Resolution Number for Academic year 2019-20 syllabus

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

S.P. Mandali's

Ramnarain Ruia 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 III

COURSE CODE	UNIT	TITLE	Credits	Lectures / Week
RUSPHY301		**Mechanics & Thermodynamics**	**2**	**3**
	I	Mechanics		
	II	Thermal Physics		
	III	Thermodynamics & Statistical Physics		
RUSPHY302		**Vector calculus, Analog and Digital Electronics**	**2**	**3**
	I	Vector Calculus		
	II	Analog Electronics		
	III	Analog and Digital Electronics		
RUSPHY303		**Applied Physics I**	**2**	**3**
	I	Acoustics , laser and Fiber		
	II	Biophysics		
	III	Materials- Properties and Applications		
RUSPHP03	**Practicals based on above three courses**		**3**	**9**
		Total	**9**	**18**

SEMESTER IV

COURSE CODE	UNIT		Credits	Lectures / Week
RUSPHY401		**Optics, Applied optics**	**2**	**3**
	I	Interference in thin films , Diffraction- Fresnel & Fraunhoffer		
	II	polarization		
	III	Applied Optics		
RUSPHY402		**Introduction to Quantum Mechanics**	**2**	**3**
	I	Origin of Quantum Mechanics		
	II	Quantum Mechanics		
	III	Applications of Schrodinger's Steady State Equation		
RUSPHY403		**Applied Physics II**	**2**	**3**
	I	Synthesis of Nano-materials		
	II	Analysis techniques		
	III	Microprocessor-8085		
RUSPHP 04	**Practicals based on above three courses**		**3**	**9**
		Total	**9**	**18**

Course Code: RUSPHY301

Course Title: Mechanics and Thermodynamics

Academic year 2019-20

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.

Learning Outcomes:

On successful completion of this course, students will be able to:

a. Understand the concepts of mechanics & properties of matter, how to apply them to problems
b. Comprehend the basic concepts of thermodynamics & its applications in physical situation
c. Learn about situations at low temperature
d. Demonstrate cautious problem solving skills in all above areas

Detail Syllabus

SEMESTER III		
Course Code	**Title**	**2 Credits**
RUSPHY 301	**Mechanics and thermodynamics**	
Unit I	**Mechanics by H. S Hans & S. P Puri (HP)**	**15 lectures**
	Compound pendulum: Expression for period, maximum and minimum time period, centers of suspension and oscillations, reversible compound pendulum. Kater's reversible pendulum, Advantages of a compound pendulum over a simple pendulum; Problems from all topics **HP: 9.1.1 (pages 279 to 289)**	

	Center of Mass, Motion of the Center of Mass, Linear momentum of a Particle, Linear momentum of a System of Particles, Linear momentum with respect to CM coordinate (i.e. shift of origin from Lab to CM), Conservation of Linear Momentum , Some Applications of the Momentum Principle , System of Variable Mass **Halliday and Resnik -Physics part I** **9.1, 9.2, 9.3, 9.4, 9.5, 9.6** Torque Acting on a Particle, Angular Momentum of a Particle, Angular Momentum of System of Particles, and total angular momentum with respect to CM coordinates. Conservation of Angular Momentum. **Halliday and Resnik -Physics part I** **12.1, 12.2, 12.3, 13.4** Oscillations, The Simple Harmonic Oscillator, Relation between Simple Harmonic Motion and Uniform Circular Motion, Two Body Oscillations, Damped Harmonic Motion , Forced Oscillations and Resonance. **Halliday and Resnik -Physics part I** **15.1, 15.2, 15.6, 15.8, 15.9, 15.10**	
Unit II	**Thermal Physics by A. B Gupta & H. Roy (ABG)**	**15 lectures**
	(Review of Zeroeth and first law of thermodynamics) Heat engine, Carnot's cycle, Second law of Thermodynamics, Statement, Equivalence of Kelvin & Planck Statement, Carnot's Theorem, Reversible & Irreversible Process, Absolute scale of Temperature. **ABG: 7.1,7.2,7.3,7.5, 7.5.1, 7.6, 7.7, 7.8** Clausius theorem, Entropy, Entropy of a cyclic process, Reversible process, Entropy change, Reversible heat transfer, Principle of increase in entropy, generalized form of first and second law, entropy change of an ideal gas, entropy of steam, entropy and unavailable energy, entropy and disorder, absolute entropy **ABG: 7.9, 7.10, 7.11, 7.12, 7.12.1, 7.12.2, 7.13, 7.14, 7.14.1, 7.14.3, 7.15, 7.16, 7.17**	
Unit III	**Heat, Thermodynamics & Statistical Physics**	**15 lectures**
	Third law of thermodynamics, Nernst heat theorem, Consequences of the third law, Maxwell's thermodynamic relations, Clausius – Clapeyron equation. **ABG: 10.12, 10.12.1, 10.12.2 BS: 6.3, 6.11**	

	Steam engine, Rankine cycle **ABG: 11.2, 11.3** Low temp Physics: Different methods of liquefaction of gases, methods of freezing mixtures, Cooling by evaporation under reduced pressure, cooling by adiabatic expansion. **BS: 7.1, 7.2, 7.3, 7.4** Joule - Thompson effect, JT effect of Van der Waal's gas, Liquefaction of helium, properties and uses of liquid Helium **ABG: 10.2, 10.2.2, 10.6,10.6.1**	
	References: Resnick and Halliday : Physics – I Mechanics – H. S. Hans and S. P. Puri, Tata McGraw Hill (2nd ED.) Thermal Physics, AB Gupta and H. Roy, Book and Allied (P) Ltd, Reprint 2008,2009. Heat thermodynamics and Statistical Physics, Brijlal, N. Subramanyam, P. S. Hemne, S. Chand , edition 2007. **Additional reference:** a) Mechanics by K.R Symon b) Classical Dynamics of particles and systems by Thornton and Marian, (CENGAGE Learning) c) Basic Thermodynamics: Evelyn Guha (Narosa Publications) d) Classical mechanics by Kleppener, Kollenkov e) A treatise on heat : Meghanad Saha and BN Srivastava , 1969, India Press f) Mechanics and Electrodynamics Rev Edn. 2005 by Brijlal and Subramanyan and Jeevan Seshan g) Thermal Physics: Philip M. Morse (W.A. Benjamin Inc. New York) h) Heat & Thermodynamics: Robert and Miller (ELBS)	
	PRACTICALS	
	➢ Note: Exemption of two experiments from section A and / or B and / or C may be given if student carries out any one of the following activity. • Execute a mini project to the satisfaction of teacher in-charge of practical • Participate in a study tour or visit & submit a study tour report	

	➢ Each experiment will be of three hours' duration. Minimum 7 from each group and in all minimum 21 experiments must be reported in certified journal. ➢ All the skill experiments are required to be completed compulsorily. ➢ Internal component of Practical examination Evaluation is based on regular experiments and skill experiments. ➢ A learner will be allowed to appear for the semester end practical examination only if he/she submits a certified journal of Physics (8 Skill experiments and 21 Main experiments for certified Journal) ➢ For external practical examination, the learner will be examined in three experiments (one from each group)	
RUSPHP03 (A)	**PRACTICALS**	**1 Credit**
	1. Y by bending(metal beam)	
	2. Flat spiral spring (Y)	
	3. Optical lever: determination of μ	
	4. R.P. of telescope.	
	5. Fresnel's bi-prism: determination of λ	
	6. Determination of wavelength of laser using grating	
	7. Determination of R.I. of liquid by laser	

References:

1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit & B Saha. (6th Edition) Book and Allied Pvt Ltd
2. B.Sc Practical Physics – Harnam Singh S.Chand & Co. Ld. 2001
3. A test 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 and Co Ltd
5. Practical Physics CL Squires (3rd Edition) Cambridge University
6. University Practical Physics – DC Tayal. Himalaya Publication
7. Advanced Practical Physics – Worsnop &Flint.

Course Code: RUSPHY302

Course Title: Vector calculus, Analog and Digital Electronics

Academic year 2019-20

Learning Objectives:

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

(6) The ability to apply the principles of physics to solve new and unfamiliar problems
(7) The ability to analyze and interpret quantitative results in the areas of physics
(8) The ability to use contemporary experimental apparatus and analysis tools to acquire, analyze and interpret scientific data
(9) The ability to communicate scientific results effectively in presentations or posters
(10) 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.

Learning Outcomes:

On successful completion of this course students will be able to:

a) Understand the basic concepts of mathematical physics and their applications in physical situations
b) Understand the basic laws of electrodynamics and be able to perform calculations using them
c) Understand the basics of transistor biasing, operational amplifiers, their applications
d) Understand the basic concepts of oscillators and be able to perform calculations using them
e) Demonstrate quantitative problem solving skill in all the topics covered

SEMESTER III		
Course Code	**Title**	**2 Credits**
RUSPHY 302	**Vector calculus, Analog and Digital Electronics**	
Unit I	**Vector Calculus**	**15 lectures**
	Line, Surface and Volume Integrals, The Fundamental Theorem of Calculus: The Fundamental Theorem of Gradient, The Fundamental Theorem of Divergence, The Fundamental	

	Theorem of Curl (Statement and Geometrical interpretation is included, Proof of these theorems are omitted). Problems based on these theorems are required to be done. **DG: 3.1, 3.2, 3.3, 3.4, 3.5** Curvilinear Coordinates: Spherical Coordinates, Cylindrical Coordinates **DG: 4.1, 4.2**	
Unit II	**Analog Electronics**	**15 lectures**
	Transistor Biasing, Inherent Variations of Transistor Parameters, Stabilization, Essentials of a Transistor Biasing Circuit, Stability Factor, Methods of Transistor Biasing, Base Resistor Method, Emitter Bias Circuit, Circuit analysis of Emitter Bias, Biasing with Collector Feedback Resistor, Voltage Divider Bias Method, Stability factor for Potential Divider Bias. **MM: 9.2 to 9.13** General amplifier characteristics: Concept of amplification, amplifier notations, current gain, Voltage gain, power gain, input resistance, output resistance, general theory of feedback, reasons for negative feedback, loop gain. **AM: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 17.1, 17.2, 17.3** **SC: 9.3, 9.4** Practical circuit of transistor amplifier, phase reversal, frequency response, Decibel gain and Band width. **MM: 13.4, 13.5**	
Unit III	**Analog and Digital Electronics**	**15 lectures**
	Oscillators: Introduction, effect of positive feedback. Requirements for oscillations, phase shift oscillator, Wien Bridge Oscillator, Colpitt's oscillator, Hartley oscillator **MM: 14.1 to 14.11, 14.13, 14.14.** **Operational Amplifiers**: Introduction, Schematic symbol of OPAMP, Output voltage from OPAMP, AC analysis, Bandwidth of an OPAMP, Slew rate, Frequency Response of an OPAMP, OPAMP with Negative feedback, Inverting Amplifier, Non-Inverting Amplifier, Voltage Follower, Summing Amplifier, Applications of Summing amplifier, OPAMP Integrator and Differentiator, Critical frequency of Integrator, Comparator **Digital Electronics** Flip-flops and counters: R-S flip flops, Clocked R-S, D Flip flop, J K Master slave flip flop, counters: Synchronous and Asynchronous: 3 bit ripple up counter, mod-3.	

	Digital Principles and Applications – Donald Leach, A Malvino, Goutam Saha (13th Edition): 8.1, 8.2,8.5, 8.8 , 10.1 555 Timer: Block diagram, Monostable and Astable Operation **Electronic Principles – A. P Malvino and D. J Bates (7th Ed.): 23.7, 23.8, 23.9**	
	References: 1. Introduction to Electrodynamics 3rd Ed by D.J. Griffith 2. Principles of Electronics – V. K. Mehta and Rohit Mehta. (S. Chand – Multi-colored illustrative edition) **3.** Electronic devices and circuits – An introduction Allan Mottershed (PHI Pvt. Ltd.– EEE – Reprint – 2013)	
RUSPHP03 (B)	**PRACTICALS**	**1 Credit**
	1. Figure of merit of a mirror galvanometer.	
	2. Measurement of self Inductance of coil	
	3. Opamp: Inverting amplifier /Non inverting amplifier with different gains	
	4. Transistorized Bistable multivibrator-	
	5. Passive low pass filter/high pass filter	
	6. Counters mod 2,5 and 10	
	7. MS-JK Flipflop	

Course Code: RUSPHY303

Course Title: Applied Physics - I

Academic year 2019-20

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.

Learning Outcomes:

On completion of this, it is expected that

a) Students will appreciate the role of Physics in 'interdisciplinary areas related to Materials, Nano-sciences, Bio-physics , Acoustics etc.
b) The learner will understand the scope of the subject in Industry & Research
c) Experimental learning opportunities will faster creative thinking

SEMESTER III		
Course Code	**Title**	**2 Credits**
RUSPHY 303	**Applied Physics – I**	
Unit I	**Acoustics, Lasers and fiber optics**	**15 lectures**
	1) **Acoustics of Buildings:** Reverberation, Sabine's formula (without derivation) Absorption coefficient, Acoustics of Buildings, factors affecting Acoustics of Buildings, Sound distribution in an auditorium. **Reference:** Properties of matter and Acoustics – R Murugeshan and K. Shivaprasath, S Chand & Co.Ltd. (2005-Ed)—5.9,5.10, 5.12,5.13,5.14, 5.15 2) **Laser :** Introduction, transition between Atomic energy states (without derivation), Principle of Laser, Properties of Laser, Helium–Neon Laser, Application of Laser, Holography. **Reference**:- Modern Physics Concept and Applications – Sanjeev Puri, Narosa Publication—9.1 to 9.6 , 9.10, 9.11 3) **Fiber Optics:** Light propagation through Fibers, Fiber Geometry, Internal reflection, Numerical Aperture, Step-Index and Graded-Index Fibers, Applications of Fibers. **Reference:** Modern Physics Concept and Applications – Sanjeev Puri, Narosa Publication— 13.3, 13.5, 13.9	
Unit II	**Biophysics**	**15 lectures**
	Introduction, definition, History & scope of biophysics, biological fluids, physico-chemical properties, viscosity, surface tension, pH,	

	osmosis, osmotic pressure. Diffusion, Ficks' laws of diffusion, dialysis, Cell is unit of life, fundamental understanding prokaryotic and eukaryotic cell structure and function, eukaryotic cell membrane, Fundamentals of transport process through biological membrane, membrane channels. electrical properties of cell, Action potential, propagation of action potential, methods of measurement of action potential, Nernst equation, Golman equation, The Hodgkin-Huxely model of action potential, voltage clamp technique, Patch clamp technique, cell impedance and capacitance . **Reference**:- Biophysics-principles and techniques by M.A. Subramanian-MJP publishers-chapter3 and 8 full. **Other Reference**s: 1. Cellular and Molecular Biology: Concept and Experiment by Gerald Karp 2. The Cell: A Molecular Approach by Geoffery Cooper 3. Introductory Biophysics: Perspective on living state by James Claycomb 4. Medical Physiology by Guyton 5. Molecular Biology of Cell by Bruce Albert 6. Text Book of Biophysics by R N Roy	
Unit III	**Materials – properties and applications**	**15 lectures**
	Classification and selection of materials: Classification of materials, organic, inorganic and biological materials, semiconductor materials, current trends and advances in materials. Material structure and examination, selection of materials. Crystal geometry and structure: Crystals, single crystal, Whiskers, lattice point and space lattice. Unit cell, primitive cell, Atomic radius, Density of crystal, Direction lattice planes, Miller indices, Inter planar spacing, Crystal planes in cubic unit cell, common planes in simple cubic structure. Coordination number, Crystal growth. **KK: CHAPTER 1(3 TO 9) KK CHAPTER 3 (1 TO 18, 33)** **References:** 1. Material Science – S. K. Kakani and Amit Kakani, New Age International (P) Ltd. – Reprint 2004 (**KK)** 2. Electronic Properties of Materials, Rolf E Hummel 3. Materials Science and Engineering: A First Course by V. Raghavan	

RUSPHY 03 (C)	PRACTICALS	1 Credit
	1. Standardization of pH meter & acid-base titration.	
	2. Surface tension of Biological fluid.	
	3. Determination of thermal conductivity of bad conductor by Lee's Method.	
	4. Concept of beats	
	5. Solar cell	
	6. Thermal relaxation time constant of a series bulb	
	7. Understanding UV-Visible spectra of protein/Nucleic Acids.	
	References: 1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit & B Saha. (6th Edition) Book and Allied Pvt Ltd 2. B.Sc Practical Physics – Harnam Singh S.Chand & Co. Ld. 2001 3. A test 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 and Co Ltd 5. Practical Physics CL Squires (3rd Edition) Cambridge University 6. University Practical Physics – DC Tayal. Himalaya Publication 7. Advanced Practical Physics – Worsnop &Flint.	
	Skill Experiments: 1. Soldering technique 2. Wiring of a simple circuit on a Bread Board 3. Lateral shift removal on optical bench 4. Use of Digital Storage Oscilloscope (DSO) 5. Component testing: resistor, capacitor, diode, transistor on CRO 6. Study of SRIM (Stopping and range of ions in matter)-free software 7. Radius of ball bearings (single pan balance) 8. Drawing of graph on Semi-logarithmic or Logarithmic Scale 9. Study of LT-Spice, free software for simulation of electronic circuits. **10.** Spectrometer: mean μ of yellow doublet of mercury source.	

SEMESTER-IV

Course Code: RUSPHY401

Course Title: Optics, Applied optics

Academic year 2019-20

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.

Learning Outcomes:

On successful completion of this course students will be able to:

1) Understand the diffraction and polarization processes and applications.
2) Understand the applications of interference in design and working of interferometers.
3) Introduction to application of optics- fiber optic sensors, non –reflecting and high reflecting thin films, grating structure in optical fiber
4) Demonstrate quantitative problem solving skills in all the topics covered.

Detail Syllabus

SEMESTER IV		
Course Code	**Title**	**2 Credits**
RUSPHY 401	**Optics, Applied optics**	
Unit I	**Interference in thin films , Diffraction- Fresnel & Fraunhoffer**	**15 lectures**
	Interference: Interference in thin films, Fringes in Wedge shaped films, Problems **SBA: 15.1, 15.2.1 to 15.2.5, 15.3, 15.5, 15.6.1, 15.6.2, 15.6.3** **A text book of Optics – Subramanyam, Brijlal, Avadhanulu (SBA)** **Fresnel's diffraction:** Introduction, Huygen's-Fresnel's theory,	

	Fresnel's assumptions, Distinction between interference and diffraction, Fresnel and Fraunhoffer types of diffraction, diffraction due to single edge, position of maximum and minimum intensity, intensity at a point inside a geometrical shadow, diffraction due to a narrow slit, diffraction due to narrow wire. **Fraunhoffer diffraction**: introduction, Fraunhoffer diffraction at a single slit, intensity distribution in diffraction pattern due to single slit, Fraunhoffer diffraction due to double slit, distinction between single slit and double slit diffraction patterns, plane diffraction grating, theory of plane transmission grating, width of principal maxima, prism and grating spectra. **SBA: 17.1, 17.2, 17.3, 17.6, 17.7, 17.10, 17.10.1, 17.10.2, 17.11, 17.12, 18.1, 18.2, 18.2.1, 18.4, 18.4.2, 18.7, 18.7.1, 18.7.2, 18.7.8(i to vi)**	
Unit II	**Polarization**	**15 lectures**
	Types of polarization, Plane polarized light, circularly polarized light, Elliptically polarized light, Partially polarized light, Production of Plane polarized light, Polarization by reflection from dielectric surface, Polarization by refraction –pile of plates, Polarization by scattering, Polarization by selective Absorption, Polarization by double refraction, Polarizer and Analyzer, Malus' Law, Anisotropic crystal, Calcite crystal, Optic Axis, Double refraction in calcite crystal, Huygens' explanation of double refraction, Ordinary and Extra ordinary rays, Positive and Negative crystals, Superposition of waves linearly polarized at right angles, Superposition of e-Ray and o-Ray, Retarders, Quarter wave plate, Half wave plate, Production of linearly polarized light, Production of elliptically polarized light, Production of circularly polarized light, Analysis of polarized light, Applications of polarized light. **AG: 19.1, 19.2.1, 19.2.2, 19.2.3, 19.3, 19.4, 19.4.1, 19.5, 19.6.** **Optics by Ajoy Ghatak 4th Ed (AG)** **Additional References:** 1. Fundamentals of Optics – Jenkins and White. (4th Ed) 2.Optics by C. L Arora	
Unit III	**Applied Optics**	**15 lectures**
	Non-reflecting films (13.4 but not 13.4.1, 13.4.2), high reflectivity by thin film deposition (13.5), reflection by a periodic structure (13.6) , Fiber –Bragg gratings (13.6.1) Newton's rings (13.10, Ex. 13.2,Ex. 13.3), Michelson interferometer	

	(13.11) Self focusing phenomenon (16.11) Fiber optic sensors (24.14) **Reference: OPTICS by Ajoy Ghatak-3 rd edition, McGraw-Hill publications.**	
RUSPHP04 (A)	**PRACTICALS**	**1 credit**
	1. Flat spiral spring (n)	
	2. Young's modulus by Koenig's method.	
	3. Optical fibre: transmission of signal	
	4. Brewster's/ Malus's law verification	
	5. R.P. of grating	
	6. Cylindrical obstacle: determination of λ	
	7. Single slit diffraction	
	References: 1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit & B Saha. (6th Edition) Book and Allied Pvt Ltd 2. B.Sc Practical Physics – Harnam Singh S.Chand & Co. Ld. 2001 3. A test 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 and Co Ltd 5. Practical Physics CL Squires (3rd Edition) Cambridge University 6. University Practical Physics – DC Tayal. Himalaya Publication 7. Advanced Practical Physics – Worsnop &Flint.	

Course Code: RUSPHY402

Course Title: Quantum Mechanics

Academic year 2019-20

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.

Learning Outcomes:

On successful completion of this course students will be able to:

(1) Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics
(2) Demonstrate quantitative problem solving skills in all the topics covered

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SEMESTER IV		
Course Code	**Title**	**2 Credits**
RUSPHY 402	**Introduction to Quantum Mechanics**	
Unit I	**Origin of Quantum Mechanics:**	**15 lectures**
	• Historical Background: **Review --** Black-body Radiation, Photoelectric effect , Matter waves –de Broglie Hypothesis, Wave-particle duality • Concept of wave packet, phase velocity, group velocity and relation between them • Heisenberg's Uncertainty Principle (with thought experiments e.g. γ-ray microscope, electron diffraction experiment)	

	• Different form of Uncertainty relation • Physical interpretation of wave function – Max Born Interpretation of wave function • Requirements of wave function • Schrodinger's Equation: Schrodinger's time dependent wave equation and time independent wave function (Steady State) • Analogy between wave equation and Schrodinger's wave equation • Linearity and Superposition, Problems from all topics. Reference: AB: 2.2, 2.3, 3.1, 3.2, 3.3, 3.4 MJ: 4.3, 4.4, 4.5, 5.1, 5.2, 5.3 and numericals from chapter 1, 4 and 5 GA: 2.1 to 2.10 1. Concepts of modern physics by Arthur Beiser (AB) 2. Quantum Mechanics: A text book for undergraduates by Mahesh Jain (MJ) 3. Quantum Mechanics by G. Arul dhas 4. Quantum Mechanics (2nd edition) by H. C Verma - Additional Reference	
Unit II	**Quantum Mechanics**	**15 lectures**
	• Probability current density, equation of continuity, and its physical significance • Definition of an operator, Eigen value and Eigen function • Operators in Quantum Mechanics –Position, Momentum, and total energy (Hamiltonian) operators • Basic Commutator Algebra in Quantum Mechanics • Commutator brackets using position and momentum operators • Expectation Values , Problems from all topics. Reference: SPS: 4.9 MJ: 6.1 to 6.8 1. Quantum Mechanics by S. P Singh, M. K Bagade, Kamal Singh 2. Quantum Mechanics: A text book for undergraduates by Mahesh Jain	
Unit III	**Applications of Schrodinger's Steady State Equation:**	**15 lectures**
	Particle in an infinitely deep potential well (in detail – its relation with Heisenberg's uncertainty principle), Particle in a cube, Step potential, free particle, barrier potential and tunneling-	

	infinitely deep potential well, concepts of cube, step potential, free particle, barrier potential and tunneling (no mathematical formulations required) Problems from all topics **References:** SPS: 5.1 to 5.6, 6.1 to 6.3 MJ: 6.9, 7.1 to 7.4 GA: 4.1 to 4.3 1. Quantum Mechanics by S. P Singh, M. K Bagade, Kamal Singh, Chand 2004 Edition 2. Quantum Mechanics by G. Aruldhas	
	Additional References: 1. Basic Quantum Mechanics – Ajoy Ghatak 2. Introduction to Quantum Mechanics by D. J Griffith 3. Introductory Quantum Mechanics (4th Edition) by R. Liboff 4. ***The Feynman Lectures on Physics, Volume III*** by Leighton, Feynman, and Sands (transcribed from a lecture series given by Richard Feynman at Caltech) 5. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles 2nd Edition by Robert Eisberg , Robert Resnick 6. For problems of all units: 500 problems on Quantum Mechanics by G Aruldhas - chapters 1, 2, 3, 4	
RUSPHP04 (B)	**PRACTICALS**	**1 credit**
	1. Determination of absolute capacitance using BG	
	2. Measurement of resistance of galvanometer (G by shunting)	
	3. Transistorized Astable multivibrator -	
	4. Passive band pass filter.	
	5. CE amplifier: variation of gain with load	
	6. Colpitt's oscillator-	
	7. Opamp: Integrator and Differentiator-	
	References: 1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit & B Saha. (6th Edition) Book and Allied PLtd 2. B.Sc Practical Physics – Harnam Singh S.Chand . 2001 3. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3rd edition) 4. B.Sc. Practical Physics – CL Arora (1st Ed) 2001 S. Chand 5. Practical Physics CL Squires (3rd Ed) Cambridge Univ. 6. University Practical Physics – DC Tayal. Himalaya Publ. 7. Advanced Practical Physics – Worsnop &Flint.	

Course Code: RUSPHY403

Course Title: Applied Physics – II

Academic year 2019-20

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.

Learning Outcomes: On completion of this, it is expected that

a) Students will appreciate the role of Physics in interdisciplinary areas related to Nano-sciences, **Nanomaterials,** Acoustics etc.
b) The learner will understand the scope of the subject of **Microprocessors.**
c) The learner will understand the scope of **Analysis Techniques used regularly in material science.**
d) The learner will understand the scope of the subject in Industry & Research
e) Experimental learning opportunities will faster creative thinking

SEMESTER IV		
Course Code	**Title**	**2 Credits**
RUSPHY403	**Applied Physics – II**	
Unit I	**Synthesis of Nano-materials**	**15 lectures**
	Synthesis of Nanomaterials – Physical Methods: Introduction, Mechanical Methods – High Energy Ball Milling, Melt Mixing; Methods based on Evaporation – Physical, Vapour Deposition, Ionized cluster beam deposition, Ablation (laser vaporization), Laser Pyrolysis, Chemical Vapour Deposition **SK: 3.1, 3.2. 3.2.1, 3.2.2, 3.3, 3.3.1, 3.3.2, 3.3.3, 3.3.4, 3.5** **Synthesis of Nanomaterials – Chemical Methods**	

	Introduction, Colloids & Colloids in Solution, Nucleation& Growth of Nanoparticles, Langmuir-Bodgett (LB) Method, Micro-emulsions, Sol-Gel Method **SK: 4.1, 4.2, 4.3, 4.6, 4.7, 4.8** **Synthesis of Nanomaterials – Biological Methods** Introduction, Synthesis using Microorganisms, Synthesis using Plant extracts, Use of Proteins, Templates like DNA, S-Layers, etc., Synthesis of Nanoparticles using DNA **SK: 5.1, 5.2, 5.3, 5.4, 5.5**	
Unit II	**Analysis Techniques**	**15 lectures**
	Introduction, Microscopes, Electron Microscope – Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Diffraction Techniques – X-Ray Diffraction (XRD), Atomic Scattering Factor, Bragg's Law of Diffraction, Diffraction from different types of Samples. **SK: 7.1, 7.2, 7.3, 7.3.1, 7.3.2, 7.5, 7.5.1, 7.5.2, 7.5.3, 7.5.4** **Reference:-** Sulabha Kukarni – Nanotechnology Principles and Practices **(SK)**	
Unit III	**Microprocessors**	**15 lectures**
	8085 Microprocessor and Basic Assembly Language Programming Introduction, Historical Perspective, Organization of a Microprocessor Based system, how does the Microprocessor works, Machine Language, Assembly Language, High Level Languages, Writing and executing an Assembly Language Program. **RG: 1.1, 1.1.2, 1.1.3, 1.2 (omit 1.2.4)** 8085 Bus Organization, 8085 Programming Model, The 8085 Microprocessor, Pin connection diagram and function of each pin, A detailed look at 8085 Microprocessor. **RG: 3.1.1, 2.1.1, 2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.1.5** Basic definitions: Instruction, Op-code, operand. Instruction word Size, instruction Format, data format, Addressing Modes, The 8085 Instruction Set(Classification) Data transfer Operations, Arithmetic Operations, Logical Operations Branch Operations, Introduction to Advanced Instructions Flowchart **RG: 2.3.1, 2.3.2, 6.11, 2.11, 6.1, 7.2.1, 7.2.2, 7.3.3, 6.2, 7.2.4, 7.3.1, 6.3, 7.4, 7.5, 6.4, 9.2 (omit 9.2.1, 9.2.2), 9.3, 10.7, 6.1.2** **References:**	

	Microprocessor Architecture, programming and Applications with 8085 - Ramesh Gaonkar, 5th Edition, Prentice Hall of India **(RG)**	
RUSPHP04 (C)	**PRACTICALS**	
	1. Study of 8085 microprocessor kit and commands	
	2. 8 -bit addition, subtraction and display	
	3. 8 -bit addition, subtraction with carry and display	
	4. 8 –bit multiplication	
	5. Memory block transfer from one location to another	
	6. Find largest/smallest number in given block.	
	7. Arrange given number in ascending/descending order	
	References: 1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit & B Saha. (6th Edition) Book and Allied Pvt Ltd 2. B. Sc Practical Physics – Harnam Singh S. Chand & Co. Ld. 2001 3. A test 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 and Co Ltd 5. Practical Physics CL Squires (3rd Edition) Cambridge University 6. University Practical Physics – DC Tayal. Himalaya Publication 7. Advanced Practical Physics – Worsnop &Flint.	
	Demonstration Experiments: 1. Error Analysis and Concept of Beats 2. Study of stepper motor 3. Wave-form Generation using Opamp 4. Double Refraction 5. Straight Edge Fresnel Diffraction 6. Hysteresis Experiment 7. Coupled Oscillations and Resonance 8. First Order Active Filter-LP and HP 9. PC simulation of 8085. 10. Use of DAD instruction in programming of 8085.	

MODALITY OF ASSESSMENT

SEM---III

Theory Examination Pattern:

A) Internal Assessment (40% of 100 marks) = 40 marks**.**

Theory Paper- Paper code	Internal test marks	Assignment	Marks distribution	Total Marks per paper
Mechanics & Thermodynamics RUSPHY301	**20**	15 questions on units1,2,3	Assessment- 15 Viva on it --05 ---------- **Total= 20 mark**	**40**
Vector calculus, Analog and Digital Electronics RUSPHY302	**20**	15 questions on units1,2,3	Assessment- 15 Viva on it --05 ---------- **Total= 20 mark**	**40**
Applied Physics- I RUSPHY303	**20**	15 questions on units1,2,3	Assessment- 15 Viva on it --05 ---------- **Total= 20 mark**	**40**

B) External examination - 60 % of 100 marks = 60 MARKS,
Semester End Theory Question paper of 60 marks

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

i. Paper Pattern: All questions shall be compulsory with internal choice within.

Questions	Options	Marks	Questions on
Q.1)A)	*Any 2 out of 4*	*14*	*Unit I*
Q.1)B)	*Any 1 out of 2*	*01*	
Q.2)A)	*Any 2 out of 4*	*14*	*Unit II*
Q.2)B)	*Any 1 out of 2*	*01*	
Q.3)A)	*Any 2 out of 4*	*14*	*Unit III*
Q.3)B)	*Any 1 out of 2*	*01*	
Q.4)A)	*Any 1 out of 2*	*5*	*Unit I*
Q.4)B)	*Any 1 out of 2*	*5*	*Unit II*
Q.4)C)	*Any 1 out of 2*	*5*	*Unit III*
Total marks		***60***	

Practical Examination Pattern: (A) Internal Examination:

Sr. No.	Activity	Practical-Group-A	Practical-Group-B	Practical-Group-C
1.	**Working Journal completion (1 mark per experiment)**	7 mark	7 mark	7 mark
2.	**Continuous Assessment (1 mark per experiment)**	7 mark	7 mark	7 mark
3.	**Main Journal**	6 mark	6 mark	6 mark
	Total (=1 +2+ 3)	**20 mark**	**20 mark**	**20 mark**
	Skill experiments= 8 for certified Journal. Main experiments = 21 for certified Journal.			

(B) External (Semester-end practical examination):

Particulars	Practical-Group-A	Practical-Group-B	Practical-Group-C
Laboratory work	*25*	*25*	*25*
Viva	*5*	*5*	*5*
Total	**30**	**30**	**30**

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 of the department / laboratory In-charge of the respective class by presenting working(rough) journal to the HOD. If the student did not present such lost certificate at the practical examination, he/she will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

Semester III

Course	RUSPHY***301***			RUSPHY***302***			RUSPHY**303**			Grand Total
	Internal	**External**	**Total**	**Int.**	**Ext.**	**Total**	**Int.**	**Ext.**	**Total**	
Theory	**40**	**60**	**100**	**40**	**60**	**100**	**40**	**60**	**100**	**300**
Practicals	**20**	**30**	**50**	**20**	**30**	**50**	**20**	**30**	**50**	**150**

MODALITY OF ASSESSMENT

SEM---IV

Theory Examination Pattern: Internal Assessment (40% of 100 Marks) = 40 Marks**.**

Theory Paper-Paper code	Internal test marks	Assignment	Marks distribution	Total Marks per paper
Optics, Applied optics RUSPHY401	**20**	15 questions on units1,2,3	Assessment- 15 Viva on it --05 ---------- **Total= 20 mark**	**40**
Introduction to Quantum Mechanics RUSPHY402	**20**	15 questions on units1,2,3	Assessment- 15 Viva on it --05 ---------- **Total= 20 mark**	**40**
Applied Physics- II RUSPHY403	**20**	15 questions on units1,2,3	Assessment- 15 Viva on it --05 ---------- **Total= 20 mark**	**40**

B) External examination - 60 % of 100 marks = 60 MARKS

Semester End Theory Assessment - 60 marks

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

ii. Paper Pattern: All questions shall be compulsory with internal choice within

Questions	Options	Marks	Questions on
Q.1)A)	*Any 2 out of 4*	*14*	*Unit I*
Q.1)B)	*Any 1 out of 2*	*01*	
Q.2)A)	*Any 2 out of 4*	*14*	*Unit II*
Q.2)B)	*Any 1 out of 2*	*01*	
Q.3)A)	*Any 2 out of 4*	*14*	*Unit III*
Q.3)B)	*Any 1 out of 2*	*01*	
Q.4)A)	*Any 1 out of 2*	*5*	*Unit I*
Q.4)B)	*Any 1 out of 2*	*5*	*Unit II*
Q.4)C)	*Any 1 out of 2*	*5*	*Unit III*
Total marks		***60***	

Practical Examination Pattern: **(A) Internal Examination:**

Sr. No.	Activity	Practical-Group-A	Practical-Group-B	Practical-Group-C
1.	**Working Journal completion (1 mark per experiment)**	7 mark	7 mark	7 mark
2.	**Continuous Assessment (1 mark per experiment)**	7 mark	7 mark	7 mark
3.	**Main Journal**	6 mark	6 mark	6 mark
	Total (=1 +2+ 3)	**20 mark**	**20 mark**	**20 mark**
	Demonstration experiments= 8 for certified Journal. Main experiments = 21 for certified Journal.			

(B) External (Semester-end practical examination):

Particulars	Practical-Group-A	Practical-Group-B	Practical-Group-C
Laboratory work	*25*	*25*	*25*
Viva	*5*	*5*	*5*
Total	**30**	**30**	**30**

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 of the department / laboratory In-charge of the respective class by presenting working(rough) journal to the HOD. If the student did not present such lost certificate at the practical examination, he/she will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

Semester IV

Course	RUSPHY*401*			RUSPHY*402*			RUSPHY403			Grand Total
	Internal	External	Total	Int.	Ext.	Total	Int.	Ext.	Total	
Theory	40	60	100	40	60	100	40	60	100	300
Practicals	20	30	50	20	30	50	20	30	50	150

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