Resolution Number for Academic year 2019-20 syllabus

AC/I(19-20).2.RUS10

S.P.Mandali's

RamnarainRuia Autonomous College

Syllabus for UG

Program: B.Sc. (Physics)

Course: RUSPHY

(Credit Based Semester and Grading System with effect from the academic year 2019–2020)

SEMESTER V

COURSE CODE	UNIT		Credits	Lec / Week
RUSPHY501		**Mathematical Methods of Physics, Thermal & Statistical Physics**	**2.5**	**4**
	I	Probability		
	II	Differential equations		
	III	Statistical & Thermal Physics		
	IV	Statistical Mechanics and Quantum Statistics		
RUSPHY502		**Solid State Physics**	**2.5**	**4**
	I	Crystal Physics		
	II	Electrical properties of metals		
	III	Conduction in Semiconductors		
	IV	Diode,magnetism and superconductivity		
RUSPHY503		**Atomic & Molecular Physics**	**2.5**	**4**
	I	Schrödinger's equation and Hydrogen		
	II	Electron Spin		
	III	Zeeman effect and Paschen-Back effect		
	IV	Molecular Spectra		
RUSPHY504		**Electrodynamics**	**2.5**	**4**
	I	Electrostatics		
	II	Polarisation& Magnetostatics		
	III	Magnetism & Varying Fields		
	IV	Electromagnetic Waves		
RUSPHP 05	Practical Course (RUSPHYP501 – Group A)		**3**	**8**
	Practical Course (RUSPHYP502 – Group B)		**3**	**8**
		Total	**16**	**32**

SEMESTER VI

COURSE CODE	UNIT		Credits	Lec / Week
RUSPHY601		**Classical Mechanics& Non Linear Mechanics**	**2.5**	**4**
	I	Central Force		
	II	Lagrange's equations		
	III	Kinematics		
	IV	Non linear mechanics		
RUSPHY602		**Electronics**	**2.5**	**4**
	I	FET &SCR		
	II	Regulated DC power supply, Differential Amplifier, Transistor Multivibrators		
	III	Operational Amplifier and 555 Timer		
	IV	Logic family		
RUSPHY603		**Nuclear Physics**	**2.5**	**4**
	I	Alpha & Beta Decay		
	II	Gamma Decay & Nuclear Models		
	III	Particle Accelerators & Energy Generation		
	IV	Meson theory & Elementary particles		
RUSPHY604		**Special Theory of Relativity**	**2.5**	**4**
	I	Special Theory of Relativity & Relativistic Kinematics		
	II	Relativistic Kinematics		
	III	Relativistic Dynamics		
	IV	Relativity and Electromagnetism		
RUSPHP 06	Practical Course (RUSPHYP601 – Group A)		**3**	**8**
	Practical Course (RUSPHYP602 – Group B)		**3**	**8**
		Total	**16**	**32**

Learning Objectives:

Upon completion of this course, students would acquire the following knowledge & skills:

(1) The ability to apply the principles of physics to solve new and unfamiliar problems
(2) The ability to analyze and interpret quantitative results in the areas of physics
(3) The ability to use contemporary experimental apparatus and analysis tools to acquire, analyze and interpret scientific data
(4) The ability to communicate scientific results effectively in presentations or posters
(5) A comprehensive, quantitative and conceptual understanding of the core areas of physics, including mechanics, optics, thermodynamics, electrostatics, electrodynamics at a level attuned with graduate programs in physics at peer institutions.

SEMESTER V

COURSE CODE	UNIT	TITLE	Credits	Lec / Week
RUSPHY501		**Mathematical Methods in Physics, Thermal & Statistical Physics**	**2.5**	**4**
	I	**Probability**		
		Review of basic concepts: sample space, events, independent events, conditional probability, probability theorems, permutations and combinations, discrete and continuous random variables, binomial distribution, joint distributions and covariance, the normal distribution, the Poisson distribution, statistics and experimental measurements, Chebyshev's inequality, law of large numbers, central limit theorem. **MB: Chapter 15**		
	II	**Differential Equations**		
		Second-order non-homogeneous linear differential equations with constant coefficients: the method of successive integrations and the method of undetermined coefficients. Forced vibrations and resonance.		

		The Laplace transform and its use in the solution of differential equations **CH – Sections 5.2.4, 8.2.1, 8.2.2, 8.2.4 MB – Sections 8.6, 8.8 and 8.9** Fourier series: Introduction, Fourier cosine and sine series, Change of interval, Fourier Integral,Complex form of the Fourier series **CH: 7.1, 7.1.1, 7.1.2, 7.1.3, 7.1.4, 7.2.** Fourier transforms: Introduction, Formal development of the complex Fouriertransform, Cosine and Sine transforms, The transforms of derivatives (with proof) **CH: 8.1, 8.2.1, 8.2.2, 8.2.4, 8.2.5, 8.2.6**		
	III	**Statistical & Thermal Physics**		
		Description of a system:Why statistical approach, Particle-states, System-states, Microstates and Macrostates of a system, Equilibrium and Fluctuations, Irreversibility, The equi-probabilitypostulate, Statistical ensemble, Number of states accessible to a system, Phase space, Reversible processes. **LG: 1.1 to 1.11** Thermal and Adiabatic Interactions: Thermal interaction, Canonical distribution, Energy fluctuations, Entropy of asystem in a heat bath, Helmholtz free energy, Adiabatic interaction and enthalpy,General interaction and the first law of thermodynamics, Infinitesimal generalinteraction, Gibbs free energy, Phase transitions. **LG: 2.1, 2.3 to 2.11**		
	IV	**Statistical Mechanics and Quantum Statistics**		
		Statistical Mechanics:Phase space, The probability of a distribution, The most probable distribution, Maxwell-Boltzmann statistics, Molecular speeds. **AB: 15.1 to 15.5** Quantum Statistics:Bose-Einstein statistics, Black-body radiation, The Rayleigh-Jeans formula, ThePlanck radiation formula, Fermi-Dirac statistics, Comparison of results, Transitionbetween states. **AB: 16.1 to 16.7**		

	References: 1. Mathematical Methods in the Physical Sciences – Mary L. Boas (**MB**) 2. Introduction to Mathematical Physics – Charlie Harper (**CH**) 3. Statistical & Thermal Physics by S. Lokanathan& R. S Gambhir (**LG**) 4. Perspectives of Modern Physics – Arthur Beiser (**AB**)			

COURSE CODE	UNIT	TITLE	Credits	Lec / Week
RUSPHY502		**Solid State Physics**	**2.5**	**4**
	I	**Crystal Physics**		
		Lattice points and space lattice, The basis and crystal structure, Unit Cells and lattice parameters, Primitive Cells, Crystal Systems, Crystal Symmetry, Bravais space lattices, Metallic crystal structures, Relation between the density of crystal material and lattice constant in a cubic lattice, Directions, Planes, Miller Indices, Important planes in simple cubic structure, separation between lattice planes in a cubic crystal, Reciprocal Lattice, X-ray Diffraction **SOP: Ch. 4 Art – II, III, IV, V, VI, VII, XIV,XV, XVI, XVIII, XX, XXII, XXV, XXVI**		
	II	**Electrical properties of metals**		
		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, Heat capacity of the electron gas, Mean energy of electron gas at 0 K **SOP: Ch. 6 Art – I to V, XIV, XV, XVII, XVIII** Band theory of solids, The Kronig- Penney model (Omit eq. 6.184 to 6.188), Brillouin zones, Number of wave functions in a band, Motion of electrons in a one-dimensional periodic potential, Distinction between metals,		

		insulators and intrinsic semiconductors **SOP: Ch. 6 Art – XXXVII, XXXVIII, XXXIX,XXXX, XXXXI**		
	III	**Conduction in Semiconductors**		
		Electrons and Holes in an Intrinsic Semiconductor, Conductivity, 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 2.Magnetic Properties of matter: Diamagnetism and Paramagnetism, The origin of permanent magnetic dipoles, Diamagnetism and Larmor precession, the static paramagnetic susceptibility **D: 18.1 to 18.4**		
	IV	**Diode, magnetism and superconductivity**		
		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 **MH: 4.1 to 4.10; 5.1, 5.2, 5.3** 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 **MH: 5.4 to 5.8** Superconductivity: survey, Mechanism of Superconductors, Effects of magnetic field, Critical Currents, The Meissner effect, the penetration depth, Type I and Type II Superconductors **SOP: Chapter 8: II, III, IV, VI, VII, XII, XIII**		
	References: 1. Solid State Physics: S. O. Pillai, New Age International. 6th Ed**. (SOP)** 2. Electronic Devices and Circuits: Millman, Halkias&Satyabrata Jit. (3rd Ed.) Tata McGraw Hill. **(MH)** 3. Solid State Physics: A. J. Dekker, Prentice Hall**(D)**			

COURSE CODE	UNIT	TITLE	Credits	Lec / Week
RUSPHY503		**Atomic & Molecular Physics**	**2.5**	**4**
RUSPHY503	**I**	**Schrödinger's equation and Hydrogen atom**		
		Schrödinger's equation for Harmonic oscillator, its solution by operatormethod. Graphical representation of its energy level and wave functions. **PTM: 5.2; AB: 8.7** Hydrogen atom: Schrödinger's equation for Hydrogen atom, Separation ofvariables, Quantum Numbers: Total quantum number, Orbital quantum number,Magnetic quantum number. Angular momentum, Electron probability density (Radial part) **AB: 9.1 to 9.9**		
	II	**Electron Spin**		
		Electron Spin: The Stern-Gerlach experiment, Pauli's Exclusion Principle, Symmetric and Antisymmetric wave functions. **AB: 10.1, 1.03** Spin orbit coupling, Hund's Rule, Total angular momentum, Vector atom model,L-S and j-j coupling. Origin of spectral lines, Selection rules. **AB:10.2,10.6,10.7, 10.8, 10.9; 11.1 and 11.2.**		
	III	**Zeeman effect and Paschen-Back effect**		
		Effect of Magnetic field on atoms, Zeeman effect, Earlier discoveries and developments, Experimental arrangement, The normal Zeeman effect and its explanation(Classical and Quantum) **HSA: 9.14, 9.15** The Lande g factor, Anomalous Zeeman effect; Paschen-Back effect, Paschen-Back effect of principal series doublet, Selectionrules for Paschen-Back effect. **HEW: 9.16, 9.17, 10.7, 10.8, 10.9**		

	IV	**Molecular Spectra :**		
		Molecular Spectra (Diatomic Molecules): Rotational energy levels, Rotationalspectra, Vibrational energy levels, Vibrational-Rotational spectra.Electronic Spectra of Diatomic molecules: The Born-Oppenheimer approximation,Intensity of vibrational-electronic spectra: The Franck-Condon principle. **AB: 14.1, 14.3, 14.5, 14.7** **BM: 6.11, 6.13** Raman Effect: Quantum Theory of Raman Effect, Classical theory of Raman Effect, Experimental Setup of Raman Effect, Applications of Raman Spectroscopy. **BM: 4.1.1, 4.1.2**		
		Reference: 1. Introduction to Quantum mechanics – P. T Mathews (**PTM**) 2. Perspectives of Modern Physics – Arthur Beiser (**AB**) 3. Introduction to Atomic & Nuclear Physics – Henry Semat& J. R Albright (5th Ed) (**HSA**); Introduction to Atomic Spectra – H. E White (**HEW**) 4. Fundamentals of Molecular Spectroscopy – C. N Banwell& E. M McCash (**BM**)		

COURSE CODE	UNIT	TITLE	Credits	Lec / Week
RUSPHY504		**Electrodynamics**	**2.5**	**4**
RUSPHY504	**I**	**Electrostatics**		
		Electric Field lines, Flux and Gauss' law, The divergence of **E**, Applications ofGauss' law, The curl of **E**. Introduction to potential, Comments on potential, Poisson's equation andLaplace's equation, The potential of a localized charge distribution, Review of Conductors & Faraday's Cage **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 **DG: 3.1.5, 3.2.1 to 3.2.3.**		
	II	**Polarisation& Magnetostatics**		
		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. **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'sLaw in the case of a long straight wire and a long solenoid, Comparison of Magneto-statics and Electrostatics. **DG: 5.3.1 to 5.3.4.**		
	III	**Magnetism & Varying Fields**		
		Magnetization, Bound currents and their physical interpretation, Ampere's law in magnetized materials, Adeceptive parallel, Magnetic susceptibility and permeability. **DG: 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. **DG: 7.2.4, 7.3.1 to 7.3.6.**		
	IV	**Electromagnetic Waves**		
		The continuity equation, Poynting's theorem,Newton's third law in electrodynamics. **DG: 8.1.1, 8.1.2., 8.2.1.** 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, Electromagnetic waves in conductors, guided waves-wave guides **DG: 9.2.1 to 9.2.3, 9.3.1 to 9.3.2, 9.4.1, 9.5.1**		

		References: Introduction to Electrodynamics by David Griffith (3 rd edition)-Prentice hall of India With good number of solved examples and unsolved examples from David Griffith**(DG)** **Additional References:** 1. Introduction to Electrodynamics: A. Z. Capria and P. V. Panat. 2. Electricity and Magnetism: NavinaWadhwani		
		Practicals		

RUSPHYP05 – Physics Laboratory Course

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

i) Understanding relevant concepts
ii) Planning of the experiments
iii) Layout and adjustments of the equipment
iv) Recording of observations and plotting of graphs
v) Calculation of results and estimation of possible errors in the observation of results

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

Skill Experiments: All the skills are compulsory and must be reported in the journal. Skills will be tested during the examination through viva or practical. The certified journal must contain a minimum of 16 regular experiments (8 from each group), with all Skills in semester V.

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

- Internal component of Practical examination Evaluation is based on regular experiments and skill experiments.
- For external practical examination, the learner will be examined in two experiments (one from each group)
- A learner will be allowed to appear for the semester end practical examination only if he submits a certified journal of Physics

Skill experiments		**1.**	Study of DSO		
		2.	Dual Trace CRO: Phase Shift Measurement.		
		3.	PCB making using etching process.		
		4.	Hologram making Apparatus-making – part A		
		5.	Hologram making Apparatus-making –		

			part B		
		6.	LT spice-circuit simulator-free software		
		7.	Temperature and Pressure measurement-BMP --Sensor and Arduino board, PC.		
		8.	Bread Board Circuit using three IC		
		9.	BG: C1 /C2 by comparing θ1 / θ2		
		10	Use of electronic balance: Radius of a small ball bearing.		
Group A (RUSPHYP501)		1.	Determination of g by Kater's Pendulum	**Credits = 3**	
		2.	Resolving power of prism		
		3.	Diameter of Lycopodium Powder		
		4.	Goniometer		
		5.	Thermal Diffusivity of Brass		
		6.	Hologram Making		
		7.	Diode as Temperature Sensor		
		8.	Hall Effect		
		9.	Curie-Weiss Law		
Group B (RUSPHYP502)		1.	Mutual Inductance by BG	**Credits = 3**	
		2.	Hysteresis by Magnetometer		
		3.	Maxwell's Bridge		
		4.	Band-gap Energy		
		5.	LM317 as voltage regulator		
		6.	Log Amplifier using OpAmp		
		7.	First order Active High Pass Filter		
		8.	First Order Active Low Pass Filter		
		9.	Wein Bridge Oscillator		
		10.	Schmitt Trigger using OPAMP		

References:

1. Advanced course in Practical Physics: D. Chattopadhya, 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 (4rd 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.
8. DSO –tektronics, Aplab manual CD.
9. Hologram –Holmark manual.
10. PCB making video and EAGLE free software

SEMESTER VI

COURSE CODE	UNIT	TITLE	Credit	Lec / Week
RUSPHY601		**Classical Mechanics& Non Linear Mechanics**	**2.5**	**4**
	I	**Central Force**		
		Motion under a central force, central force inversely proportional to the square of the distance, Elliptical orbits. The Kepler problem. Hyperbolic Orbits: The Rutherford problem – Scattering cross section. **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) **KRS: Art. 7.1 to 7.5**		
	II	**Lagrange's equations**		
		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. **KRS: Art. 9.1 to 9.6; G:1.4**		
	III	**Kinematics**		
		Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow. **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 notation). **KRS: Art. 11.1, 11.2, 11.4, 11.5;** **BO: 6.7**		

	IV	**Non-linear mechanics**		
		Non-linear mechanics: Qualitative approach to chaos, The anharmonic oscillator, Numerical solution of Duffing's equation, Transition to chaos: Bifurcations and strange attractors, Aspects of chaotic behaviour. **BO: Art. 11.1, 11.3 to 11.5**		
		References: **1.** Mechanics by Keith R. Symon **(KRS)** 2. Classical Mechanics – A Modern Perspective by V. D Barger & M. S Olsson **(BO)** 3. Classical Mechanics by Herbert Goldstein **(G)** **Additional References:** 1. An Introduction to Mechanics – Daniel Kleppner& Robert Kolenkow 2. Chaotic Dynamics – An Introduction – Baker and Gollup		

COURSE CODE	UNIT	TITLE	Credits	Lec / Week
RUSPHY602		**Electronics**	**2.5**	**4**
	I	**FET and SCR:**		
		Field Effect Transistors: JFET: Basic ideas, Drain Curve, The trans-conductance curve, Biasing in the ohmic region and the active region, Trans-conductance, JFET common source amplifier, JFET analog switch, multiplexer, voltage controlled resistor, Current sourcing. MOSFET: Depletion and enhancement mode, MOSFET operation andcharacteristics, digital switching. Thyristors: SCR – Working, Equivalent circuit, important terms, I-VCharacteristics, SCR as a switch, half wave rectifier and full wave rectifier. TRIAC: Construction, Operation, I-V Characteristics, Applications. DIAC: Construction, Operation, Characteristics and applications. **1. MB: Art. 13.1 to 13.9, 14.1, 14.2, 14.4, 14.6.**		

		2. VKM: Art. 20.1 to 20.10, 21.1 to 21.6, 21.8, 21.9, 21.10. **3. VKM: Art 7.7 to 7.11. MB: 7.10.**		
	II	**Regulated DC power supply, Differential Amplifier and Transistor Multivibrators**		
		Regulated DC power supply: Supply characteristics, series voltage regulator,short circuit protection (current limit and fold back) Monolithic linear IC voltageregulators. (LM 78XX, LM 79XX, LM 317). Differential Amplifier using transistor: The Differential Amplifier, DC and ACanalysis of a differential amplifier, Input characteristic-effect of input bias, Off-setcurrent and input offset voltage on output, common mode gain, CMRR. Transistor Multivibrators: Astable, Monostable and Bistable Multivibrators,Schmitt trigger. **1. MB: Art 17.1 to 17.5.** **2.KVR:Art. 14.5.2.1, 14.5.2.5, 14.5.2.6, 14.5.4.1.** **3.MB: Art. 20.5, 20.8, 21.4, 22.7,22.8, 23.2.** **MH: 16.14.**		
	III	**Operational Amplifier and 555 Timer**		
		Op Amp Applications: Log amplifier, Instrumentation amplifiers, Voltagecontrolledcurrent sources (grounded load), First order Active filters, Astableusing OP AMP, square wave and triangular wave generator using OPAMP,Wein-bridge oscillator using OP AMP. 555 Timer: Block diagram, Triggered linear ramp generator. **1. MB: Art. 23.7 to 23.9.** **2. ML: Art. 6.2, 6.4, 6.6, 6.7, 7.2 to 7.4.**		
	IV	**Logic families**		
		Logic families: Standard TTL NAND, TTL NOR, Open collector gates, Three state TTL devices, MOS inverters, CMOS NAND and NOR gates, CMOScharacteristics. Applications of JK flip flop: Types of registers, 4-bit shift register (serial in-serialout), Asynchronous counters, 4-bit up-down counter, MOD-3, MOD-5, Decadecounter, Shift counter. Electronic communication techniques: Radio broadcasting, Transmission andreception, Modulation, Amplitude modulation, Modulation		

		factor, Analysis ofamplitude modulated wave, Side band frequencies in AM wave, Transistoramplitude modulator, Power in AM wave, Limitations of AM, Frequencymodulation. (Qualitative) **1 ML: Art 10.1, 10.2, 11.1, 11.3 to 11.5, 11.7.** **2. MB: Art 24.1, 24.3, 24.4.** **3. VKM: Art. 16.1 to 16.11.**		
		References: 1. MB: Electronic Principles: A. P. Malvino and D.J. Bates (7th Ed.) – (TMH). 2. VKM: Principles of Electronics: V. K. Mehta and Rohit Mehta. S. Chand Publications. (11th Ed.). 3. KVR: Functional Electronics: K .V. Ramanan (TMH). 4. ML: Digital Principles and Applications: Malvino and Leach (4th Ed) (TMH). 5. MH: Integrated Electronics: Millman&Halkias Mc Graw Hill International. **Additional References:** 1. Electronic Devices and Circuits: S. Salivahanan, N. Suresh Kumarand A. Vallavaraj. (2nd Ed.) (Tata McGraw Hill) 2. Pulse, Digital & Switching Waveforms: Millman&Taub. (TMH)		

COURSE CODE	UNIT	TITLE	Credit	Lec / Week
RUSPHY603		**Nuclear Physics**	**2.5**	**4**
	I	**Alpha & Beta Decay**		
		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), Beta decay: Introduction, Velocity and energy of 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. **K: 13.1,13.2,13.5; P: 4. II. 1, 4. II. 2, 4. II. 3, 1.II.3 K:14.1,14.7 P: 4.III.1,4.III.2, 4.III.3, 4.III.5; G: 5.5.**		
	II	**Gamma Decay & Nuclear Models**		
		Gamma decay: Introduction, Internal conversion, nuclear isomerism, Mossbauer effect Nuclear Models: 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. Shell model (Qualitative), Magic numbers in the nucleus **P 4. IV. 1, 4. IV. 3, 4. IV. 4, 9.4.** **P: 5.1, 5.3, 5.4, 5.5. AB: 11.6-pages (460,461)**		
	III	**Particle Accelerators & Energy Generation**		
		Particle Accelerators: Van de Graff Generator, Cyclotron, Synchrotron, Betatron and Idea of Large Hadron Collider 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 reactors, Natural fusion, Possibility of controlled fusion **P: 1.I.4 (i), 1.I.4 (ii), 1.I.4 (iii), 1.I.4 (iv), AB 15.7** **P: 6.1, 6.3 to 6.9, 9.6, 9.7**		
	IV	**Meson theory & Elementary particles**		
		Meson theory of Nuclear Force- A qualitative discussion Elementary particles: Introduction, Classification of elementary particles, Particle interactions, Conservation laws(linear &angular momentum ,energy, charge, baryon number & lepton number),particles and anti-particles(Electrons and positrons, Protons and anti-protons, Neutrons and anti- neutrons, Neutrinos and anti-neutrinos), Photons, Mesons, Quark model(Qualitative). **1. P:8.6** **2. T: 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. P: Nuclear Physics: S.B. Patel (Wiley Eastern Ltd.). 3. K: Nuclear Physics: Irving Kaplan (2nd Ed.) (Addison Wesley). 4. G: Nuclear Physics: S. N. Ghoshal (S. Chand & Co.) 5. T: 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 JivanSeshan.) S. Chand. 3. Atomic & Nuclear Physics: A B Gupta & Dipak Ghosh Books & Allied (P) Ltd. 4. Introduction to Elementary Particles: David Griffiths, Second Revised Edition, Wiley-VCH

COURSE CODE	UNIT	TITLE	Credits	Lec / Week
RUSPHY604		**Special Theory of Relativity**	**2.5**	**4**
	I	**Special Theory of Relativity & Relativistic Kinematics**		
		Experimental background of special theory of relativity and relativistic kinematics: Galilean transformations, Newtonian relativity, Electromagnetism and Newtonian relativity. Attempts to locate absolute frame: Michelson-Morley experiment, Attempts to preserve the concept of a preferred ether frame: Lorentz Fitzgerald contraction and ether drag hypothesis, Attempt to modify electrodynamics, postulates of the special theory of relativity. Relativistic Kinematics: 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 1.6, 1.8, 1.9 , 2.1, to 2.5**		
	II	**Relativistic Kinematics**		
		Relativistic Kinematics (continued): The relativistic addition of velocities and 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**		
	III	**Relativistic Dynamics**		
		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**		
	IV	**Relativity and Electromagnetism**		
		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**		
		References: 1. RR: Introduction to Special Relativity: Robert Resnick (Wiley Student Edition) 2. Special theory of Relativity: A. P. French		

Practicals

RUSPHYP06 – Physics Laboratory Course

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

i. Understanding relevant concepts.
ii. Planning of the experiments

iii. Layout and adjustments of the equipment
iv. Recording of observations and plotting of graphs
v. Calculation of results and estimation of possible errors in the observation of results.

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

Demo Experiments: The demonstration experiments are to be performed by the teacher in the laboratory and students should be encouraged to participate and take observation wherever possible. Demonstration experiments are designed to bring about interest and excitement in Physics. Students are required to enter details of these 'demo' experiments in their journal. The certified journal must contain a minimum of 16 **regular experiments (8 from each practical course**), with **minimum 6 demonstration** experiments in semester VI. A separate index and certificate in journal is must for each semester course. There will be two turns of three hours each for the examination of practical courses

Demonstration Experiments:		1.	Amplitude Modulation	
		2.	Frequency Modulation	
		3.	Iodine absorption spectra	
		4.	Equation Solver	
		5.	Michelson's interferometer	
		6.	Open CRO, power Supply, Signal Generator: Discuss Block Diagram	
		7.	Firing of TRIAC using DIAC	
		8.	Use of PC / μP to control real world parameters	
		9.	Standing waves in liquid using Ultrasonic waves	
		10.	Zeeman Effect	
		11.	Millikan's oil drop experiment	
		12.	Seven segment display	
		13.	Data sheets reading for Diodes, transistor, Opamp, and Optoelectronic devices	
		14.	Circuit Designing – single stage amplifier, Transistor Multivibrator etc. and designing on Breadboard.	
Group A (RUSPHYP601)		1.	Quincke's method for surface tension of Mercury	**Credits = 3**
		2.	Lloyd's mirror	
		3.	Double refraction	
		4.	FET characteristics	
		5.	UJT as relaxation oscillator	
		6.	SCR characteristics	
		7.	Photodiode characteristics	
		8.	Applications of MOSFET	
		9.	SCR-Half Wave rectifier	

Group B (RUSPHYP602)		1.	Capacitance by using parallel bridge	**Credits = 3**
		2.	Calbration of Si diode & copper constantan thermocouple as temperature sensor	
		3.	Maxwell's, deSauty's and Maxweel-Wein Bridge	
		4.	555 timer as Monostable Multivibrator	
		5.	555 timer as AstableMultivibrator	
		6.	Transistor series regulator – foldback	
		7.	555 timer as ramp generator	
		8.	LM317 as current regulator	
		9.	OPAMP as monostable /astable multivibrator using breadboard	

MODALITY OF ASSESSMENT

Theory Examination Pattern:-Sem-V

A) Internal Assessment - 40% = 40 marks.

Theory Paper-Paper code	Test Marks	Assignment	Marks distribution	Total Marks per paper
Math. Methods of Physics, Thermal & Statistical Physics RUSPHY501	**20**	**15 questions on units1,2,3**	**Assessment- 15 mark Viva on it --05 mark ---------- Total= 20 mark**	**40**
Solid State Physics RUSPHY502	**20**	**15 questions on units1,2,3**	**Assessment- 15 mark Viva on it --05 mark ---------- Total= 20 mark**	**40**
Atomic & Molecular Physics RUSPHY503	**20**	**15 questions on units1,2,3**	**Assessment- 15 mark Viva on it --05 mark ---------- Total= 20 mark**	**40**
Electrodynamics RUSPHY504	**20**	**15 questions on units1,2,3**	**Assessment- 15 mark Viva on it --05 mark ---------- Total= 20 mark**	**40**

B) External examination - 60 %

Semester-end Theory Assessment - 60 marks

i. Duration - These examinations shall be of **2 hours** duration.

ii. Paper Pattern:

1. There shall be **5** questions each of **12** marks. On each unit there will be one question & last question will be based on all the 4 units.
2. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1)A)	*Any 1 out of 2*	*6*	*Unit I*
Q.1)B)	*Any 1 out of 2*	*6*	
Q.2)A)	*Any 1 out of 2*	*6*	*Unit II*
Q.2)B)	*Any 1 out of 2*	*6*	
Q.3)A)	*Any 1 out of 2*	*6*	*Unit III*
Q.3)B)	*Any 1 out of 2*	*6*	
Q.4)A)	*Any 1 out of 2*	*6*	*Unit IV*
Q.4)B)	*Any 1 out of 2*	*6*	
Q.5)A)	*Any 1 out of 2*	*3*	*Unit I*
Q.5)B)	*Any 1 out of 2*	*3*	*Unit II*
Q.5C)	*Any 1 out of 2*	*3*	*Unit III*
Q.5)D)	*Any 1 out of 2*	*3*	*Unit IV*

Practical Examination Pattern:

(A)Internal Examination:

Sr. No.	Activity	Practical-Group-I	Practical-Group-II
1.	**Seminar on experiment from each group:** Content- 2 mark Presentation-2 mark Q(Teacher) --2 mark Q(Student) -2 mark	**8 mark**	**8 mark**
2.	**Working Journal completion** (1 mark per experiment)	**8 mark**	**8 mark**
3.	**Continuous Evaluation** (2 mark per regular experiment)	**16 mark**	**16 mark**
4.	**Main Journal** (1 mark per regular experiment)	**8 mark**	**8 mark**
	Total (1+2+3+4)	**40 mark**	**40 mark**
	Requirement for the certification Skill experiments= 10 and Main (regular)experiments = 16		

(B) External (Semester end practical examination):

Particulars	Practical I	Practical II
Laboratory work	*50*	*50*
Viva	*10*	*10*
Total	**60**	**60**

PRACTICAL BOOK/JOURNAL

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

Semester---- V

Course	RUSPHY501			RUSPHY502			RUSPHY503			RUSPHY504			Grand Total
	Int	Ext.	Total	I	E	T	I	E	T	I	E	T	
Theory	40	60	100	40	60	100	40	60	100	40	60	100	400

Course	RUSPHYP501			RUSPHYP502			Grand Total
	Int.	Ext.	Total	Int.	Ext.	Total	
Practicals	40	60	100	40	60	100	200

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