Resolution Number for Academic year 2019-20 syllabus

AC/II(18-19).2.RUS10

S.P. Mandali' s

Ramnarain Ruia Autonomous College

Syllabus for *FYBSc*

Program: *BSc*

Course: Physics*(RUSPHY)*

(Credit Based Semester and Grading System with effect from the academic year 2019-20)

		SEMESTER-I		
COURSE CODE	**UNIT**	**TITLE**	**Credits**	**Lecture / Week**
RUSPHY101		**Mechanics, Optics &Thermodynamics**	**2**	**3**
	I	Mechanics		
	II	Optics		
	III	Thermodynamics		
RUSPHY102		**Nuclear Physics & Quantum Mechanics**	**2**	**3**

	I	Nuclear Physics basics and Radioactivity		
	II	Nuclear detectors and Nuclear		
SEMESTER II				
COURSE CODE	**UNIT**	**TITLE**	**Credits**	**Lecture / Week**
	III	Origin of Quantum Theory and X-rays		
RUSPHP01	Physics Laboratory Course (Group A + Group B + Skill Experiments)		**2**	**6**
RUSPHY201		**Mathematical Physics & Mechanics**	**2**	**3**
		Total	**6**	**12**
	I	Vector algebra and Vector calculus		
	II	Differential equations and Transient		

	III	Harmonic Oscillations and Wave Motion		
RUSPHY202		**Electronics & Electricity**	**2**	**3**
	I	Circuit theorems and Alternating		
	II	Rectifier Circuit and Transistor as an		
	III	Digital electronics and binary algebra		
RUSPHP01	Physics Laboratory Course (Group A + Group B + Skill Experiments)		**2**	**6**
	Total		**6**	**12**

Course Code: RUSPHY101

Course Title: Mechanics, Optics & Thermodynamics

Academic year 2019-20

Learning Objectives: After successful completion of this course, students would acquire the following knowledge & skills:

(1) The ability to apply the principles of physics to solve innovative and unfamiliar problems

(2) The ability to explore and deduce quantitative results in the extentsof 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, modern physics, thermodynamics, electrostatics at a level attuned with graduate programs in physics at peer institutions

Learning Outcomes: After the successful completion of this course, the student will be able to:

1. Understand Newton's laws and apply them in calculations of the motion of simple systems
2. Use the free body diagrams to analyze the forces on the object
3. Understand the concepts of friction and the concepts of elasticity, fluid mechanics and be able to perform calculations using them
4. Understand the concepts of lens system and interference
5. Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process
6. Demonstrate quantitative problem solving skills in all the topics covered

Detail Syllabus

SEMESTER I		
Course Code	**Title**	**Credits**
RUSPHY101	**Mechanics, Optics & Thermodynamics**	**2**
Unit I	**Mechanics**	**15 lectures**
	Newton's laws – Newton's first, second law and third laws of motion; Interpretation and applications; Inertial and non-inertial frames of reference; Pseudo forces. Worked out problems [Numerical from	

	references- HP,HCV and HRW] **HCV: 5.1, 5.2, 5.3, 5.4, 5.5, 5.7**	
	Elasticity – Review of elastic constants - Y, K, η and σ; Equivalence of shear strain to compression and extension strains; Relation between elastic constants; Couple for twist in cylinder; Problems from all topics. **HP: 15.2A, 15.3A, 15.4A, 15.5A, 15.7A**	
	Fluid Dynamics –Introduction, Viscosity, Equation of continuity; Bernoulli's equation; streamline and turbulent flow; lines of flow in airfoil; Poiseuille's equation; Problems from all topics. **HP: 15.1B, 15.2B, 15.3B, 15.4B, 15.5B, 15.6B**	
Unit II	**Optics**	**15 lectures**
	Review of Lens Maker's Formula; Newton's Lens Equation; Magnification – Lateral, Longitudinal and Angular. Equivalent focal length of two thin lenses, thick lens, cardinal points of thick lens, Ramsden & Huygens Eyepiece. **BSA: 4.10, 4.10.1, 4.11, 4.12, 4.12.1, 4.12.2, 4.12.3, 4.17, 4.14.1 to 4.17.4, 6.1, 6.2, 6.2.1 to 6.2.3, 10.10, 10.11**	
	Aberration: Spherical aberration, reduction in spherical aberration, Chromatic & Achromatic aberration, Condition for achromatic aberration. **BSA: 9.2, 9.3, 9.4, 9.5, 9.5.1, 9.6, 9.10, 9.11, 9.12, 9.13(1) (2)**	
Unit III	**Thermodynamics**	**15 lectures**
	Behavior of Real Gases & Real gas equation; van der Waal equation. Thermodynamic Systems; Zeroeth law of Thermodynamics; Concept of Heat; First law of Thermodynamics; Non-adiabatic process & Heat as a path function; Internal energy; Heat capacity & specific heat; Application of first law to simple processes; General Relations from the first law; Indicator diagrams; Work done during Isothermal & Adiabatic	

	Process. Worked out examples, Problems from all topics **BSH: 2.1 to 2.12, 4.1 to 4.14**	
	PRACTICALS	
	Skill Experiments: 1. Absolute and Relative Error Calculation 2. Graph Plotting 3. Use of Digital Multimeter 4. Use of Screw Gauge, Vernier Calipers, and Travelling Microscope 5. Spectrometer (Schuster's Method)	
	Regular Experiments:	
	Group A	**1 credit**
	1. Torsional oscillations	
	2. Y by vibration	
	3. Thermistor Characteristics	
	4. Helmholtz Resonator	
	5. J by Electrical method	
	6. η by Poiseuille's method	
	Any one out of the following is equivalent to two experiments from Group A and/or Group B 1. Student should carry out **mini-project** up to the satisfaction of the Professor or In-Charge of the Practical 2. Study Tour: Students participated in study tour must submit a **study tour report** Ø Minimum 8 experiments (4 from each group) from the list should be completed in the first semester Ø Any FOUR skill experiments are to be reported in the Journal Ø Certified Journal is a MUST for a candidate to be eligible in the end semester practical examination. Ø Internal component of Practical examination Evaluation is based on regular experiments and skill experiments.	

	Ø For External practical examination, the learner will be examined in 2 experiments (one from each group).	

References:

1. Mechanics – Concepts of Physics by H. C Verma (Vol. 1) **(HCV)**
2. Mechanics by Hans & Puri **(HP)**
3. A text book of Optics by Brijlal, Subramanyam & Avadhanulu **(BSA)**
4. Heat, Thermodynamics & Statistical Physics by Brijlal, Subramanyam & Hemne **(BSH)**

Additional References:

1. Classical Dynamics by Thornton & Marion (5th Ed)
1. Fundamental of Physics (extended) – Haliday, Resnick & Walker (6th Ed.)
2. Optics by C. L Arora
3. Fundamentals of Optics – Khanna and Gulati
4. Principles of Optics – B. K. Mathur and T. P. Pandya (3rd Ed.)
5. Heat & Thermodynamics by M. W Zemansky & R. H Dittman
6. Basic Thermodynamics by Evylen Guha
7. Theory and Experiments on Thermal Physics – D. K. Chakrabarti (2006 Ed)

Course Code: RUSPHY102

Course Title: Nuclear Physics & Quantum Mechanics

Academic year 2019-20

Learning Objectives: After successful completion of this course, students would acquire the following knowledge & skills:

(1) The ability to apply the principles of physics to solve innovative and unfamiliar problems
(2) The ability to explore and deduce quantitative results in the extents 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, modern physics, thermodynamics, electrostatics at a level attuned with graduate programs in physics at peer institutions

Learning Outcomes:

After successful completion of the course, the student will be able to:

1. Understand the concept of lens and apply it to practical eyepieces
2. Understand the phenomenon of interference with examples
3. Get an idea about the nucleus and its properties
4. Get a glimpse of dual nature of light
5. Study the particle nature of matter with Compton effect

Detail Syllabus

SEMESTER I		
Course Code	**Title**	**Credits**
RUSPHY102	**Nuclear Physics & Quantum Mechanics**	**2**
Unit I	**Nuclear Physics basics and Radioactivity**	**15 lectures**
	Structure of Nuclei: Basic Nuclear Properties, Composition, Charge, Size **BSS: 10.1; AB: 11.1, 11.2** Rutherford's α-scattering experiment for estimation of nuclear size, Measurement of Nuclear radius – Hofstadter's Experiment **SBP: 4.1.1, 4.1.2** Mass Defect, Binding Energy, Packing Fraction, BE/A vs A plot, Stability of Nuclei (N vs Z Plot); Problems from all topics. **IK: 9.5; BSS: 10.5, 10.6; AB: 11.3, 11.4**	
	Radioactivity: Radioactive Disintegration, Concept of Natural & Artificial Radioactivity, Properties of α, β, & γ-rays, Radioactive Decay, Laws of Radioactive growth & decay, half-life, mean life, units of	

	radioactivity, successive disintegration, radioactive equilibrium (Ideal, Secular & Transient Equilibrium), Determination of age of Earth. Radioactive series, Carbon Dating, Radioactive Isotopes and its applications (Medicine, Food & Agriculture, Industry, Archaeological Field) **SBP: 2.1, 2.2, 2.3, 2.6, 2.7, 2.8, 2.9, 2.9, 2.10, 2.11, 2.12, 2.13** **IK: 10.1, 10.2; AB: 12.1, 12.2**	
Unit II	**Nuclear detectors and Nuclear Reactions**	**15 lectures**
	Interaction between particles and matter, Ionization chamber, Proportional counter and GM counter, problems **SBP: 1.1.2, 1.1.3 (I & ii); IK: 2.8; BSS: 9.13, 9.14**	
	Nuclear Reactions: Types of Reactions and Conservation Laws. Concept of Compound and Direct Reaction, Q value equation and solution of the Q equation, problems. **SBP: 3.1 to 3.5; BSS: 3.3, 3.4, 3.5; 11.2, 11.3, 11.5, 11.6** Fusion and fission definitions and qualitative discussion with examples. **BSS: 12.3, 12.7; AB: 12.9, 12.11**	
Unit III	**Origin of Quantum Theory ,X-rays, and Compton Effect**	**15 lectures**
	Origin of Quantum Theory: Black-body Radiation, Black Body Spectrum, Wien's Displacement law; Wave particle Duality, deBroglie Waves, Experimental Verification of deBroglie Waves, (Davisson-Germer Experiment, G. P Thomson Experiment) Heisenberg's Uncertainty Principle, Different forms if Uncertainty principle, Applications of Uncertainty Principle. **BSS: 2.1 to 2.5, 3.1 to 3.6, 3.9**	
	X-Rays: Production (Coolidge tube), Continuous & Characteristics of x-ray spectra, x-ray diffraction (Laue's diffraction pattern) Bragg's Law, Bragg's x-ray spectrometer, Properties & Applications of x-rays. **BSS: 6.1, 6.2, 6.3, 6.4; AB: 2.5, 2.6;**	
	Compton Effect, Pair Production, Photons & Gravity, Gravitational Red Shift. Problems from all topics.	

	AB: 2.7 to 2.9	
	PRACTICALS	**1 credit**
	Regular Experiments: Group B	
	1. Frequency of A.C. Mains	
	2. Spectrometer (Angle of Prism)	
	3. Combination of lenses	
	4. Newton's ring / Wedge shaped film	
	5. NAND, NOR gates as Universal Building Blocks	
	6. EX-OR gate, Half Adder & Full Adder	

References

1. Nuclear Physics – An Introduction by S. B Patel **(SBP)**
2. Atomic and Nuclear Physics – N Subramanyam, Brijlal & Seshan**(BSS)**
3. Concepts of Modern Physics by Arthur Beiser **(AB)**

Additional References:

1. Atomic Physics by S. N Ghoshal
2. Nuclear Physics by S. N Ghoshal
3. Atomic and Nuclear Physics - A. B. Gupta and Deepak Ghosh
4. Basic Quantum Mechanics by Ajoy Ghatak
5. Elements of x-ray diffraction by B. D Cullity

SEMESTER-II

Course Code: RUSPHY201

Course Title: Mathematical Physics & Mechanics
Academic year 2019-20

Learning Objectives: After successful completion of this course, students would acquire the following knowledge & skills:

1. The ability to apply the principles of physics to solve innovative and unfamiliar problems
2. The ability to explore and deduce quantitative results in the extents 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, modern physics, thermodynamics, electrostatics at a level attuned with graduate programs in physics at peer institutions

Learning Outcomes:

After successful completion of this course, student will be able to:

1. Understand the basic mathematical concepts and applications of them in physical situations.
2. Demonstrate quantitative problem solving skills in all the topics covered

SEMESTER II		
Course Code	**Title**	**Credits**
RUSPHY201	**Mathematical Physics & Mechanics**	**2**
Unit I	**Vector algebra and Vector calculus**	**15 lectures**
	Vector and Scalars: Vectors, Scalars, Vector algebra, Laws of Vector algebra, Unit vector, Rectangular unit vectors, Components of a vector, Scalar fields, Vector fields, Problems based on Vector algebra. Dot or Scalar product, Cross or Vector product, Commutative and Distributive Laws, Scalar Triple product, Vector Triple product (Omit proofs). Problems and applications based on Dot, Cross and Triple products. **MS: Ch. 1, 2(Omit Reciprocal sets of vectors)**	

	Gradient, divergence and curl: The ∇ operator, Definitions and physical significance of Gradient, Divergence and Curl; Distributive Laws for Gradient, Divergence and Curl (Omit proofs); Product Rule Problems based on Gradient, Divergence and Curl, product Rules **MS: Ch. 4 (Omit formulae no 4 to 12 involving ∇ and Invariance)**	
Unit II	**Differential equations and Transient response of circuits**	**15 lectures**
	Differential equations: Introduction, Ordinary differential equations, First order homogeneous and non- homogeneous equations with variable coefficients, exact differentials, and General first order Linear Differential Equation, Second-order homogeneous equations with constant coefficients. Problems depicting physical situations like LC and LR circuits, Simple Harmonic motion (spring mass system) **CH: 5.1, 5.2, 5.2.1 (A, B, C) (Omit D), 5.2.3**	
	Transient response of circuits: Series LR, CR, LCR circuits. Growth and decay of currents/charge **CR: 14.1, 14.2, 14.3**	
Unit III	**Harmonic Oscillations and Wave Motion**	**15 lectures**
	Composition of two Collinear Harmonic Oscillations: Linearity & Superposition Principle. Superposition of two Collinear Oscillations having (i) equal frequencies, and (ii) different frequencies (Beats) Superposition of two mutually perpendicular harmonic oscillations: Graphical & Analytical methods, Lissajous figures with equal & unequal frequencies; its uses.	
	Wave Motion: Transverse waves on string, Travelling & Standing waves on a string, Normal modes of a string; Group velocity, Phase velocity, plane waves, spherical waves, wave intensity; Problems from all topics. **SPP: 2.4.1, 2.4.3, 2.4.4, 2.4.1, 2.3.4 FC: 1.5**	

	PRACTICALS	1 credit
	Demonstration Experiments: 1. Use of Cathode Ray Oscilloscope (or Digital Storage Oscilloscope) 2. Conservation of Angular Momentum 3. Laser Beam Divergence, Intensity 4. Charging Discharging of a Capacitor 5. Use of PC for graph Plotting 6. Light Dependent Switch 7. Clipper & Clamper Circuits - **5 minimum demo-experiments should be reported in journal**	
	Regular Experiments: Group A	
	1. Zener diode as Regulator	
	2. Surface Tension	
	3. Spectrometer (Minimum Angle of deviation & μ)	
	4. LDR Characteristics	
	5. Verification of Stefan's law	

References:

1. Schaum's outline of Theory and problems of Vector Analysis – Murray Spiegel **(MS)**
2. Fundamentals of Vibrations & Strings by S. P Puri **(SPP)**
3. Berkeley Physics Course, vol. 3, Francis Crawford **(FC)**
4. Electricity and Magnetism by D. Chattopadhaya & P. C. Rakshit **(CR)**

Additional References:

1. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
2. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
3. Additional References:
4. Brijlal, N. Subrahmanyam, Jivan Seshan, Mechanics and Electrodynamics, , (S. Chand) (Revised & Enlarged ED. 2005)
5. A K Ghatak, Chua, Mathematical Physics, 1995, Macmillan India Ltd.
6. Ken Riley, Michael Hobson and Stephen Bence, Mathematical Methods for Physics and Engineering, Cambridge (Indian edition).
7. H. K. Dass, Mathematical Physics, S. Chand & Co.
8. Jon Mathews & R. L. Walker, Mathematical Methods of Physics: W A Benjamin Inc

Course Code: RUSPHY202

Course Title: Electronics

Academic year 2019-20

Learning Objectives: After successful completion of this course, students would acquire the following knowledge & skills:

6. The ability to apply the principles of physics to solve innovative and unfamiliar problems
7. The ability to explore and deduce quantitative results in the extents 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, modern physics, thermodynamics, electrostatics at a level attuned with graduate programs in physics at peer institutions

Learning Outcomes:

After successful completion of this course, a student will be able to:

1. Understand the details of electronics
2. Understand the working of various electronic equipments used in day-to-day life
3. Understand the working behind Logic Gates

SEMESTER II		
Course Code	**Title**	**Credits**
RUSPHY202	**Electronics**	**2**
Unit I	**Circuit theorems and Alternating Current**	**15 lectures**
	Circuit theorems: Thevenin's theorem, Norton theorem, Reciprocity theorem, Maximum power transfer theorem. **CR: 7.7, 7.8, 7.9, 7.10, 7.11**	
	Alternating Current: Sinusoid, Ac response of a Resistance, Inductance and a capacitance, Representation of sinusoids by complex numbers, sinusoidal voltage to series RL circuit, sinusoidal voltage to series RC circuit, sinusoidal voltage to series RLC circuit, Series and parallel resonance. **CR: 15.1, 15.2, 15.5, 15.6, 15.7, 15.8, 15.9, 15.11**	

Unit II	**Rectifier Circuit and Transistor as an amplifier**	
	Rectifier Circuit: (Half wave and Full wave rectifier: Review) Bridge rectifier: Efficiency and Ripple factor of Full wave Rectifier, Filter circuits: Types of filter circuits – capacitor filter, Voltage stabilization– Zener diode as voltage stabilizer. **VKM: 9.10 to 9.20, 9.22, 9.23**	
	Transistor as an amplifier: Definition of gain α, β (dc &ac) and relation between them, CE amplifier: operation, Load line Analysis, operating point, cut off and saturation points. **VKM**: **11.7 to 11.17, 11.21**	
Unit III	**Digital electronics and binary algebra**	
	Digital electronics: Review of Logic Gates; Boolean algebra, Boolean Theorems, De-Morgan's Theorems, NAND & NOR as Universal Building blocks. **EX-OR gate:** Implementation of basic gates using NAND & NOR gates and their applications: Controlled inverter, Half Adder, Full adder. Problems **VKM: 28.8 to 28.14, 28.19; LM: 6.7**	
	Binary number system, Arithmetic building blocks, Types of registers. Number system: Decimal, binary, hexadecimal number system and their mutual conversions. **Digital Principles and Applications – Donald Leach, A Malvino, Goutam Saha (13th Edition): 5.2 to 5.5, 5.7**	
	Binary addition, binary subtraction, unsigned Binary numbers, Sign-magnitude Numbers, 2's compliment representation and 2's compliment arithmetic: addition and subtraction. **Digital Principles and Applications – Donald Leach, A Malvino, Goutam Saha (13th Edition): 6.1 to 6.6**	

	PRACTICALS	1 credit
	Regular Experiments: Group B	
	1. LR Circuit	
	2. CR Circuit	
	3. Thevenin's Theorem	
	4. Norton's Theorem	
	5. Bridge Rectifier – Load Regulation	

References:

1. Electricity and Magnetism by D. Chattopadhaya & P. C. Rakshit **(CR)**
2. Principles of Electronics – V. K. Mehta & Rohit Mehta **(VKM)**
3. Digital Principles and Applications – Leach & Malvino **(LM)**

Additional References:

1. Digital Principles and Applications by Leach & Malvino
2. Digital Electronics by Tolkheim

MODALITY OF ASSESSMENT

Theory Examination Pattern:

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

Sr No	Evaluation type	Marks
1	One Assignment/Case study/Project	10
2	One class Test (multiple choice questions / objective)	20
3	Active participation in routine class instructional deliveries (case studies/ seminars/presentation)	05
4	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05

B) External examination - 60 % of 100 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 the questions.

Questions	Options	Marks	Questions on
Q.1)A)	*Any 2 out of 3*	*12*	*Unit I*
Q.1)B)	*Any 2 out of 4*	*04*	
Q.2)A)	*Any 2 out of 3*	*12*	*Unit II*
Q.2)B)	*Any 2 out of 4*	*04*	
Q.3)A)	*Any 2 out of 3*	*12*	*Unit III*
Q.3)B)	*Any 2 out of 4*	*04*	
Q.4)	*Any 3 out of 5*	*12*	*Unit I,II,III*
Total marks		*60*	

Practical Examination Pattern:

(A) Internal Examination:

Heading	Mark
Journal	*05*
Test-skill	*10*
Participation	*05*
Total	**20**

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

Particulars	Practical 1
Laboratory work	*25*
Viva	*5*
Total	**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/ Co-coordinator / In charge of the department; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

Semester I

Course	*101*			102			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

Semester II

Course	*201*			*202*			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

----------x----------x----------x----------x----------