Resolution No. AC/I/(23-24).3.RUS10

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE

Explore • Experience • Excel

Syllabus for

Program: S.Y.B.Sc.

Semester - III

Program Code: (RUSPHY)

2025-26

(As per the guidelines of National Education Policy 2020)

(Choice based Credit System for the Academic year 2025-26)

Graduate Attributes

S. P. Mandali's Ramnarain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Bachelors Program in Science also encourages students to reflect on the broader purpose of their education.

Graduate Attributes	Graduate Attributes Description **A student completing Bachelor's Degree in Science program will be able to:**
GA 1	Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science.
GA 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences
GA 3	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.
GA 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyze results.
GA 5	Take complex challenges, work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner.
GA 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
GA 7	Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.
GA 8	Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner

PROGRAM OUTCOMES

PO	Description **A student completing Bachelor's Degree in Science program in the subject of Statistics will be able to:**
PO 1	To demonstrate fundamental and procedural knowledge related to different areas of study in Physics including mechanics, optics, modern physics, thermodynamics, electronics, electrodynamics at a level attuned with graduate programs in physics at peer institutions
PO 2	To demonstrate comprehensive, quantitative and conceptual understanding of the core areas of physics.
PO 3	To apply the principles and acquired skill-set related to physics, to handle innovative and unfamiliar problems, so that effective solution or strategy to deal with, could be developed.
PO 4	To explore and deduce quantitative results in the extents of physics.
PO 5	To use contemporary experimental apparatus and analysis tools to acquire, analyse and interpret scientific data in the extents of physics.
PO 6	To communicate scientific results effectively in presentations or posters in the extents of physics to both the scientists and public at large.
PO 7	Utilize acquired ICT skills, physics practical skills, mathematical skills to prepare for employment, for advancement of a career path and also for lifelong learning in Physics.

CREDIT STRUCTURE B.Sc.

Semester	Subject 1		Subject 2	GE/ OE course (Across disciplines)	Vocational and Skill Enhancement Course (VSC) & SEC	Ability Enhancement Course/ VEC/IKS	OJT/FP/CEP CC, RP	Total Credits
	DSC	DSE						
1	4		4	4 (2*2)	VSC-2 + SEC -2	AEC- 2 (CSK) + VEC- 2 (Env Sc.) + IKS-2		22
2	4		4	4 (2*2)	VSC-2 + SEC-2	AEC-2 (CSK)+ VEC-2 (Understanding India)	CC-2	22
Total	8		8	8	8	10	2	44
Exit option: award of UG certificate in Major with 44 credits and an additional 4 credit Core NSQF course/ Internship or Continue with Major and Minor								
3	Major 8		Minor 4	2	VSC-2	AEC-2 MIL	FP -2, CC-2	22
4	Major 8		Minor 4	2	SEC-2	AEC-2 MIL	CEP-2, CC-2	22
Total	16		8	4	4	4	8	44
Exit option: award of UG Diploma in Major with 88 credits and an additional 4 credit Core NSQF course/ Internship or Continue with Major and Minor								
5	DSC-12	DSE 4	Minor 2		VSC-2		CEP/FP-2	22
6	DSC-12	DSE 4	Minor 2				OJT-4	22
Total	24	8	4		2		6	44
	Exit option: award of UG Degree in Major with 132 credits or Continue with Major for Honors/ Research							

PROGRAM OUTLINE(B.Sc.)

YEAR	SEM	COURSE CODE	Type of Course	COURSE TITLE	CREDITS
S.Y.B.Sc.	III	RUSMJPHYO201	Department Specific Course (DSC-1) (Major)	Vector Calculus, Mechanics and Thermodynamics	3
	III	RUSMJPHYPO201	Practical based on Major subject		1
	III	RUSMJPHYO202	Department Specific Course (DSC-2) (Major)	Laser, Nuclear Physics, Material Properties	3
	III	RUSMJPHYPO202	Practical based on Major subject		1
	III	RUSMIPHYO202	Department Specific Course (Minor)	Laser, Nuclear Physics, Material Properties	3
	III	RUSMIPHYPO202	Practical based on Minor subject		1
	III		Generic Elective/Open Elective		2
	III	RUSVSCPHYPO201	Vocational Skill Course (VSC)	Study of Electronics and Magnetism	2
		Total Credits			**16**
	IV	RUSMJPHYE211	Department Specific Course (DSC-1) (Major)	Optics, Applied Optics	3
	IV	RUSMJPHYPE211	Practical based on Major subject		1
	IV	RUSMJPHYE212	Department Specific Course (DSC-2) (Major)	Introduction to Quantum Mechanics	3
	IV	RUSMJPHYPE212	Practical based on Major subject		1
	IV	RUSMIPHYE212	Department Specific Course (Minor)	Introduction to Quantum Mechanics	3
	IV	RUSMIPHYPE212	Practical based on Minor subject		1
	IV		Generic Elective/Open Elective		2
	IV	RUSSECPHYPE211	Skill Enhancement Course (SEC)	Microprocessor 8085 and Digital electronics	2
		Total Credits			**16**

Course Code-Department Specific Course: RUSMIPHYO202

Course Title: Laser, Nuclear Physics, Material Properties

Academic year 2025-26

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	To understand working of LASERS and its working.
CO 2	Understand basic knowledge about Nucleus.
CO 3	The ability to use contemporary experimental apparatus and analysis tools to acquire, analyse and interpret scientific data
CO 4	Understand about different types of materials, their synthesis and applications
CO 5	Understand and determine various crystal lattices.

DETAILED SYLLABUS

Course Code	Unit	Course Title	Credits/ Hours
RUSMIPHYO202		**Laser, Nuclear Physics, Material Properties**	**3 Credit / 45 Hours**
	Unit I	**Laser and Optical Fiber**	
		Laser: Introduction, transition between atomic energy states (without derivation), Principle of Laser, Properties of Laser, Helium–Neon Laser, Application of Laser, Holography. **Fiber Optics**: Light propagation through Fibers, Fiber Geometry, Internal reflection, Numerical Aperture, Step-Index and Graded-Index Fibers, Applications of Fibers.	**15 Hours**
	Unit II	**Nuclear Physics**	
		Review -Radioactive Decay, Laws of Radioactive growth & decay, half-life, mean life, units of radioactivity). Rutherford's α-scattering experiment for estimation of nuclear size, Measurement of Nuclear radius – Hofstadter's experiment. Successive disintegration, radioactive equilibrium (Ideal, Secular & Transient Equilibrium), Determination of age of Earth. Radioactive series, Carbon Dating, Radioactive Isotopes and its applications in Medicine, Food & Agriculture, Industry, Archaeological Field. Interaction between particles and matter-Compton Effect, Ionization chamber, Proportional counter and GM counter, problems	**15 Hours**
	Unit III	**Material Properties and their Applications**	
		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.	**15 Hours**

References:

1. Concepts of Modern Physics by Arthur Beiser (AB)
2. Material Science – S. K. Kakani and Amit Kakani, New Age International (P) Ltd. – Reprint 2004 (KK)
3. Modern Physics Concept and Applications – Sanjeev Puri, Narosa Publication (SP)
4. Nuclear Physics, An Introduction- S. B Patel (SBP)
5. Nuclear Physics-Irvin Kaplan (IK)

Sr. No.	Practical Based on RUSMIPHYO202	Credit / Hrs
1.	Optical Fiber.	1 Credit / 30 Hours
2.	Determination of Wavelength of He-Ne Laser using Grating Elements.	
3.	Standardization of pH meter	
4.	Determination of Refractive Index of Liquid using diode laser.	
5.	Laser-Polariser	
6.	Study of Origin Software for determination of Lattice Parameters of XRD Data	
7.	R.P.of grating	

Please Note:

- Student doing **mini-project** up to the satisfaction of the Professor or In-Charge of the Practical.
- Study Tour: Study Tour: Students participated in study tour must submit a study tour report will be exempted for one practical.
- **Minimum 6 experiments out of 7 experiments** from the list should be reported in the Journal.
- **Certified Journal is a MUST** for a candidate to be eligible in the **end semester practical examination**.

For **Practical examination**, student will be **examined in 1 regular experiments**.

Modality of Assessment: Department Specific Course (3 Credit Theory Course for BSc)

A. Internal Assessment- 40%- 30 Marks

Sr. No.	Evaluation type	Marks
1	Class Test	20
2	Assignment	10
TOTAL		**30**

B. External Examination (Semester End)- 60%- 45 Marks

Semester End Theory Examination:

1. Duration – The duration for these examinations shall be of **One hour 30 Minutes**.
2. Theory question paper pattern:

Paper Pattern:

Questions	Options	Marks	Questions based on:
Q.1) A)	Any 2 out of 4	10	Unit I
Q.1) B)	Any 1 out of 2 (Numerical)	05	
Q.2) A)	Any 2 out of 4	10	Unit II
Q.2) B)	Any 1 out of 2 (Numerical)	05	
Q.3) A)	Any 2 out of 4	10	Unit III
Q.3) B)	Any 1 out of 2 (Numerical)	05	
Total marks		45	

Modality of Assessment: Department Specific Course (1 Credit Practical course)

Semester End Practical Examination:

Duration – The duration for these examinations shall be of **2 Hours.**

Paper Pattern:

Questions	Options	Marks
1	Laboratory work	20
2	Viva	5
Total (1 + 2)		25

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Syllabus for

Program: S.Y.B.Sc.

Semester - IV

Program Code: (RUSPHY)

(As per the guidelines of National Education Policy 2020)

(Choice based Credit System for the Academic year 2025-26)

Course Code-Department Specific Course: RUSMIPHYE212

Course Title: Introduction to Quantum Mechanics

Academic year 2025-26

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics
CO 2	Demonstrate quantitative problem-solving skills in all the topics covered
CO 3	Formulate the Schrodinger time independent and dependent equation and Derive equation of continuity with physical significance.
CO 4	Understand the different operators and Commutator brackets in quantum mechanics.
CO 5	Understand the application of Schrodinger steady state equation.
CO 6	Understand the basics of infinite potential well and particle in cube.
CO 7	Recognize barrier potential, tunnelling effect, step potential and solutions to it.

DETAILED SYLLABUS

Course Code	Unit	Course Title	Credits/ Hours
RUSMIPHYE212		**Introduction to Quantum Mechanics**	**3 Credits / 45 Hours**
	Unit I	**Quantum Mechanics**	
		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.	**15 Hours**
	Unit II	**Applications of Schrodinger's Steady State Equation:**	
		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 tunnelling- infinitely deep potential well, concepts of cube, step potential, free particle, barrier potential and tunnelling (no mathematical formulations required) Problems from all topics	**15 Hours**
	Unit III	**Schrödinger's equation and Hydrogen Atom**	
		Schrödinger's equation for one dimensional Harmonic oscillator, its solution by operator method. Graphical representation of its energy level and wave functions. Hydrogen atom: Schrödinger's equation for Hydrogen atom, Separation of variables, Quantum Numbers: Total quantum number, Orbital quantum number, Magnetic quantum number. Angular momentum, Electron probability density (Radial part), Zeeman effect.	**15 Hours**

References:

1. Concepts of modern physics by Arthur Beiser (AB)
2. Introduction to Quantum mechanics – P. T Mathews (**PTM**)
3. Quantum Mechanics by G. Arul Das
4. Quantum Mechanics by S. P Singh, M. K Bagade, Kamal Singh
5. Quantum Mechanics: A text book for undergraduates by Mahesh Jain (MJ)

Additional References:

1. Basic Quantum Mechanics – Ajoy Ghatak
2. For problems of all units: 500 problems on Quantum Mechanics by G Aruldhas
3. Introduction to Quantum Mechanics by D. J Griffith
4. Introductory Quantum Mechanics (4th Edition) by R. Liboff
5. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles 2nd Edition by Robert Eisberg, Robert Resnick
6. The Feynman Lectures on Physics, Volume III by Leighton, Feynman, and Sands (transcribed from a lecture series given by Richard Feynman at Caltech)

Practical

Sr. No.	Practical Based on RUSMJPHYPE212	Credits / Hours
1	Photoelectric Effect.	1 Credit / 30 Hours
2	Diffraction by double slit.	
3	Study of I-V Characteristics of Solar Panel.	
4	Simulation experiments.	
5	Michelson interferometer.	
6	Zeeman effect.	
7.	R.P. of telescope	

Please Note:

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Q.2) A)	Any 2 out of 4	10	Unit II
Q.2) B)	Any 1 out of 2 (Numerical)	05	
Q.3) A)	Any 2 out of 4	10	Unit III
Q.3) B)	Any 1 out of 2 (Numerical)	05	
Total marks		45	

Modality of Assessment: Department Specific Course (1 Credit Practical course)

Semester End Practical Examination:

Duration – The duration for these examinations shall be of **2 Hours.**

Paper Pattern:

Questions	Options	Marks
1.	Laboratory work	20
2.	Viva	5
Total (1 + 2)		25