S.N.D.T. WOMEN'S UNIVERSITY

Syllabus for B.Sc.

Subject: Physics

B Sc (Physics) Programme

To be implemented from the Academic year 2013-2014

1. The eligibility for the course is 12^{th} pass from any recognized board for the first year admission.

2. For second year admission the student must have cleared semester 1 and 2 or can have maximum A.T. K. T of 40% credits. And the student must have taken mathematics at F. Y. B. Sc. Level as one of the subject.

   For III year admission the student must have cleared F. Y. B. Sc. And can have maximum 40% credits A.T. K. T in second year B. Sc. and should have mathematics as second subject.

3. Students taking Physics as one of the subject at S Y level should have completed Mathematics course of F Y level of SNDT University. Similarly students taking Physics as one of the subject at T Y level should have completed Mathematics course of F Y and S Y levels of SNDT University.

4. A bridge course of mathematical physics is recommended to be conducted before students enter in T Y B Sc.

5. The lateral entry may be permitted if the student qualifies the exam conducted by the SNDT University should have eligibility criteria.

6. The lateral exit can be given at any time with showing the number of credit student has earned at FY/ SY level.

Physics
1 Credit = 15 Lectures = 25 Marks, Total Credits= 66.

Class	Sem.	Paper	Title	Marks	Credits
F.Y.B.Sc.	I	103101	Mechanics-I	50	2
		103102	Heat & Thermodynamics	50	2
		103201	Practical based on 103101 and 103102	50	2
				(150)	(6)
F.Y.B.Sc.	II	203101	Electricity & Electromagnetism	50	2
		203102	Waves & Oscillations	50	2
		203201	Practical based on 203101 and 203102	50	2
				(150)	(6)
				300	**12**
S.Y.B.Sc.	III	303101	Mechanics-II	75	3
		303102	Electronics-I	75	3
		303201	Practical based on 303101 and 303102	75	3
				(225)	(9)
S.Y.B.Sc.	IV	403101	Thermodynamics and Electrodynamics-I.	75	3
		403102	Optics and Modern Physics	75	3
		403201	Practical based on 403101 and 403102	75	3
				(225)	(9)
				450	**18**
T.Y.B.Sc.	V	503101	Thermal and Statistical Mechanics	75	3
		503102	Solid State Physics	75	3
		503103	Atomic and Molecular Physics	75	3
		503104	Electrodynamics-II	75	3
		503201	Practical based on 503101 and 503102	75	3
		503202	Practical based on 503103 and 503104	75	3
				(450)	(18)
T.Y.B.Sc.	VI	603101	Classical Mechanics	75	3
		603102	Electronics-II	75	3
		603103	Nuclear Physics.	75	3
		603104	Special Theory of Relativity	75	3
		603201	Practical based on 603101 and 603102	75	3
		603202	Practical based on 603103 and 603104	75	3
				(450)	(18)
				900	**36**

Semester-I

Paper Code	Paper Nomenclature	Lectures	Credits
103101	Mechanics-I	30	02
103102	Heat & Thermodynamics	30	02
103201	Practical based on 103101 and 103102	30	02

Semester-I		
Paper Code	**Theory**	**Credits:2**
103101	**Title: Mechanics-I**	**30 L**
Unit 1	**Rotational motion**	**15 L**
	Rotational Kinematics: Rotational motion and angular displacement, Angular velocity and angular acceleration, Equations of rotational kinematics, Angular variables and tangential variables, centripetal acceleration, Rolling motion, The vector nature of angular variables. Ref: PHY: 8.1 to 8.8. ***Rotational Dynamics:*** The effects of forces and torque on the motion, Rigid objects in equilibrium, Center of gravity, Newton's second law of rotational motion, Rotational work and energy, Angular momentum. Ref: PHY: 9.1 to 9.7	
Unit 2	**SHM, Solids and Fluids**	**15 L**
	Simple Harmonic motion and Elasticity: The ideal spring and SHM, SHM and reference circle, Energy and SHM, The pendulum, Damped harmonic motion, Driven harmonic motion and resonance, Elastic deformation, Stress, strain and Hook's law. Ref: PHY: 10.1 to 10.9 ***Fluids:*** Mass density, Pressure, Pressure and depth in static fluid, Pressure gauges, Pascal's principle, Archimede's principle, Fluids in motion, The equation in continuity, Bernoulli's equation, Application, Viscous flow. Ref: PHY: 11.1 to 11.12	
References:		
Physics by Cutnell and Johnson--- Wiley India Edition (5th Edition). (PHY)		
Additional References:		
1. Fundamentals of physics by Alan Giambattista, betty McCarthy Richardson, Robert C Richardson- Tata McGraw Hill. 2. Physics: (Volumes I and II) H. C. Verma. 3. Physics: (Volumes I and II) by Resnick, Halliday and Krane- Wiley India Edition (5th Edition)		

103102	Title: Heat & Thermodynamics	30 L
Unit 1	**Heat**	**15 L**
	Temperature and Heat: Common temperature scales, Kelvin temperature scale, thermometers, linear thermal expansions, volume thermal expansions, heat and thermal energy, heat and temperature change, heat and phase change, equilibrium between phase of matter, humidity. Ref: PHY 12.1 to 12.11. ***The Transfer of Heat:*** Convection, conduction, radiation, applications. Ref: PHY 13.1 to 13.5	
Unit 2	**Thermodynamics**	**15 L**
	The ideal gas laws and Kinetic theory: The mole Avogadro number, The ideal gas law, The kinetic theory of gases, Diffusion. Ref: 14.1 to 14.5 ***Thermodynamics.*** Thermodynamic system and surroundings, The Zeroth law of Thermodynamics, The first law of thermodynamics, Thermal process, Thermal process that utilizes ideal gas, Specific heat capacities and First law, The second law of thermodynamics, Heat engines, Carnot's principle and engine, Refrigerator, Entropy, The third law of thermodynamics, Concepts and calculation. Ref: 15.1 to 15.13.	

References:

Physics by Cutnell and Johnson--- Wiley India Edition (5th Edition). (PHY)

Additional References:

1. Fundamentals of physics by Alan Giambattista, betty McCarthy Richardson, Robert C Richardson- Tata McGraw Hill.
2. Physics: (Volumes I and II) H. C. Verma.
3. Physics: (Volumes I and II) by Resnick, Halliday and Krane- Wiley India Edition (5th Edition)

103201	Title: Practical based on 103101 and 103102	Credits: 2 30 L
Group A	**Mechanics-I**	
	1. Determination of acceleration due to gravity by Kater's pendulum. 2. Y by bending of a beam loaded at the centre. 3. Determination of Y by cantilever (oscillation method). 4. M. I. by bifilar suspension. 5. M. I. of Flywheel. 6. Determination of Y & η of the material of a flat spiral spring. 7. Y by Searle's apparatus. 8. Flywheel 9. Torsional oscillations 10. Bifilar Pendulum	
Group B	**Heat & Fluids**	
	1. Thermal conductivity of a bad conductor by Lee's disc mefhod. 2. Determination of Stefans's constant. 3. Thermal conductivity of rubber tube 4. Measurement of thermo-emf. 5. J by Callender &. Barne's method. 7. Determination of coefficient of viscosity by Poiseuille's method 8. S. T. by Jaeger's method. 9 .J by Electrical Method 10. η by Maxwell's needle.	
Minimum 4 experiments should be carried out from each group		
References:		
1. Advanced Practical Physics – Worsnop & Flint 2. Advanced course in Practical Physics D. Chattopadhya , P.C. Rakshit & B. Saha 3. B. Sc. Practical Physics –C. L. Arora		

Minimum two skill experiments and two demonstration experiments should be performed

Skill Experiments

1. Use of Vernier Callipers, Micrometer Screw Gauge and Travelling Microscope
2. Graph plotting (Exponential, Straight line with intercept, Resonance curve etc.)
3. Use of calculator

Demonstration experiments

1. Angular momentum conservation (Rotating platform)
2. Resonance Pendulum
3. Use of PC for graphs
4. Experimental statistical probability for two option system using a coin.

Workload

Theory 2 lectures per week per paper.
Practical: 1 practical of 2 lecture periods per week per batch. Two lecture periods of the practicals shall be conducted in succession together on a single day.

Scheme of Examination

Theory examination:

Duration - 2 Hours duration for each paper.

Theory Question Paper Pattern (For Paper I, and II):

1. There shall be three questions. On each unit there will be one question of 15 marks and the third one will be based on entire syllabus of 20 marks.
2. All questions shall be compulsory with internal choice within the questions. (Each question on each unit will be of 20 to 23 marks with options and a question on entire syllabus will be of 25 to 27 marks with options)
3. Question may be subdivided into sub-questions a, b, c … and the allocation of marks depend on the weightage of the topic.

Practical examination:

Duration - 3 Hours duration for practical.

Practical examination is conducted out of 50 marks.

Semester-II

Paper Code	Paper Nomenclature	Lectures	Credits
203101	Electricity & Electromagnetism	30	02
203102	Waves & Oscillations	30	02
203201	Practical based on 203101 and 203102	30	02

Semester-II		
Paper Code	**Theory**	**Credits:2**
203101	**Title: Electricity & Electromagnetism**	**30 L**
Unit 1	**Electricity**	**15 L**
	Electric forces and fields: The origin of electricity, charged objects and electric force, conductors and insulators, charging by contacts and induction, coulomb's law, Electric field, Electric field lines, The Electric field inside the conductor, Gauss's law, Copiers and computer printers, Concepts and calculations. Ref: PHY 18.1 to 18.11 ***Electric potential energy and electric potential*** Potential energy, Potential difference, Electric potential difference by point charges, Equi-potential surfaces, Capacitors and dielectrics, Biomedical applications. Ref: PHY 19.1 to 19.7 ***Electric Circuits:*** Electromotive forces and Current, Ohm's law, Resistance and resistivity, Electric power, Alternating current, Series wiring, Parallel wiring, Circuits wired partially in series and partially in parallel, Internal resistance, Kirchoff's rules, measurements of currents and voltage, Capacitors in series and parallel, RC circuits, Safety and physiological effects, Ref: PHY 20.1 to 20.15	

Unit 2	Electromagnetism	15 L
	Magnetic forces and fields: Magnetic fields, forces exerted by magnetic fields on moving charges, motion of charged particles in magnetic field, mass spectrometer, forces on current in magnetic field, torque on current carrying coil, magnetic field produced by current, Ampere's law, Magnetic materials. Ref: PHY 21.1 to 21.10 ***Electromagnetic Induction:*** Induced EMF and current, Motional EMF, Magnetic flux, Faradays laws of electromagnetic induction, Lenz's law, Application of electromagnetic induction, The Electric generator, Mutual inductance and self inductance, Transformers. Ref: PHY 22.1 to 22.10 ***Alternating currents:*** Capacitors and capacitive reactance, Inductors and inductive reactance, Circuits with L C R, Resonance in electric circuits, Semiconductors devices Ref: PHY 23.1 to 23.6.	

References:

Physics by Cutnell and Johnson--- Wiley India Edition (5^{th} Edition). (PHY)

Additional References:

1. Fundamentals of physics by Alan Giambattista, betty McCarthy Richardson, Robert C Richardson- Tata McGraw Hill.
2. Physics: (Volumes I and II) H. C. Verma
3. Physics: (Volumes I and II) by Resnick, Halliday and Krane-Wiley India Edition (5^{th} Edition)

203102	Title: Waves & Oscillations	30 L
Unit 1	**Sound**	**15 L**
	Waves and Sound: The nature of waves, Periodic waves, The speed of wave on the strings, The mathematical description of a wave, The nature of sound, The speed of sound, Sound intensity, Decibels, The Doppler effect, Application of sound in medicine, The sensitivity of human ear, Concepts and calculations. Ref: PHY: 16.1 to 16.12. ***The Principal Linear superposition and Interference phenomenon.*** The principle of superposition, Constructive and destructive interference, Diffraction, Beats, Transverse standing waves, Longitudinal waves, Complex sound waves. Ref: PHY: 17.1 to 17.8	

Unit 2	Electromagnetic, Light and Particle waves	15 L
	Electromagnetic waves: The nature of electromagnetic waves, The electromagnetic spectrum, The speed of light, The energy carried by waves, The Doppler effect, Polarization. Ref: PHY: 24.1 to 24.7 ***Wave nature of light:*** The principle of superposition, Young's double slit experiment, Thin film interference, The Michelson interferometer, Diffraction, Resolving power, The diffraction Grating, Compact discs, DVD and use of interference. Ref: PHY: 27.1 to 27.10 ***Particles and waves:*** The wave particle duality, Black body radiation and Planck's constant, Photons and photo electric effect, The momentum of a photon, The de Broglie's wavelength and wave nature of matter, The Heisenberg's principle. Ref: PHY: 29.1 to 29.7	
References:		
Physics by Cutnell and Johnson--- Wiley India Edition (5^{th} Edition). (PHY)		
Additional References:		
1. Fundamentals of physics by Alan Giambattista, betty McCarthy Richardson, Robert C Richardson- Tata McGraw Hill. 2. Physics: (Volumes I and II) H. C. Verma. 3. Physics: (Volumes I and II) by Resnick, Halliday and Krane- Wiley India Edition (5^{th} Edition)		

203201	Title: Practical based on 203101 and 203102	Credits: 2 30 L
Group A	**Electricity & Electromagnetism**	
	1. Temperature coefficient of thermister using Carey-Foster's bridge 2. LR circuit 3. CR circuit 4. LCR Series Resonance 5. LDR characteristics 6. Determination of AC mains using sonometer 7. Determination of.absolute capacity of 8. Determination of low resistance using 9. Comparison of capacities by Desauty's method 10. Field along the axis of a circular coil	

Group B	Waves & Oscillations	
	1. Velocity of sound by Quincke's tube 2. Velocity of sound by volume resonator 3. Combination of lenses (cardinal points) 4. Study of temperature dependence of total radiation 5. Determine frequency by Lissajous figures using CRO 6. Calibration of a spectrometer 7. Spectrometer (determination of refractive index μ of material of prism) 8. Dispersive power of prism 9. Newton's rings	
Minimum 4 experiments should be carried out from each group		
References:		
1. Advanced Practical Physics – Worsnop & Flint 2. Advanced course in Practical Physics D. Chattopadhya , P.C. Rakshit & B. Saha 3. B. Sc. Practical Physics –C. L. Arora		

Minimum two skill experiments and two demonstration experiments should be performed

Skill Experiments
Use of oscilloscope
Use of DMM
Spectrometer : Schuster's Method

Demonstration experiments
Charging and Discharging of a capacitor
Faraday's Induction Experiment
Laser beam divergence, intensity

Workload

Theory 2 lectures per week per paper.
Practical: 1 practical of 2 lecture periods per week per batch. Two lecture periods of the practicals shall be conducted in succession together on a single day.

Scheme of Examination

Theory examination:

Duration - 2 Hours duration for each paper.

Theory Question Paper Pattern (For Paper I, and II):

1. There shall be three questions. On each unit there will be one question of 15 marks and the third one will be based on entire syllabus of 20 marks.

2. All questions shall be compulsory with internal choice within the questions. (Each question on each unit will be of 20 to 23 marks with options and a question on entire syllabus will be of 25 to 27 marks with options)
3. Question may be subdivided into sub-questions a, b, c … and the allocation of marks depend on the weightage of the topic.

Practical examination:

Duration - 3 Hours duration for practical.

Practical examination is conducted out of 50 marks.

Semester-III

Paper Code	Paper Nomenclature	Lectures	Credits
303101	**Mechanics-II**	**45**	**03**
303102	**Electronics-I**	**45**	**03**
303201	**Practical based on 303101 and 303102**	**45**	**03**

Semester-III		
Paper Code	**Theory**	**Credits:03**
303101	**Title: Mechanics-II**	**45 L**
Unit 1	**Kinematics and Dynamics**	**15 L**
	Motion in One Dimension: Average Velocity, Instantaneous Velocity, Analysis Models—The Particle Under Constant Velocity, Acceleration, Motion Diagrams, The Particle Under Constant Acceleration, Freely Falling Objects. ***Motion in Two Dimensions****:* The Position, Velocity, and Acceleration Vectors, Two-Dimensional Motion with Constant Acceleration, Projectile, The Particle in Uniform Circular Motion, Tangential and Radial Acceleration, Relative Velocity Ref.: SJ1: Chapters 1,2,3. ***Rotational Motion:*** Angular Position, Speed, and Acceleration, Rotational Kinematics: The Rigid Object Under Constant Angular Acceleration, Relations Between Rotational and Translational Quantities, Rotational Kinetic Energy, Torque and the Vector Product, The Rigid Object in Equilibrium, The Rigid Object Under a Net Torque, Angular Momentum, Conservation of Angular Momentum, Processionals Motion of Gyroscope, Rolling motion of rigid objects. Ref.: SJ1: Chapter 10 ***Oscillatory Motion:*** Motion of a Particle Attached to a Spring, Energy Considerations in Simple Harmonic Motion, The Simple Pendulum, The Physical Pendulum, Damped Oscillations, Forced Oscillations. Ref.: SJ1: Chapter 12	

Unit 2		**15 L**
	Applications of Newton's Laws**:* Forces of Friction, Newton's Second Law Applied to a Particle in Uniform Circular Motion, Non uniform Circular Motion, Motion in the Presence of Velocity-Dependent Resistive Forces, The Fundamental Forces of Nature. ***Energy and Energy Transfer**:* Systems and Environments, Work Done by a Constant force, The Scalar Product of Two Vectors, Work Done by a Varying Force, Kinetic Energy and the Work-Kinetic Energy Theorem, The Non isolated System, Situations Involves Kinetic Friction, Power. Ref.: SJ1: Chapters 4, 5, 6. ***Mechanical Waves: Propagation of a Disturbance, The Wave Model, The Travelling Wave, The Speed of Transverse Waves on Strings, Reflection and Transmission of Waves, Rate of Energy Transfer by Sinusoidal Waves on Strings, Sound waves, The Doppler Effect. Ref.: SJ1: Chapter 13. ***Fluid Mechanics:*** Pressure, Variation of Pressure with Depth, Pressure Measurements, Buoyant Forces and Archimedes's Principle, Fluid Dynamics, Streamlines and the Continuity Equation for Fluid, Bernoulli's Equation, Other Applications of Fluid Dynamics. Ref.: SJ1: Chapter 15.	
Unit 3		**15 L**
	Potential Energy Potential Energy of a System, The Isolated System, Conservative and Non conservative Forces, Conservative Forces and Potential Energy, The Non isolated System in Steady State, Potential Energy for Gravitational and Electric Forces, Energy Diagrams and Stability of Equilibrium. Ref.: SJ1: Chapters 7 ***Relativity:*** The Principle of Newtonian Relativity, The Michelson-Morley Experiment, Einstein's Principle of Relativity, Consequences of Special Relativity, The Lorentz Transformation Equations, Relativistic Momentum and the Relativistic Form of Newton's Laws, Relativistic Energy, Mass and Energy, General Relativity. Ref.: SJ1: Chapter 9.	

	Gravity, Planetary Orbits, and the Hydrogen Atom: Neon's Law of Universal Gravitation Revisited Structural Models, Kepler's Laws, Energy Considerations in Planetary and Satellite Motion, Atomic Spectra and the Bohr Theory of Hydrogen. Ref.: SJ1: Chapter 11.	
References:		
Physics: A Calculus based approach (Volume I) by Serway and Jewett (SJ1)		
Additional References:		
1) Physics: (Volumes I and II) H. C. Verma. 2) Physics: (Volumes I and II) by Resnick, Halliday and Krane- Wiley India Edition (5th Edition)		
303102	**Title: Electronics I**	**45 L**
Unit 1		**15 L**
	Transient response of circuits: Series LR, CR and LCR circuit. Growth and decay of current Ref.: CR: 14.1 to 14.3 ***Alternating current theory*** *(Concept of L, R and C: Review):* Complex numbers, AC circuit containing pure R, Pure L and pure C, Series L-R, C-R and LCR circuits. Resonance in LCR circuit (both series and parallel), Power in AC circuit, Q-factor, transformer. (CR: Art 5.12, Omit phasor diagram & Auto transformer) Ref.: CR: 15.2 ,15.5 to 15.12 ***Transistor Biasing****:* Inherent variations of transistor parameters, stabilization, essentials of transistor biasing circuit, stability factor, methods of transistor biasing, Base resistor method, biasing with feedback resistor (Collector to base bias), voltage divider bias method, midpoint biasing. Silicon versus germanium. Ref.: MM: 12.2 To 12.10, 12.12, 12.14 ***General amplifier characteristics:*** Concept of amplification, amplifier notations, current gain, Voltage gain, power gain, input resistance, output resistance Decibels and frequency response: general theory of feedback, reasons for negative feedback, loop gain, practical circuit of transistor amplifier, phase reversal. Ref.: AM 7.1-7.7, 17.1-17.3. SC: 9.3, 9.4. MM: 13.4, 13.5.	

Unit 2		**15 L**
	Transistor as amplifier: CB, CE, CC modes. Definition of gain (dc & ac) and relation between them. Ref.: VKM 11.7 to 11.17, 11.21. ***Digital electronics*** *(Logic Gates : Review):* De-Morgan's Theorems, NAND & NOR as Universal Building blocks, EX-OR gate: Logic expression, logic symbol, truth table, Implementation using basic gates, Number system: Decimal, Binary and Hexadecimal (their conversion), Simple Addition and Subtraction of binary numbers. Ref.: VKM 28.8 to 28.14, 28.19.	
	Number system: Decimal, binary, hexadecimal number system and their mutual conversions, binary arithmetic, representation of Binary numbers, addition and subtraction using 2's compliment. ***Implementation of logic circuit from truth tables:*** Sum of products and product of sums method ***Flip-flop and counters:*** R-S flip flops, clocked RS flip flop D Flip flop, edge triggered J K flip flop, Master slave flip flop, T flip flop, D Flip flop using JK flip flop, 4 bit binary ripple up counter, 4 bit binary ripple down counter. Ref.: SC 1) 15.3, 15.3.1, 15.3.2, 15.3.4, 15.3.5, 15.3.6 2) 15.7, 15.7.1, 15.7.2. 3) 15.11, 15.11.1, 15.11.2, 15.11.3 TO 15.11.8, 15.12.2	
Unit 3		**15 L**
	Circuit theorems: Thevenin theorem, Norton theorem, Reciprocity theorem, Maximum power transfer theorem. Ref.: CR 7.7, 7.8, 7.9, 7.10, 7.11 (More problems oriented). ***A C bridges:*** General AC Bridge, Maxwell, de-Sauty, Wien, Schering. Ref.: CR 15.14 (More problems oriented). ***Electromagnetic Measuring Instruments:*** General theory of MCG, Dead beat and Ballistic galvanometer. Difference between Dead beat and Ballistic galvanometer. Ref.: CR 12.1, 12.2, 12.4, 12.5.	

	Oscillators: Introduction, effect of positive feedback. Requirements for oscillations, phase shift oscillator, Wien bridge oscillator, Colpitt's oscillator. Ref.: AM 18.0 to 18.3, 18.5, 18.6. ***Operational amplifiers****:* Symbol, ideal op-Amp, Op-amp IC, architecture, Inverting amplifier, Non inverting amplifier, frequency Response and slew rate, Op-amp applications: summing amplifier, differential amplifier, integrator, differentiator, and emitter coupled differential amplifier. Ref.: SC 11.1-115.5, 11.8.2, 11.8.3, 11.9, 11.9.1 – 11.9.4. MM 17.4.	

References:

1) Electricity and Magnetism by D. Chattopadhaya and P. C. Rakshit (4th Ed, Reprint – 2000) Books and Allied (P) Ltd. (CR).
2) Principles of Electronics by V. K. Mehta & Rohit Mehta. (S. Chand – Multicoloured illustrative edition) (MM)
3) Electronic devices and circuits: An introduction by Allan Mottershead (PHI Pvt. Ltd; EEE; Reprint: 2007) (AM)
4) A textbook of electronics by Santanu Chattopadhyay; New Central Book Agency; 2006 Ed. (SC)
5) Principles of Electronics by V. K. Mehta and Rohit Mehta (2006 revised Ed), S. Chand and Co (VKM)

303201	**Title: Practical based on 303101 and 303102**	**Credits: 3** **45 L**
Group A	**Mechanics-II**	
	1) Surface tension by Jaeger's Method. 2) Bar pendulum: determination of g. 3) Resonance pendulum. 4) Y by bending. 5) Searle's experiment : determination of μ 6) Logarithmic decrement 7) Modulus of rigidity by Static torsion method 8) Viscosity of liquid by Searl's Viscometer	
Group B	**Electronics-I**	
	1) CE amplifier: determination of bandwidth 2) CE amplifier : variation of gain with load 3) Wein bridge oscillator (transistorized). 4) Colpitt's oscillator. 5) Half adder and full adder (7486, 7408) 6) Study of MS-JK flip flop and divide by counter. 7) Op Amp: inverting amplifier 8) Op amp: non-inverting amplifier and voltage follower	
Minimum 4 experiments should be carried out from each group		

References:
1) Advanced course in Practical Physics D. Chattopadhya, PC. Rakshit & B. Saha. (6th Edition) Book & Allied Pvt. Ltd.
2) BSc Practical Physics – Harnam Singh S. Chand & Co. Ltd. – 2001
3) A Text book of advanced Practical Physics – Samir Kumar Ghosh, New Central Book Agency – (3rd edition)
4) B Sc. Practical Physics – CL Arora (1st Edition) – 2001 S. Chand & Co. Ltd.
5) Practical Physics – CL Squires – (3rd Edition) Cambridge University Press.
6) University Practical Physics – D C Tayal. Himalaya Publication.
7) Advanced Practical Physics – Worsnop & Flint.

Minimum three skill experiments and three demonstration experiments should be performed

Skill experiments:

1) Wiring of a simple circuit using bread board
2) Error analysis of a given experiment
3) Travelling microscope (radius of capillary)
4) Component testing, color code of resistors, capacitors etc.

Demonstration Experiments:

1) Optical fibre: transmission of signal
2) Concept of beats
3) Wave form generator using Op-amp
4) First order active filter.

Workload

Theory 3 lectures per week per paper.

Practical: 1 practical of 3 lecture periods per week per batch. Three lecture periods of the practicals shall be conducted in succession together on a single day.

Scheme of Examination

Theory examination:

Duration - 2 Hours duration for each paper.

Theory Question Paper Pattern (For Paper I, and II):

1. There shall be three questions. On each unit there will be one question of 20 marks and the fourth one will be based on entire syllabus of 15 marks.

2. All questions shall be compulsory with internal choice within the questions. (Each question on each unit will be of 25 to 27 marks with options and a question on entire syllabus will be of 20 to 23 marks with options)
3. Question may be subdivided into sub-questions a, b, c … and the allocation of marks depend on the weightage of the topic.

Practical examination:

Duration - 3 Hours duration for practical.

Practical examination is conducted out of 75 marks.

Semester-IV

Paper Code	Paper Nomenclature	Lectures	Credits
403101	Thermodynamics and Electrodynamics-I	45	03
403102	Optics and Modern Physics	45	03
403201	Practical based on 403101 and 403102	45	03

Semester-IV		
Paper Code	**Theory**	**Credits:3**
403101	**Title: Thermodynamics and Electrodynamics**	**45 L**
Unit 1		**15 L**
	Temperature and the Kinetic Theory of Gases*:* Temperature and the Zeroth Law of Thermodynamic, Thermometers and Temperature Scales, Thermal Expansion of Solids and Liquids, Macroscopic Description of an Ideal Gas,The Kinetic Theory of Gases. Ref.: SJ2 chapter 1 ***Energy in Thermal Process:*** Heat and Internal Energy, Specific Heat, Latent Heat and Phase Changes , Work in Thermodynamic Processes, The First Law of Thermodynamics ,Some Applications of the First Law of Thermodynamics, Molar Specific Heats of Ideal Gases Adiabatic Processes for an Ideal Gas, Molar Specific Heats and the Equal partition of Energy, Energy Transfer, Mechanisms in Thermal Processes. Ref.: SJ2 Chapter 2 ***Heat Engines and the Second Law of Thermodynamics:*** Reversible and Irreversible Processes, The Carnot Engine , Heat Pumps and Refrigerators An Alternative Statement of the Second Law, Entropy, Entropy and the Second Law of Thermodynamics, Entropy Changes in Irreversible Processes. Ref.: SJ 2 Chapter 3.	
Unit 2		**15 L**
	Electric Forces and fields: Historical Overview, Properties of Electric Charges, Insulators and Conductors, Coulomb's Law, Electric Fields, Electric Field Lines, Motion of Charged Particles in a Uniform Electric Field, Electric Flux, Gauss's Law, Application of Gauss's Law to Symmetric Charge Distributions, Conductors in Electrostatic Equilibrium. Ref.: SJ 2 Chapter 4.	

	Electric potential and capacitance: Potential Difference and Electric Potential, Potential Differences in a Uniform Electric Field, Electric Potential and Electric Potential Energy Due to Point Charges, Obtaining Electric Field from Electric Potential, Electric Potential Due to Continuous Charge Distributions, Electric Potential of a Charged Conductor, Capacitance, Combinations of Capacitors , Energy Stored in a Charged Capacitor, Capacitors with Dielectrics. Ref.: SJ 2 Chapter 5. ***Direct Current Circuits:*** Electric Current, Resistance and Ohm's Law, Superconductors ,A Structural Model for Electrical Conduction, Electric Energy and Power, Sources of emf ,Resistors in Series and in Parallel , Kirchhoffs Rules ,RC Circuits. Ref.: SJ 2 Chapter 6.	
Unit 3		**15 L**
	Magnetic forces and Magnetic Fields: Historical Overview, The Magnetic Field, Motion of a Charged Particle in a Uniform Magnetic Field , Applications Involving Charged Particles Moving in magnetic fields, Torque on a Current Loop in a Uniform Magnetic Field , The Biot-Savart Law The Magnetic Force Between two Parallel Conductors**,** Ampere's Law. The Magnetic Field of a Solenoid, Magnetism in Matter. Ref.: SJ 2 Chapter 7. **Faraday's Law and Inductance** Faraday's Law of Induction, Motional emf , Lenz'sLaw, Induced emfs and Electric Fields, Self-Inductance , RL Circuits, Energy Stored in a Masnetic Field. Ref.: SJ 2 Chapter 8. **Electromagnetic Waves:** Displacement Current and the Generalized Ampere's Law, Maxwell's Equations, Electromagnetic Waves, Hertz's Discoveries, Energy Carried by Electromagnetic Waves, Momentum and Radiation Pressure, The Spectrum of Electromagnetic Waves, Polarization. Ref.: SJ 2 Chapter 9.	
References:		
Physics: A Calculus based approach (Volume II) by Serway and Jewett (SJ2)		
Additional References:		
1) Physics: (Volumes I and II) H. C. Verma. 2) Physics: (Volumes I and II) by Resnick, Halliday and Krane- Wiley India Edition (5^{th} Edition)		

403102	Title: Optics and Modern Physics	45 L
Unit 1		**15 L**
	Reflection and Refraction of light: The Nature of Light, The Ray Model in Geometric Optics, The Wave Under Reflection, The Wave Under Refraction, dispersion and Prisms, Huygens's Principle, Total Internal Reflection. Ref.: SJ2 Chapter 10 ***Image Formation by Mirrors and Lenses:*** Images Formed by Flat Mirrors, Images Formed by Spherical Mirrors, Images Formed by Refraction, Thin Lenses. Ref.: SJ2 11.	
Unit 2		**15 L**
	Wave Optics: Conditions for Interference, Young's Double-Slit Experiment, Light Waves in interference, Change of Phase Due to Reflection, Interference in Thin Films, Diffraction Patterns, Resolution of Single-Slit and Circular Apertures, The Diffraction Grating, Diffraction of X-Rays by Crystals. Ref.: SJ2 Chapter 12 ***Quantum Physics:*** Blackbody Radiation and Planck's Theory, The Photoelectric Effect ,The Compton Effect , Photons and Electromagnetic Waves, The Wave Properties of Particles , The Quantum Particle, The Double-Slit Experiment Revisited , The Uncertainty Principle, An interpretation of Quantum Mechanics , Particle in a Box ,The Quantum Particle Under Boundary Conditions , The Schrodinger Equation, Tunnelling Through a Potential Energy Barrier. Ref.: SJ2 Chapter 13	
Unit 3		**15 L**
	Atomic Physics: Early Structural Models of the Atom, The Hydrogen Atom Revisited ,The Wave Functions for Hydrogen, Physical Interpretation of the Quantum Numbers, The Exclusion Principle and the Periodic Table, More on Atomic Spectra: Visible and X-Ray. Ref.: SJ2 Chapter 14 ***Nuclear Physics:*** Some Properties of Nuclei, Binding Energy, Radioactivity The Radioactive Decay Processes. Ref.: SJ2 Chapter 15	

	Particle Physics: The fundamental forces in Nature, Positrons and other particles, Mesons and the beginning of particle physics, Classifications of particles, Conservation laws, Strange particles and strangeness, Measuring particles life time, Finding patterns in the particles, Quarks, Colored quarks, The standard model. Ref.: SJ2 Chapter 16	

References:

Physics: A Calculus based approach (Volume II) by Serway and Jewett (SJ2)

Additional References:

3) Physics: (Volumes I and II) H. C. Verma.
4) Physics: (Volumes I and II) by Resnick, Halliday and Krane- Wiley India Edition (5th Edition)

403201	**Title: Practical based on 403101 and 403102**	**Credits: 3 45 L**
Group A	**Thermodynamics and Electrodynamics-I**	
	1) Determination of absolute capacitance using BG 2) High resistance by mirror galvanometer 3) Series Capacitance Bridge. 4) LCR parallel resonance. 5) Verification of maximum power transfer theorem. 6) Mutual induction by Carry-foster's method using B G. 7) Determination of Stefan's constant by using thermocouple. 8) Ratio of specific heats of air at constant pressure and constant volume by Clement and Desormen's method.	
Group B	**Optics and Modern Physics**	
	1) Optical lever : determination of μ 2) Determination of Couchy's constants. 3) Cylindrical obstacle : determination of λ 4) Fresnel's biprism : determination of λ 5) Resolving power of telescope. 6) Brewster's law : determination of μ 7) Determination of Rydberg's constant using spectrometer. 8) Study of divergence of Laser beam.	

Minimum 4 experiments should be carried out from each group

References:

1) Advanced course in Practical Physics D. Chattopadhya, PC. Rakshit & B. Saha. (6th Edition) Book & Allied Pvt. Ltd.
2) BSc Practical Physics – Harnam Singh S. Chand & Co. Ltd. – 2001
3) A Text book of advanced Practical Physics – Samir Kumar Ghosh, New Central Book Agency – (3rd edition)
4) B Sc. Practical Physics – CL Arora (1st Edition) – 2001 S. Chand & Co. Ltd.
5) Practical Physics – CL Squires – (3rd Edition) Cambridge University Press.
6) University Practical Physics – D C Tayal. Himalaya Publication.
7) Advanced Practical Physics – Worsnop & Flint.

Minimum three skill experiments and three demonstration experiments should be performed

Skill experiments:

1) Spectrometer: mean μ of yellow doublet of mercury source.
2) Drawing of graph on semi logarithmic / logarithmic scale.
3) To find the sum of the sine and cosine series.
4) To convert a given integer to a binary number and vice versa.
5) To draw the histogram of the theoretical Gaussian Curve.

Demonstration experiments:

1) Laser experiments : straight edge, single slit, ruler grating
2) Coupled oscillations and resonance
3) PC simulations: graph, curve fitting etc.
4) Straight edge Fresnel diffraction
5) Double refraction

Workload

Theory 3 lectures per week per paper.
Practical: 1 practical of 3 lecture periods per week per batch. Three lecture periods of the practicals shall be conducted in succession together on a single day.

Scheme of Examination

Theory examination:

Duration - 2 Hours duration for each paper.

Theory Question Paper Pattern (For Paper I, and II):

1. There shall be three questions. On each unit there will be one question of 20 marks and the fourth one will be based on entire syllabus of 15 marks.
2. All questions shall be compulsory with internal choice within the questions. (Each question on each unit will be of 25 to 27 marks with options and a question on entire syllabus will be of 20 to 23 marks with options)
3. Question may be subdivided into sub-questions a, b, c … and the allocation of marks depend on the weightage of the topic.

Practical examination:

Duration - 3 Hours duration for practical.

Practical examination is conducted out of 75 marks.

Semester-V

Paper Code	Paper Nomenclature	Lectures	Credits
503101	Thermal and Statistical Mechanics	45	03
503102	Solid State Physics	45	03
503103	Atomic and Molecular Physics	45	03
503104	Electrodynamics-II	45	03
503201	Practical based on 503101 and 503102	45	03
503202	Practical based on 503103 and 503104	45	03

Semester-V		
Paper Code	**Theory**	**Credits:3**
503101	**Title: Thermal and Statistical Mechanics**	**45 L**
Unit 1	**Engines and Entropy**	**15 L**
	Engine: Clapeyron's Latent heat equation using Carnot's cycle and its applications Steam engine (Rankin cycle) Mollier'sdiagram, Otto engine (Petrol Engine), Diesel Engine Ref.: BSH ***Entropy:*** Review of concept of entropy, Change in entropy, Change in entropy in adiabatic process, Change in entropy in Reversible cycle, Principle of increase in entropy, Change in entropy in Irreversible Process. Temperature entropy diagram and its Physical Significance , Entropy of perfect gas, Kelvin thermodynamic scale of temperature,(Omit alternative method using Carnot cycle) The size of a Degree , Zero of Absolute scale, Identity of perfect Gas scale and Absolute scale . Third Law of Thermodynamics, Zero Point energy, Negative temperatures (Not possible), Heat Death of the Universe. Ref.: BSH	
Unit 2		**15 L**
	Thermodynamic Potential and Maxwell's relations: Review of Thermodynamic Potential, Maxwell's thermodynamic relations and its applications. 1^{st} order and 2^{nd} order phase transitions. Liquefaction of Oxygen, Hydrogen, Helium and Adiabatic demagnetization. Ref.: BSH, EG, SS	

Unit 3		15 L
	Description of a system: Why statistical approach, Particle-states, System-states, Microstates and Macro states of a system, Equilibrium and Fluctuations, Irreversibility, The equi-probability postulate, Statistical ensemble, Number of states accessible to a system, Phase space, Reversible processes. Ref.: LG ***Thermal and Adiabatic Interactions:*** Thermal interaction, Canonical distribution, Energy fluctuations, Entropy of a system in a heat bath, Helmholtz free energy, Adiabatic interaction and enthalpy, General interaction and the first law of thermodynamics, Infinitesimal general interaction, Gibbs free energy, Phase transitions. Ref.: LG	

References:

1) Heat, Thermodynamics and Statistical Physics by Brij lal, Subramanyam, Hemne. (BSH)
2) Basic Thermodynamics by Evelene and Guha (EG)
3) Treatise of Heat by Saha and Srivastava. (SS)
4) Statistical and Thermal Physics an introduction by S. Lokanathan and R. S. Gambhir. (Prentice Hall of India : 2008) (LG)

Additional References:

1) Evelene and Guha — Basic Thermodynamics
2) Zemansky-Heat and Thermodynamics Entropy
3) Fundamentals of Statistical and Thermal Physics by F. Reif, McGraw-Hill.

503102	Title: Solid State Physics	45 L
Unit 1		**15 L**
	Electrical properties of metals: Classical free electron theory of metals, Drawbacks of classical theory, Relaxation time, Collision time and mean free path, 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, Thermionic emission. Ref.: SOP Ch. 6 Art I to V, XIV to XX, XXXI.	

Unit 2		15 L
	Superconductivity: A survey, Mechanism of Superconductors, Effects of magnetic field, The Meissner effect, The penetration depth, Type I and Type II Superconductors. ***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.: SOP: Ch. 8 Art II, III, IV, VII, XII and XIII. SOP: Ch. 6 Art XXXVI to XXXXI.	
Unit 3		**15 L**
	Conduction in Semiconductors: Electrons and Holes in an Intrinsic Semiconductor, Conductivity, Carrier concentrations, Donor and Acceptor impurities, Charge densities in a Semiconductor, Fermi level in extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation, The Hall effect. ***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.: MH Art 4.1 to 4.10 MH Art 5.1 to 5.8	

References:

1) Solid State Physics by S. O. Pillai, New Age International (SOP)
2) Electronic Devices and Circuits by Millman, Halkias & Satyabrata Jit. (2nd Ed.) Tata McGraw Hill (MH)

Additional References:

1) Solid State Physics by A. J. Dekker, Macmillan India Ltd. (D)
2) Modern Physics and Solid State Physics: Problems and solutions by S. O. Pillai, New Age International.
3) Solid State Physics by S. P. Kakani and Amit Kakani, New Age International.
4) Semiconductor Physics and Devices by Donald Neamen (3rd Ed.).
5) Introduction to Solid State Physics by Ali Omer, Addison Wesley Longman.

503103	Title: Atomic and Molecular Physics	45 L
Unit 1		**15 L**
	Schrödinger's equation: Schrödinger's equation for Harmonic oscillator, its solution by operator method. Graphical representation of its energy level and wave functions. Ref.: M 5.2; B 8.7. ***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). Ref.: B 9.1 to 9.9.	
Unit 2		**15 L**
	Electron Spin: The Stern-Gerlach experiment, Pauli's Exclusion Principle Symmetric and Antisymmetric wave functions. Ref.: B 10.1, 10.3. Spin orbit coupling, Hund's Rule, Total angular momentum, Vector atom model, L-S and j-j coupling. Origin of spectral lines, Selection rules Ref.: B 10.2, 10.6, 10.7, 10.8, 10.9 B 11.1 and 11.2.	
Unit 3		**15 L**
	Effect of Magnetic field on atoms: The normal Zeeman effect and its explanation (Classical and Quantum), The Lande g factor, Anomalous Zeeman effect. Ref.: SA 9.14, 9.15, 9.16, 9.17. Paschen-Back effect, Paschen-Back effect of principal series doublet, Selection rules for Paschen-Back effect. Ref.: W 10.7, 10.8, 10.9.	

References:

1) Prospective of Modern Physics by Arthur Beiser, McGraw Hill. (B)
2) Introduction to Atomic & Nuclear Physics by H. Semat & J. R. Albright (5th Ed.) Chapman & Hall. (SA)
3) Introduction to Atomic Spectra by H. E. White, McGraw Hill. (W)
4) Introduction to Quantum Mechanics by P. T. Mathews (M)

Additional References:

1) Fundamentals of Molecular Spectroscopy by C. N. Banwell & E. M. McCash, 4th Ed.

503104	Title: Electrodynamics II	45 L
Unit 1		**15 L**
	Field lines, Flux and Gauss' law: The divergence of **E**, Applications of Gauss' law, The curl of **E**. Introduction to potential, Comments on potential, Poisson's equation and Laplace's equation, The potential of a localized charge distribution. Ref.: DG 2.2.1 to 2.2.4, 2.3.1 to 2.3.4. First Uniqueness theorem (Without proof), The classic image problem Infinite conducting plane, Ref.: DG 3.1.5, 3.2.1 to 3.2.3.	
Unit 2		**15 L**
	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, Energy in dielectric systems. Ref.: 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. ***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 Magneto-statics and Electrostatics. Ref.: DG 5.3.1 to 5.3.4.	
Unit 3		**15 L**
	Diamagnets, Paramagnets, Ferro magnets: Magnetization, Bound currents and their physical interpretation, Ampere's law in magnetized materials, A deceptive parallel, Magnetic susceptibility and permeability. Ref.: DG 6.1.1, 6.1.4, 6.2.1, 6.2.2, 6.3.1, 6.3.2, 6.4.1. ***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. Ref.: DG 7.2.4, 7.3.1 to 7.3.6.	
References:		
1) Introduction to Electrodynamics by David J. Griffiths, 3rd Ed, Prentice Hall of India. (DG)		
Additional References:		
1) Introduction to Electrodynamics by A. Z. Capria and P. V., Panat Publishing House. 2) Engineering Electrodynamics by William Hayt Jr. & John H. Buck. 3) Electricity and Magnetism by Navina Wadhwani, PHI – 2010.		

503201	Title: Practical based on 503101 and 503102	Credits: 3 45 L
	1) Determination of "g" by Kater's pendulum. 2) Flat spiral spring (Y) 3) Stefan's constant σ 4) Koenig's method 5) R.P. of grating 6) Goniometer 7) R.I of liquid using laser 8) Rydberg's constant 9) Edser's A pattern 10) Diameter of lycopodium powder 11) Determination of e/m	
503202	**Title: Practical based on 503103 and 503104**	**Credits: 3 45 L**
	1) Mutual inductance by BG. 2) Hysteresis by magnetometer 3) Maxwell's bridge 4) Band gap of energy. 5) Diode as temperature sensor. 6) Log amplifier using OPAMP 7) High pass (first order active filter) 8) Low pass (first order active filter) 9) Wien bridge oscillator 10) Hall effect 11) LM-317 as voltage regulator 12) LM 317 as current regulator	

A minimum of 8 experiments from each of the courses are to be performed and reported in the journal.

References:

1) Advanced course in Practical Physics by D. Chattopadhya, PC. Rakshit & B. Saha (8th Edition) Book & Allied Pvt. Ltd.
2) B. Sc. Practical Physics by Harnam Singh, S. Chand & Co. Ltd, 2001.
3) A Text book of Practical Physics by Samir Kumar Ghosh, New Central Book Agency (4th edition).
4) B Sc. Practical Physics by C. L. Arora, 1st Edition, 2001, S. Chand & Co. Ltd.
5) Practical Physics by C. L. Squires, 3rd Edition, Cambridge University Press.
6) University Practical Physics, D C Tayal, Himalaya Publication.
7) Advanced Practical Physics, Worsnop & Flint.

Minimum four skill experiments and four demonstration experiments should be performed.

Skill Experiments

1. Estimation of errors.
2. Soldering advanced circuit.
3. Bread board circuit using IC's.
4. Optical Levelling of Spectrometer.

Demonstration experiments

1. Open CRO, Power Supply, and Signal Generator: Discuss block diagram.
2. Data sheet reading for diodes, Transistor, Op amp and Optoelectronic devices.
3. Circuit designing – single stage amplifier, Transistor Multi-vibrator etc. and testing on breadboard.
4. Equation solver.
5. Amplitude Modulation.
6. Frequency Modulation.

Workload

Theory 3 lectures per week per paper.

Practical: 1 practical **each** of 3 lecture periods per week per batch. Three lecture periods of the practicals shall be conducted in succession together on a single day.

Scheme of Examination

Theory examination:

Duration - 2 Hours duration for each paper.

Theory Question Paper Pattern (For Papers I to IV):

1. There shall be three questions. On each unit there will be one question of 20 marks and the fourth one will be based on entire syllabus of 15 marks.
2. All questions shall be compulsory with internal choice within the questions. (Each question on each unit will be of 25 to 27 marks with options and a question on entire syllabus will be of 20 to 23 marks with options)
3. Question may be subdivided into sub-questions a, b, c … and the allocation of marks depend on the weightage of the topic.

Practical examination:

Duration - 3 Hours duration for **each** practical.

Practical examination is conducted out of 75 marks.

Semester-VI

Paper Code	Paper Nomenclature	Lectures	Credits
603101	Classical Mechanics	45	03
603102	Electronics-II	45	03
603103	Nuclear Physics	45	03
603104	Special Theory of relativity	45	03
603201	Practical based on 603101 and 603102	45	03
603202	Practical based on 603103 and 603104	45	03

Semester-VI		
Paper Code	**Theory**	**Credits:3**
603101	**Title: Classical Mechanics**	**45 L**
Unit 1		**15 L**
	Motion under a central force: The central force inversely proportional to the square of the distance, Elliptical orbits. The Kepler problem. Hyperbolic Orbits: The Rutherford problem – Scattering cross section. Ref.: KRS Art. 3.13 to 3.16. **Moving origin of co-ordinates:** Rotating co-ordinate systems, Laws of motion on the rotating earth, Foucault pendulum, Larmor's theorem (with proof). Ref.: KRS Art. 7.1 to 7.5.	
Unit 2		**15 L**
	Lagrange's equations: D'Alembert's principle, Generalized coordinates, Lagrange's equations using D'Alembert's principle, Examples, Systems subject to constraints, Examples of systems subject to constraints, Constants of motion and ignorable coordinates. Ref.: KRS Art. 9.1 to 9.6, G 1.4.	
Unit 3		**15 L**
	Kinematics of moving fluids: Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow. Ref.: KRS Art. 8.6 to 8.9. ***The rotation of a Rigid body:*** Motion of a rigid body in space, Euler's equations of motion for a rigid body, Euler's angles, Heavy symmetrical top (without nutation). Ref.: KRS Art. 11.1, 11.2, 11.4, 11.5, BO 6.7	

References:

1) Mechanics by Keith R. Symon, Addision Wesely, 3rd Ed. (KRS)
2) Classical Mechanics: a Modern perspective by V. D. Barger and M. G. Olsson, Mc Graw Hill International, 1995 Ed. (BO)
3) Classical Mechanics by Herbert Goldstein, Narosa, 2nd Ed. (G)

Additional References:

1. An Introduction to Mechanics by Daniel Kleppner & Robert Kolenkow, Tata Mc Graw Hill, Indian Ed. 2007.
2. Chaotic Dynamics- an introduction by Baker and Gollup.

603102	Title: Electronics-II	45 L
Unit 1		**15 L**
	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. Ref.: MB Art. 13.1 to 13.9, 14.1, 14.2, 14.4, 14.6. ***MOSFET:*** Depletion and enhancement mode, MOSFET operation and characteristics, digital switching. Ref.: VKM Art. 20.1 to 20.10, 21.1 to 21.6, 21.8, 21.9, 21.10. ***Thyristors:*** SCR – Working, Equivalent circuit, important terms, I-V Characteristics, SCR as a switch, Half wave rectifier and Full wave rectifier, TRIAC: Construction, Operation, I-V Characteristics, Applications, DIAC: Construction, Operation, Characteristics and applications. Ref.: VKM Art 7.7 to 7.11 MB 7.10. ***Optoelectronic Devices:*** Photo-diode, Phototransistor, Opto-coupler.	
Unit 2		**15 L**
	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). Ref.: MB Art 17.1 to 17.5. ***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.	

	Ref.: KVR Art. 14.5.2.1, 14.5.2.5, 14.5.2.6, 14.5.4.1. ***Transistor Multivibrators:*** Astable, Monostable and Bistable Multivibrators, Schmitt trigger. Ref.: MB Art. 20.5, 20.8, 21.4, 22.7, 22.8, 23.2. MH 16.14.	
Unit 3		**15 L**
	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. Ref.: MB Art. 23.7 to 23.9. ***555 Timer:*** Block diagram, Monostable and Astable operation (with VCO), Triggered linear ramp generator. Ref.: ML Art. 6.2, 6.4, 6.6, 6.7, 7.2 to 7.4.	
References:		
1) Electronics Principles by A. P. Malvino and D.J. Bates, 7th Ed. (MB). 2) Principles of Electronics by V. K. Mehta and Rohit Mehta, S. Chand Publications, 11th Ed. (VKM) 3) Functional Electronics by K .V. Ramanan. (KVR) 4) Digital Principles and Applications by Malvino and Leach , 4th Ed. (ML) 5) Integrated Electronics by Millman and Halkias, Mc Graw Hill International. (MH)		
Additional References:		
1) Electronic Devices and Circuits by S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, 2nd Ed, Tata McGraw Hill. 2) Pulse, Digital & Switching Waveforms by Millman & Taub..		
603103	**Title: Nuclear Physics**	**45 L**
Unit 1		**15**
	Nuclear Reactions: Types of Nuclear Reactions, Balance of mass and energy in Nuclear Reaction, the Q-equation and Solution of Q-equation. Ref.: P 3.1 to 3.5. K 8.5, 9.5 ***Alpha decay:*** Range of alpha particles, Disintegration energy, Alpha decay paradox: Barrier penetration (Gamow's theory of alpha decay and Geiger-Nuttal law), Velocity and energy, Absorption of alpha particles: Range, Ionization and stopping power, Nuclear energy levels. Ref.: P 4. II. 1, 4. II. 2, 4. II. 3, 1.II.3, K 13. 1, 13.2, 13.5.	

Unit 2		15 L
	Beta decay: Introduction, Continuous beta ray spectrum-Difficulties encountered to understand it, Pauli's neutrino hypothesis, Detection of neutrino, Velocity and energy of beta particles, Energy levels and decay schemes, Energetics of beta decay. Ref.: P 4.I.2, 4.I.3, 4. III. 1, 4. III. 2, 4. III. 3, 4. III. 5, K 14.1, 14.7, G 5.5. ***Gamma decay:*** Introduction, Internal conversion, Nuclear isomerism, Mossbauer effect. Ref.: P 4. IV. 1, 4. IV. 3, 4. IV. 4, 9.4.	
Unit 3		**15 L**
	Nuclear radiation detectors: Proportional counter, Scintillation counter, Cloud and Bubble chamber, Ionization chamber, Proportional and GM counter. Ref.: P 1. I. 3, K 2.8. ***Liquid drop model:*** Weizsacher's semi-empirical mass formula, Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. Ref.: P 5.1, 5.3, 5.4, 5.5.	

References:

1) Nuclear Physics by S.B. Patel, Wiley Eastern Ltd. (P)
2) Nuclear Physics by Irving Kaplan, 2nd Ed., Addison Wesley. (K)
3) Nuclear Physics by S. N. Ghoshal, S. Chand & Co. (G)

Additional References:

1) Concepts of Modern Physics by Arthur Beiser, 6th Ed.,
2) Nuclear Physics by D. C. Tayal, Himalayan Publishing House,
3) Modern Physics by Kenneth Krane, 2nd Ed., John Wiley & Sons.
4) Atomic & Nuclear Physics by N Subrahmanyam, Brij Lal, Revised by Jivan Seshan, S. Chand.
5) Atomic & Nuclear Physics by A B Gupta & Dipak Ghosh, & Allied (P) Ltd.

603104	Title: Special Theory of Relativity	45 L
Unit 1		**15 L**
	Relativistic Kinematics: The 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, The relativistic addition of velocities and acceleration transformation equations, Aberration and Doppler effect in relativity, The common sense of special relativity. Ref.: RR Chapter II	
Unit 2		**15 L**
	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. Ref.: RR Chapter III	
Unit 3		**15 L**
	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. Ref.: RR Chapter IV	

References:

1) Introduction to Special Relativity by Robert Resnick, Wiley Student Edition, Reprint 2007, New Delhi. (RR)

Additional References:

1) Introduction to Cosmology by J. V. Narlikar, 3rd Ed., 2002, Cambridge University Press.
2) Elements of Cosmology by J. V. Narlikar, 1996, University Press.
3) Special theory of Relativity by A. P. French.
4) General Relativity & Cosmology by S. K. Srivastava, Prentice Hall of India.

603201	Title: Practical based on 603101 and 603102	Credits: 3 45 L
	1. Lee's method for thermal conductivity 2. Quincke's method for surface tension of Mercury 3. Flat spiral spring (η) 4. R.P. of prism 5. Lloyd's mirror 6. Double refraction 7. FET characteristics 8. UJT characteristics 9. SCR characteristics 10. Photodiode and phototransistor characteristics 11. Y by flexural method	
603202	**Title: Practical based on 603103 and 603104**	**Credits: 3 45 L**
	1) M/C using B.G. 2) Capacitance by using parallel bridge. 3) Transistorized Astable multivibrator 4) Transistorized Bistable multivibrator 5) Transistorized Monostable multivibrator. 6) Schmitt trigger using OPAMP. 7) 555 Timer Astabe multivibrator 8) 555 Timer as Monostable multivibrator 9) 555 timer as ramp generator. 10) Counters mod 2, 5 10. 11) Shift register. 12) OPAMP as monostable/astable using breadboard	
A minimum of 8 experiments from each of the courses are to be performed and reported in the journal.		
References:		

1) Advanced course in Practical Physics by D. Chattopadhya, PC. Rakshit & B. Saha (8th Edition) Book & Allied Pvt. Ltd.
2) B. Sc. Practical Physics by Harnam Singh, S. Chand & Co. Ltd, 2001.
3) A Text book of Practical Physics by Samir Kumar Ghosh, New Central Book Agency (4th edition).
4) B Sc. Practical Physics by C. L. Arora, 1st Edition, 2001, S. Chand & Co. Ltd.
5) Practical Physics by C. L. Squires, 3rd Edition, Cambridge University Press.
6) University Practical Physics, D C Tayal, Himalaya Publication.
7) Advanced Practical Physics, Worsnop & Flint.

Minimum four skill experiments and four demonstration experiments should be performed.

Skill Experiments

1. Laser beam profile.
2. Use of electronic balance: radius of small ball bearing.
3. Dual trace CRO: Phase shift measurement.
4. BG: C_1 /C_2 by comparing θ_1 / θ_2.

Demonstration experiments

1. Millikan's oil drop experiment.
2. Zeeman Effect.
3. Michelson's interferometer.
4. Iodine absorption spectra.
5. Standing waves in liquid using Ultrasonic waves.
6. GM counter

Workload

Theory 3 lectures per week per paper.

Practical: 1 practical **each** of 3 lecture periods per week per batch. Three lecture periods of the practicals shall be conducted in succession together on a single day.

Scheme of Examination

Theory examination:

Duration - 2 Hours duration for each paper.

Theory Question Paper Pattern (For Papers I to IV):

1. There shall be three questions. On each unit there will be one question of 20 marks and the fourth one will be based on entire syllabus of 15 marks.
2. All questions shall be compulsory with internal choice within the questions. (Each question on each unit will be of 25 to 27 marks with options and a question on entire syllabus will be of 20 to 23 marks with options)
3. Question may be subdivided into sub-questions a, b, c … and the allocation of marks depend on the weight age of the topic.

Practical examination:

Duration - 3 Hours duration for **each** practical.

Practical examination is conducted out of 75 marks.