. L. Lipson (Mc Graw Hill International).

Course Code	Course Title SEM V	Credits	Lectures/ Week
KUSPHY24502	PAPER II - Solid State Physics	2.5	4
Course Objectives: On successful completion of this course students will be able to: 1. Understand the basics of crystallography, Electrical properties of metals, Band Theory of solids, demarcation among the types of materials, Semiconductor Physics and Superconductivity. 2. Understand the basic concepts of Fermi probability distribution function, Density of states, conduction in semiconductors and BCS theory of superconductivity. 3. Demonstrate quantitative problem solving skills in all the topics covered.			
Unit	Topics	No of Lectures	
I	Crystal Physics The crystalline state, Basic definitions of crystal lattice, basis vectors, unit cell, primitive and non-primitive cells, The fourteen Bravais lattices and the seven crystal systems, elements of symmetry, nomenclature of crystal directions and crystal planes, Miller Indices, spacing between the planes of the same Miller indices, examples of simple crystal structures, The reciprocal lattice and X-ray diffraction. Ref: Elementary Solid State Physics-Principles and Applications: M. Ali Omar, Pearson Education, 2012 : (1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.6)	15	
II	Electrical properties of metals: 1. Classical free electron theory of metals, Drawbacks of classical theory, Relaxation time, Collision time and mean free path 2. Quantum theory of free electrons, Fermi Dirac statistics and electronic distribution in solids, Density of energy states and Fermi energy, The Fermi distribution function, Heat capacity of the Electron gas, Mean energy of electron gas at 0 K, Electrical conductivity from quantum mechanical considerations, Failure of Sommerfeld's free electron Theory 3. Thermionic Emission Ref.: Solid State Physics: S. O. Pillai, New Age International. 6 th Ed. Chapter 6: II, III, IV, V, XIV, XV, XVI, XVII, XVIII, XX, XXXV, XXXI.	15	

III	1. 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. Ref.: Solid State Physics: S. O. Pillai, New Age International, 6th Ed. Chapter 6: XXXVI, XXXVII, XXXVIII, XXXIX, XXXX, XXXXI 2. 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 extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation, Hall Effect. Ref.: Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill.: 4.1 to 4.10.	15
IV	1. 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. Ref.: Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill.: 5.1 to 5.8 2. Superconductivity: Experimental Survey, Occurrence of Superconductivity, destruction of superconductivity by magnetic field, The Meissner effect, London equation, BCS theory of superconductivity, Type I and Type II Superconductors, Vortex state. Ref.: Introduction to Solid State Physics-Charles Kittel, 7th Ed. John Wiley & Sons: Topics from Chapter 12	15

References:

1. Elementary Solid State Physics-Principles and Applications: M.Ali Omar, Pearson Education, 2012.
2. Solid State Physics: S. O. Pillai, New Age International, 6th Ed.
3. Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill.
4. Introduction to Solid State Physics - Charles Kittel, 7th Ed. John Wiley & Sons.
5. Modern Physics and Solid State Physics: Problems and solutions New Age International.

Additional References:

1. Solid State Physics: A. J. Dekker, Prentice Hall.
2. Electronic Properties of Materials: Rolf Hummel, 3rd Ed. Springer.
3. Semiconductor Devices: Physics and Technology, 2nd Ed. John Wiley & Sons.
4. Solid State Physics: Ashcroft & Mermin, Harcourt College Publisher.

Course Code	Course Title SEM V	Credits	Lectures/ Week
KUSPHY24503	PAPER III- Atomic and Molecular Physics	2.5	4
Course Objectives: Upon successful completion of this course, the student will understand 1. To apply quantum mechanics in atomic physics 2. To Understand the importance of electron spin, symmetric and antisymmetric wave functions and vector atom model 3. To understand effect of magnetic field on atoms and its application 4. Learn Molecular physics and its applications.			
Unit	Topics	No of Lectures	
I	1. 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). 2. Electron spin: The Stern-Gerlach experiment, Pauli's Exclusion Principle Symmetric and Anti-symmetric wave functions. Ref – Unit – I - B: 9.1 to 9.9, B: 10.1, 10.3. 2	15	
II	1. Spin orbit coupling, Total angular momentum, Vector atom model, L-S and j-j coupling. Origin of spectral lines, Selection rules. 2. Effect of Magnetic field on atoms, the normal Zeeman effect and its explanation (Classical and Quantum), The Lande g - factor, Anomalous Zeeman effect. Ref – Unit – II - B: 10.2, 10.6, 10.7, 10.8, 10.9. B : 11.1 and 11.2	15	

III	1. Molecular spectra (Diatomic Molecules): Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational-Rotational spectra. Electronic Spectra of Diatomic molecules: The Born-Oppenheimer approximation, Intensity of vibrational-electronic spectra: The Franck-Condon principle. 2. Infrared spectrometer & Microwave spectrometer . Ref – Unit – III - B: 14.1, 14.3, 14.5, 14.7	15
IV	1. Raman effect: Quantum Theory of Raman effect, Pure Rotational Raman spectra: Linear molecules, symmetric top molecules, Asymmetric top molecules, Vibrational Raman spectra: Raman activity of vibrations, Experimental set up of Raman Effect. 2. Electron spin resonance: Introduction, Principle of ESR, ESR spectrometer 3. Nuclear magnetic resonance: Introduction, principle and NMR instrumentation. Ref – Unit – IV 1. BM: 6.11, 6.1.3. 2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.3.1. 2. GA: 8.6.1, 11.1, 11.2 and 11.3, 10.1, 10.2, 10.3	15
References: 1. B: Perspectives of Modern Physics : Arthur Beiser Page 8 of 18 McGraw Hill. 2. BM: Fundamentals of Molecular Spectroscopy : C. N. Banwell & E. M. McCash (TMH).(4th Ed.) 3. GA: Molecular structure and spectroscopy : G Aruldas (2nd Ed) PHI learning Pvt Ltd. 4. Atomic Physics (Modern Physics): S.N.Ghoshal. S.Chand Publication (for problems on atomic Physics).		

Course Code	Course Title SEM V	Credits	Lectures/ Week
KUSPHY24504	PAPER IV - Electrodynamics	2.5	4
Course Objectives: On successful completion of this course students will be able to: 1) Understand the laws of electrodynamics and be able to perform calculations using them. 2) Understand Maxwell's electrodynamics and its relation to relativity 3) Understand how optical laws can be derived from electromagnetic principles. 4) Develop quantitative problem solving skills.			
Unit	Topics	No of Lectures	
I	Electrostatics 1. Review of Coulomb & Gauss law, The divergence of E , Applications of Gauss law, The curl of E . Introduction to potential, Comments on potential, The potential of a localized charge distribution. Poisson's equation and Laplace's equation. Solution and properties of 1D Laplace equation. Properties of 2D and 3D Laplace equation (without proof). 2. Boundary conditions and Uniqueness theorems, Conductors and Second Uniqueness theorem, The classic image problem-point charge and grounded infinite conducting plane and conducting sphere. DG: 2.1.1 to 2.1.3, 2.2.2 to 2.2.4, 2.3.1 to 2.3.4 DG: 3.1.1 to 3.1.4, 3.1.5, 3.1.6, 3.2.1 to 3.2.4	15	
II	Electrostatics in Matter and Magnetostatics 1. Dielectrics, Induced Dipoles, Alignment of polar molecules, Polarization, Bound charges and their physical interpretation, Gauss' law in presence of dielectrics, A deceptive parallel, Susceptibility, Permittivity, Dielectric constant and relation between them, Energy in dielectric systems. 2. Review of Biot-Savart's law and Ampere's law, Straight-line currents, The Divergence and Curl of B , Applications of Ampere's Law in the case of a long straight wire and a long solenoid, Comparison of Magnetostatics and Electrostatics, Magnetic Vector Potential. DG: 4.1.1 to 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.4.1, 4.4.3 DG: 5.2.1, 5.3.1 to 5.3.4, 5.4.1	15	

III	Magnetostatics in Matter and Electrodynamics 1. Magnetization, Bound currents and their physical interpretation, Ampere's law in magnetized materials, A deceptive parallel, Magnetic susceptibility and permeability. 2. Energy in magnetic fields, Electrodynamics before Maxwell, Maxwell's correction to Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations in matter, Boundary conditions. DG: 6.1.1, 6.1.4, 6.2.1, 6.2.2, 6.2.3, 6.3.1, 6.3.2, 6.4.1 DG: 7.2.4, 7.3.1 to 7.3.6	15
IV	Electromagnetic Waves 1. The continuity equation, Poynting's theorem 2. The wave equation for E and B , Monochromatic Plane waves, Energy and momentum in electromagnetic waves, Propagation in linear media, Reflection and transmission of EM waves at normal incidence, Reflection and transmission of EM waves at oblique incidence. DG : 8.1.1, 8.1.2 DG : 9.2.1 to 9.2.3, 9.3.1 to 9.3.3	15
References: 1. DG: Introduction to Electrodynamics, David J. Griffiths (3rd Ed) Prentice Hall of India. 2. Introduction to Electrodynamics: A. Z. Capria and P. V. Panat, Narosa Publishing House. 3. Engineering Electrodynamics: William Hayt Jr. & John H. Buck (TMH). 4. Foundations of Electromagnetic Theory: Reitz, Milford and Christy. 5. Solutions to Introduction to Electrodynamics: David J. Griffiths (3rd Ed) Prentice Hall of India.		

Course Code	Course Title	Credits	Lectures/Week
KUSPHY245P1	PRACTICALS -SEMESTER V	2.5	6
Learning Outcome: On successful completion of this course students will be able to : 1. Understand & practice the skills while performing experiments. 2. Understand the use of apparatus and their use without fear & hesitation. 3. Correlate the physics theory concepts to practical application. 4. Understand the concept of errors and their estimation.			

Regular Experiment:

Sr No	Name of the Experiment
GROUP A	
	1. Determination of 'g' by Kater's pendulum 2. Surface tension of soap solution 3. Elastic constants of a rubber tube 4. Determination of dielectric constant 5. Logarithmic decrement 6. Searle's Goniometer 7. Determination of Rydberg's constant 8. Edser's 'A' pattern 9. Determination of wavelength by Step slit 10. Determination of e/m by Thomson's method 11. R. I. by total internal reflection 12. Velocity of sound in air using CRO
GROUP B	
	1. Mutual inductance by BG. 2. Capacitance by parallel bridge 3. Hysteresis loop by CRO 4. L/C by Maxwell's bridge 5. Band gap energy of Ge diode 6. Design and study of transistorized astable multivibrator (BB) 7. Design and study of Wien bridge oscillator 8. Design and study of first order active low pass filter circuit (BB) 9. Design and study of first order active high pass filter circuit (BB) 10. Application of IC 555 timer as a ramp generator (BB) 11. LM 317 as constant current source 12. Counters Mod 2, 5, 10 (2 x 5, 5 x 2)

	References: 1. Advanced course in Practical Physics: D. Chattopadhyaya, PC. Rakshit & B. Saha (8th Edition) Book & Allied Pvt. Ltd. 2. BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001. 3. A Text book of Practical Physics: Samir Kumar Ghosh New Central Book Agency (4th edition). 4. B Sc. Practical Physics: C. L. Arora (1st Edition) – 2001 S. Chand & Co. Ltd. 5. Practical Physics: C. L. Squires – (3rd Edition) Cambridge University Press. 6. University Practical Physics: D C Tayal. Himalaya Publication. 7. Advanced Practical Physics: Worsnop & Flint.
	Skill
	1. Estimation of errors from actual experimental data 2. Soldering and testing of an astable multivibrator (Tr./IC555) circuit on PCB 3. Optical Leveling of Spectrometer 4. Schuster's method 5. Laser beam profile 6. Use of electronic balance: Find the density of a solid cylinder 7 Dual trace CRO: Phase shift measurement 8. C1/C2 by B G 9. Internal resistance of voltage and current source 10. Use of DMM to test diode, transistor and β factor

Note: Minimum **8** experiments (Four From each group) and **4** Skill experiments should be completed and reported in the journal, in the first semester. **A Certified Journal is a must**, to be eligible to appear for the semester end practical examination.

Course Code	Course Title SEM VI	Credits	Lectures/ Week
KUSPHY24601	PAPER I- Classical Mechanics	2.5	4
Course Objectives: 1. To understand the kinds of motions that can occur under a central potential and their applications to planetary orbits. 2. To learn the concepts needed for the important formalism of Lagrange's equations and derive the equations using D'Alembert's principle. 3. To understand simple concepts from fluid mechanics dynamics of rigid bodies. 4. To analyze the drastic effect of adding nonlinear corrections to usual problems of mechanics and nonlinear mechanics can help understand the irregularity we observe around us in nature.			
Unit	Topics	No of Lectures	
I	Central Force 1. Motion under a central force, the central force inversely proportional to the square of the distance, Elliptic orbits, The Kepler problem. 2. Moving origin of coordinates, Rotating coordinate systems, Laws of motion on the rotating earth, The Foucault pendulum, Larmor's theorem. KRS: 3.13 - 3.15, 7.1 - 7.5.	15	
II	Lagrange's equations 1. D'Alembert's principle, Constraints, Examples of holonomic constraints, examples of nonholonomic constraints, degrees of freedom and generalized coordinates, virtual displacement, virtual work, D'Alembert's principle, illustrative problems. 2. Lagrange's equations (using D'Alembert's principle), properties of Lagrange's equations, illustrative problems, canonical momentum, cyclic or ignorable coordinates. PVP: 4.2 to 4.9, 5.2 to 5.4, 7.2, 7.3.	15	
III	Fluid Motion and Rigid body rotation 1. Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow. 2. Rigid dynamics: introduction, degrees of freedom, rotation about an axis: orthogonal matrix, Euler's theorem, Eulerian angles, inertia tensor, angular momentum of rigid body, Euler's equation of motion	15	

	of rigid body, free motion of rigid body, motion of symmetric top (without notation). KRS : 8.6 to 8.9 PVP: 16.1 to 16.10	
IV	Non Linear Mechanics 1. Nonlinear mechanics: Qualitative approach to chaos, The anharmonic oscillator, Numerical solution of Duffing's equation. 2. Transition to chaos: Bifurcations and strange attractors, Aspects of chaotic behavior (Logistic map). BO: 11.1, 11.3 to 11.5	15
References: 1. PVP: Classical Mechanics, P. V. Panat (Narosa). 2. KRS: Mechanics : Keith R. Symon, (Addision Wesely) 3rd Ed. 3. BO: Classical Mechanics- a Modern Perspective: V. D. Barger and M. G. Olsson. (Mc Graw Hill International 1995 Ed.) Additional References 1. Classical Mechanics: Herbert Goldstein (Narosa 2nd Ed.). 2. An Introduction to Mechanics: Daniel Kleppner & Robert Kolenkow Tata Mc Graw Hill (Indian Ed. 2007). 3. Chaotic Dynamics- an introduction: Baker and Gollub (Cambridge Univ. Press). 4. Classical Mechanics: J. C. Upadhyaya (Himalaya Publishing House).		

Course Code	Course Title SEM VI	Credits	Lectures/ Week
KUSPHY24602	Paper II - Electronics	2.5	4
Course Objectives: On successful completion of this course students will be able to: 1. Understand the basics of semiconductor devices and their applications. 2. Understand the basic concepts of operational amplifier: its prototype and applications as instrumentation amplifier, active filters, comparators and waveform generation. 3. Understand the basic concepts of timing pulse generation and regulated power supplies 4. Understand the basic electronic circuits for universal logic building blocks and basic concepts of digital communication. 5. Develop quantitative problem solving skills in all the topics covered.			
Unit	Topics	No of Lectures	
I	1. 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. 2. MOSFET: Depletion and enhancement mode, MOSFET operation and characteristics, digital switching. 3. SCR: Construction, static characteristics, Analysis of the operation of SCR, Gate Triggering Characteristics, Variable half wave rectifier and Variable full wave rectifier, Current ratings of SCR. 4. UJT: Construction, Operation, characteristics and application as a relaxation oscillator. 1. MB: 13.1 to 13.9 2. MB: 14.1, 14.2, 14.4, 14.6. 3. AM: 28.1, 28.5	15	

II	1. 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. 2. Op Amp Applications: Log amplifier, Instrumentation amplifiers, Voltage controlled current sources (grounded load), First order Active filters, Astable using OP AMP, square wave and triangular wave generator using OP AMP, Wein-bridge oscillator using OP AMP, Comparators with Hysteresis, Window Comparator. 1. MB: 17.1 to 17.5 2. MB: 20.5, 20.8, 21.4, 22.2, 22.3, 22.7, 22.8, 23.	15
III	1. Transistor Multivibrators: Astable, Monostable and Bistable Multivibrators, Schmitt trigger. 2. 555 Timer: Review Block diagram, Monostable and Astable operation Voltage Controlled Oscillator, Pulse Width modulator, Pulse Position Modulator, Triggered linear ramp generator. 3. Regulated DC power supply: Supply characteristics, series voltage regulator, Short circuit protection (current limit and fold back) Monolithic linear IC voltage Regulators. (LM 78XX, LM 79XX, LM 317, LM337). 1. AM: 18.11 2. KVR: 14.5.2.1, 14.5.2.5, 14.5.2.6, 14.5.4.1 3. MB: 23.8, 23.9 4. MB: 24.1, 24.3, 24.4	15
IV	1. Logic families: Standard TTL NAND, TTL NOR, Open collector gates, Three state TTL devices, MOS inverters, CMOS NAND and NOR gates, CMOS characteristics. 2. Digital Communication Techniques: Digital Transmission of Data, Benefits of Digital Communication, Disadvantages of Digital Communication, Parallel and Serial Transmission, Pulse Modulation, Comparing Pulse-Modulation Methods (PAM, PWM, PPM), Pulse-Code Modulation. 1. ML: 6.2, 6.4, 6.6, 6.7, 7.2 to 7.4. 2. LF: 7.1, 7.2, 7.4	15

References:

1. **MB:** Electronic Principles, Malvino & Bates -7th Ed TMH Publication.
2. **AM:** Electronic Devices and Circuits, Allen Mottershead -PHI Publication.
3. **KVR:** Functional Electronics, K.V. Ramanan-TMH Publication.
4. **ML:** Digital Principles and Applications, Malvino and Leach (4th Ed)(TMH).
5. **LF:** Communication Electronics: Principles and applications, Louis E Frenzel 4th edition TMH Publications.

Course Code	Course Title SEM VI	Credits	Lectures/ Week
KUSPHY24603	Paper III - Nuclear Physics	2.5	4

Course Objectives:

1. To understand the fundamental principles and concepts governing classical nuclear and particle physics and have a knowledge of their applications interactions of ionizing radiation with matter the key techniques for particle accelerators the physical processes involved in nuclear power generation.
2. To learn about elementary particles.
3. To understand the fundamental constituents of matter and lay foundation for the understanding of unsolved questions about dark matter, antimatter and other research oriented topics.

Unit	Topics	No of Lectures
I	Alpha & Beta Decay 1. Alpha decay: Velocity, energy, and Absorption of alpha particles: Range, Ionization and stopping power, Nuclear energy levels. Range of alpha particles, alpha particle spectrum, Fine structure, long range alpha particles, Alpha decay paradox: Barrier penetration (Gamow's theory of alpha decay and Geiger Nuttal law). 2. Beta decay: Introduction, Velocity and energy of	15

	beta particles, Energy levels and decay schemes, Continuous beta ray spectrum-Difficulties encountered to understand it, Pauli's neutrino hypothesis, Detection of neutrino, Energetics of beta decay. 1. IK: 13. 1, 13.2, 13.5, SBP: 4. II. 1, 4. II. 2, 4. II. 3, 1.II.3 2. IK: 14.1, 14.7, SBP: 4. III. 1, 4. III. 2, 4. III. 3, 4. III. 5, SNG : 5.5.	
II	Gamma Decay & Nuclear Models 1. Gamma decay: Introduction, selection rules, Internal conversion, nuclear isomerism, Mossbauer effect. 2. Nuclear Models: Liquid drop model, Weizsacker's semi-empirical mass formula, Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. Shell model (Qualitative), Magic numbers in the nucleus. 1.SBP: 4. IV. 1, 4. IV.2, 4. IV. 3, 4. IV. 4, 9.4 2.SBP: 5.1, 5.3, 5.4, 5.5. AB: 11.6-pages (460,461)	15
III	Nuclear Energy & Particle Accelerators 1. Nuclear energy: Introduction, Asymmetric fission - Mass yield, Emission of delayed neutrons, Nuclear release in fission, Nature of fission fragments, Energy released in the fission of U235, Fission of lighter nuclei, Fission chain reaction, Neutron cycle in a thermal nuclear reactor (Four Factor Formula), Nuclear power and breeder reactors, Natural fusion Possibility of controlled fusion. 2. Particle Accelerators: Van de Graaff Generator, Cyclotron, Synchrotron, Betatron and Idea of Large Hadron Collider. 1. SBP: 6.1, 6.3 to 6.9, 9.6, 9.7, 8.1,8.2,8.3 2. SBP: 1.I.4 (i), 1.I.4 (ii), 1.I.4 (iii), 1.I.4 (iv), 6.9, AB: 13.3	15
IV	Nuclear force & Elementary particles 1. Nuclear force: Introduction, Deuteron problem, Meson theory of Nuclear Force- A qualitative discussion. 2.Elementary particles: Introduction, Classification of elementary particles, Particle interactions, Conservation laws (linear & angular momentum, energy, charge, baryon number & lepton number), particles and antiparticles (Electrons and positrons, Protons and anti-protons, Neutrons and anti neutrons, Neutrinos and anti-neutrinos), Photons, Mesons, Quark model (Qualitative).	15

	1. SBP: 8.6 2. DCT: 18.1, 18.2,18.3, 18.4 , 18.5 to 18.9 AB: 13.5	
References: 1. AB: Concepts of Modern Physics: Arthur Beiser, Shobhit Mahajan, S Rai Choudhury (6th Ed.) (TMH). 2. SBP: Nuclear Physics, S.B. Patel (Wiley Eastern Ltd.). 3. IK: Nuclear Physics, Irving Kaplan (2nd Ed.) (Addison Wesley). 4. SNG: Nuclear Physics, S. N. Ghoshal (S. Chand & Co.) 5. DCT: Nuclear Physics, D. C. Tayal (Himalayan Publishing House) 5th ed. Additional References 1. Modern Physics: Kenneth Krane (2nd Ed.), John Wiley & Sons. 2. Atomic & Nuclear Physics: N Subrahmanyam, Brij Lal.(Revised by Jivan Seshan.) S. Chand. 3. Atomic & Nuclear Physics: A B Gupta & Dipak Ghosh Books & Allied (P) Ltd. 4. Introduction to Elementary Particles: David Griffith, Second Revised Edition, Wiley-VCH.		

Course Code	Course Title SEM VI	Credits	Lectures/ Week
KUSPHY24604	Paper IV - Special Theory of Relativity	2.5	4
About the Course: The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics.			
Course Objectives: After the completion of the course the student should be able to 1. Understand the significance of Michelson Morley experiment and failure of the existing theories to explain the null result 2. Understand the importance of postulates of special relativity, Lorentz transformation equations and how it changed the way we look at space and time, Absolutism and relativity, Common sense versus Einstein concept of Space and time.			

3. Understand the transformation equations for: Space and time, velocity, frequency, mass, momentum, force, Energy, Charge and current density, electric and magnetic fields.
4. Solve problems based on length contraction, time dilation, velocity addition, Doppler effect, mass energy relation and resolve paradoxes in relativity like twin paradox etc.

Unit	Topics	No of Lectures
I	Introduction to Special theory of relativity: Inertial and Non-inertial frames of reference, Galilean transformations, Newtonian relativity, Electromagnetism and Newtonian relativity. Attempts to locate absolute frame: Michelson- Morley experiment (omit derivation part), Attempts to preserve the concept of a preferred ether frame: Lorentz Fitzgerald contraction and Ether drag hypothesis (conceptual), Stellar aberration, Attempt to modify electrodynamics. Relativistic Kinematics - I: Postulates of the special theory of relativity, Simultaneity, Derivation of Lorentz transformation equations. Some consequences of the Lorentz transformation equations: length contraction, time dilation and meson experiment, The observer in relativity. RR: 1.1 to 1.9, 2.1 to 2.5	15
II	Relativistic Kinematics - II: The relativistic addition of velocities, acceleration transformation equations, Aberration and Doppler effect in relativity, The common sense of special relativity. The Geometric Representation of Space-Time: Space-Time Diagrams, Simultaneity, Length contraction and Time dilation, The time order and space separation of events, The twin paradox. RR: 2.6 to 2.8, Supplementary topics A1, A2, A3, B1, B2, B3.	15
III	Relativistic Dynamics: Mechanics and Relativity, The need to redefine momentum, Relativistic momentum, Alternative views of mass in relativity, The relativistic force law and the dynamics of a single particle, The equivalence of mass and energy, The transformation properties of momentum, energy and mass. RR: 3.1 to 3.7	15

IV	Relativity and Electromagnetism: Introduction, 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. The principle of equivalence and general relativity, Gravitational red shift. RR: 4.1 to 4.7. Supplementary topic C1, C2, C3, C4. Note: (A good number of problems to be solved from Resnick).	15
References: 1. RR: Introduction to Special Relativity: Robert Resnick (Wiley Student Edition). 2. Special theory of Relativity: A. P. French. 3. Very Special Relativity – An illustrated guide: by Sander Bais - Amsterdam University Press. 4. Chapter 1: Concepts of Modern Physics by Arthur Beiser. 5. Chapter 2: Modern Physics by Kenneth Krane.		

Course Code	Course Title SEM VI	Credits	Lectures/ Week
KUSPHY246P1	PRACTICAL - SEM IV	2.5	6
Learning Outcome: On successful completion of this course students will be able to : 1. Understand & practice the skills while performing experiments. 2. Understand the use of apparatus and their use without fear & hesitation. 3. Correlate their physics theory concepts to practical application. 4. Understand the concept of errors and their estimation.			

Regular Experiment:

Sr. No	Name of the Experiments
GROUP A	

	1. Surface tension of mercury by Quincke's method 2. Thermal conductivity by Lee's method 3. Study of JFET characteristics 4. JFET as a common source amplifier 5. JFET as switch (series and shunt) 6. UJT characteristics and relaxation oscillator 7. Study of Pulse width modulation (BB) 8. Study of Pulse position modulation (BB) 9. Determination of h/e by photocell 10. R. P. of Prism 11. Double refraction 12. Lloyd's single mirror: determination of wavelength
GROUP B	
	1. Determination of M/C by using BG 2. Self-inductance by Anderson's bridge Hall effect 3. Solar cell characteristics and determination of Voc, Isc and Pmax 4. Design and study of transistorized monostable multivibrator (BB) 5. Design and study of transistorized bistable multivibrator (BB) 6. Application of Op-Amp as a window comparator 7. Application of Op-Amp as a Log amplifier 8. Application of IC 555 as a voltage to frequency converter (BB) 9. Application of IC 555 as a voltage to time converter (BB) 10. LM-317 as variable voltage source 11. Shift register

DEMONSTRATION EXPERIMENT	
	1. Open CRO, Power Supply, and Signal Generator: block diagrams 2. Data sheets: Diodes, Transistor, Op-amp & Optoelectronic devices 3. Zeeman Effect 4. Michelson's interferometer 5. Constant deviation spectrometer (CDS) 6. Digital storage oscilloscope (DSO) 7. Determination of Op-Amp parameters (offset voltage, slew rate, input impedance, output impedance, ACM) 8. Transformer (theory, construction and working), types of transformers and energy losses associated with them. 9. Use of LCR meter 10. Lux meter / Flux meter

	References: 1. Advanced course in Practical Physics: D. Chattopadhyaya, PC. Rakshit & B. Saha (8th Edition) Book & Allied (P) Ltd. 2. BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001. 3. A Text book of Practical Physics: Samir Kumar Ghosh New Central Book Agency (4th edition). 4. B Sc. Practical Physics: C. L. Arora (1st Edition) – 2001 S. Chand & Co. 5. Practical Physics: C. L. Squires – (3rd Edition) Cambridge Univ. Press. 6. University Practical Physics: D C Tayal, Himalaya Publication. 7. Advanced Practical Physics: Worsnop & Flint.
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Note: Minimum **8** experiments (Four From each group) and **4** Demo experiments should be completed and reported in the journal, in the first semester. **Certified Journal is a must**, to be eligible to appear for the semester end practical examination.

Evaluation Scheme for Third Year (UG) under AUTONOMY

I. Internal Evaluation for Theory Courses – 40 Marks

II. External Examination for Theory Courses – 60 Marks

III. Practical Examination : 100 marks

Internal Evaluation for practical Courses – 40 Marks One small experiment :- 30 + 10 viva

External Examination for practical Courses – 60 Marks One experiment of one hour duration ----- 50 Marks, Journal : 10 marks

Evaluation Scheme for Third Year (UG) under AUTONOMY (2024-2025)

I. Internal Evaluation for Theory Courses – 40 Marks

(i) Continuous Internal Assessment 1 (Assignment- Tutorial/ Ind. Visit/– 20 Marks

(ii) Class Internal Assessment 2 – 20 Marks (Class Test with Fill in the Blanks, True or False & Answer the following)

II. External Examination for Theory Courses – 60 Marks

Duration: 2 Hours

Theory question paper pattern:

All questions are compulsory.

Question	Based on	Options	Marks
Q.1	MCQ and fill in the blanks	6 fill in the blanks and 6 MCQs on (Unit-I, II & III), 1 mark each	12
Q.2	Unit I	<i>Any 3 out of 5 sub questions, 4 marks each</i>	12
Q.3	Unit II	<i>Any 3 out of 5 sub questions, 4 marks each</i>	12
Q.4	Unit III	<i>Any 3 out of 5 sub questions, 4 marks each</i>	12
Q.5	Unit I,II,III	<i>Solve 3 out of five questions, 4 marks each (problems).</i>	12

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be sub-divided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

III. Practical Examination

- Each core subject carries 50 Marks (30 marks External + 20 marks Internal)
- Duration: 2 Hours for each practical course.
- Minimum 80% practical from each core subjects are required to be completed.
- Certified Journal is compulsory for appearing at the time of Practical Exam

**** This Syllabus will change as per the change according to University of Mumbai and will be implemented accordingly**