Resolution No. AC/I/(25-26).3.RUS10

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore • Experience • Excel

Syllabus for

Program: FYBSc

Program Code: (RUSPHY)

2025-26

(As per the guidelines of National Education Policy 2020-
Academic year 2025-26)

(Choice based Credit System)

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:
Graduate Attributes - 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.
Graduate Attributes - 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences
Graduate Attributes - 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.
Graduate Attributes - 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
Graduate Attributes - 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.
Graduate Attributes - 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
Graduate Attributes - 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.
Graduate Attributes - 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 Physics 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 BSc

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 Honours/ Research							

PROGRAM OUTLINE (BSc)

YEAR	SEM	COURSE CODE	Type of Course	COURSE TITLE	CREDITS
FYBSc	I	RUSPHYO101	Department Specific Course (DSC)	Mechanics, Thermodynamics & Quantum Mechanics	3
	I	RUSPHYPO101	Practical based on RUSPHYO101		1
	I	RUSVSCPHYE111	Vocational Skill Course (VSC)	Digital and Analog Electronics	2
FYBSc	II	RUSPHYE111	Department Specific Course (DSC)	Mathematical Physics and Electricity	3
	II	RUSPHYPE111	Practical based on RUSPHYE111		1
	II	RUSSECPHYO101	Skill Enhancement Course (SEC)	Optics	2

Course Code: RUSPHYO101

Course Title: Mechanics, Thermodynamics & Quantum Mechanics

Type of Course: Department Specific Course (DSC)

Academic year 2025-26

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Understand the concepts of Center of Mass and Linear momentum. Apply it to two- and three-dimensional objects. Apply Newton's Second Law to the motion of system of particles
CO 2	Distinguish between all types of collisions. Apply the conservation of momentum for an isolated one-dimensional collision to relate the initial momenta of the objects to their momenta after the collision. Identify that in an isolated system, the momentum and velocity of the center of mass are not changed even if the objects collide.
CO 3	Apply the conservation laws for both the total energy and the net momentum of the colliding bodies, for isolated elastic collisions in one dimension.
CO 4	Distinguish between wave equation and Schrodinger's wave equation to find out transition from classical Physics to Quantum Physics in order to explain physics at the level of atom.
CO 5	Identify practical methods for the different processes like Isothermal, Isochoric, Adiabatic, Reversible and irreversible etc. by taking into account various thermodynamic parameters.
CO 6	Acquire knowledge of the Entropy, Principle of increase in entropy and variation of Entropy of a gas.

DETAILED SYLLABUS

Course Code	Unit	Course Title	Credits/ Hours
RUSPHYO101		**Mechanics, Thermodynamics & Quantum Mechanics**	**3 Credit**
	Unit I	**Mechanics**	**15 Hours**
		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 (shift of origin from Lab to CM). Conservation of Linear Momentum-Elastic and Inelastic collision, coefficient of restitution. Numerical Some Applications of the Momentum Principle System of Variable Mass, Numerical 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	
	Unit II	**Thermodynamics**	**15 Hours**
		Zeroth law of Thermodynamics; Concept of Heat; First law of Thermodynamics. Nonadiabatic 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 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.	
	Unit III	**Introduction to Quantum Mechanics**	**15 Hours**
		Concept of wave packet, phase velocity, group velocity and relation between them. Physical interpretation of wave function – Max Born Interpretation of wave function. Requirements of Schrodinger's wave function: Schrodinger's time dependent wave equation and time independent wave function (Steady State), Postulates of quantum mechanics.	

		Analogy between wave equation and Schrodinger's wave equation. (Comparing with optics) Linearity and Superposition, Problems from all topics	

References:

1. Fundamental of Physics, Halliday, Resnick & Walker (**HRW**) (6th ed.): Part I
2. Mechanics and Thermodynamics - Ghosh and basavraju **(GB)**
3. Mechanics by Hans & Puri **(HP)**
4. Heat, Thermodynamics & Statistical Physics by Brijlal, Subramanyam & Hemne **(BSH)**
5. Thermal Physics, AB Gupta and H. Roy, Book and Allied (P) Ltd, 2009 **(ABG-HR)**
6. Quantum Mechanics by G. Arul Das **(GA)**
7. Quantum Mechanics: A text book for undergraduates by Mahesh Jain **(MJ)**

Additional References:

1. Classical Dynamics by Thornton & Marion (5th Ed).
2. Mechanics – Concepts of Physics by H. C Verma (Vol. 1) **(HCV).**
3. Basic Thermodynamics by Evylen Guha.
4. Heat & Thermodynamics by M. W Zemansky & R. H Dittman.
5. Theory and Experiments on Thermal Physics – D. K. Chakrabarti (2006 Ed).
6. Basic Quantum Mechanics by Ajoy Ghatak
7. Elements of x-ray diffraction by B. D Cullity.

Practical

Course Code: RUSPHYPO101	
Sr. No.	**Regular Experiments**
1.	To determine modulus of rigidity of the material of wire using Torsional oscillations.
2.	To determine Young's modulus Y of a material by vibration.
3.	To determine the Surface Tension of a liquid by capillary rise method.
4.	To determine 'J' by Electrical method.
5.	To study thermal characteristics of a Thermistor.
6.	To determine coefficient of viscosity η by Poiseuille's method.
7.	To Verify Stefan's law of radiation.
	Skill Experiments
1.	To perform graph plotting.

2.	To study the use of Digital Multimeter.
3.	To study the use of Screw Gauge, Vernier Calipers.

Any one out of the following 8 experiments

- 1. Student doing **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**
- **Minimum 5 experiments out of 7 experiments and 2 skill experiments out of 3 experiments (from each group)** from the list should be completed in the first semester and 2 **minimum demo-experiments** are to be reported in the Journal
- **Certified Journal is a MUST** for a candidate to be eligible in the **end semester practical examination**.

For **End Semester 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 **1 hour 30 Minutes**.
2. Theory question paper pattern:

Paper Pattern:

Questions	Options	Marks	Questions 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)

End Semester Practical Examination Pattern: Total Marks 25

1. Duration – The duration for these examinations shall be of **90 minutes.**
2. Practical question paper pattern:

Paper Pattern:

Question	Options	Marks
1	Laboratory work	**20**
2	Journal/Viva/Presentation	**05**
	Total **(= 1 + 2)**	**25**

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Course Code: RUSPHYE111

Course Title: Mathematical Physics and Electricity

Type of Course: Department Specific Course (DSC)

Academic year 2025-26

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Recognize the basic mathematical concepts of vector calculus and implementation of them in physical situations.
CO 2	Understand physical significance of various concepts such as gradient, curl and divergence
CO 3	Evaluating differential equations and its application to Transient response of electrical circuits
CO 4	Understand the basic concepts of electrical circuit theorems, its applications at various levels and basic concepts of working of alternating current circuits
CO 5	Understand the working of electronic equipment -rectifier.
CO 6	Demonstrate quantitative problem-solving skills in all the topics covered.

DETAILED SYLLABUS

Course Code	Unit	Course Title	Credits/ Hours
RUSPHYE111		**Mathematical Physics and Electricity**	**3 Credit**
	Unit I	**Vector algebra and Vector calculus**	**15 Hours**
		Review-Vector algebra Laws of Vector algebra, Unit vector, rectangular unit vectors, Components of a vector. Scalar fields, Vector fields, Dot or Scalar product, Cross or Vector product, Commutative and Distributive Laws Scalar Triple product, Vector Triple product (proofs) Applications based on Dot, Cross and Triple products Gradient, divergence and curl: The ∇ operator, Definitions and physical significance of Gradient, Divergence and Curl of a vector, Distributive Laws for Gradient, Divergence and Curl (Omit proofs)	
	Unit II	**Differential equations and Transient response of circuits**	**15 Hours**
		Review- Ordinary differential equations First order homogeneous, First order non-homogeneous equations with variable coefficients, exact differentials, General first order Linear Differential Equation. Second-order homogeneous and non-homogenous equations with constant coefficients. Transient response of circuits: Series LR, CR, LCR circuits. Growth and decay of currents/charge CR-Theory, Numerical	
	Unit III	**Circuit theorems, Rectifier, Alternating Current theory**	**15 Hours**

		Circuit theorems: -Thevenin theorem, Norton theorem, Reciprocity theorem, Maximum power transfer theorem. Bridge rectifier: Efficiency and Ripple factor of Full wave Rectifier, capacitor filter, LC filter, Pi-Filter, Zener diode as voltage stabilizer Alternating Current: *Review- Sinusoidal AC response of a Resistance, Inductance and a capacitance, Representation of sinusoids by complex numbers* sinusoidal voltage to series RL circuit, sinusoidal voltage series RC circuit, sinusoidal voltage to series RLC circuit, Series and parallel resonance.	

References:

1. Electricity and Magnetism by D. Chattopadhaya & P. C. Rakshit **(CR)**
2. Principles of Electronics – V. K. Mehta & Rohit Mehta **(VKM)**
3. **Schaum's outline -** Vector Analysis and introduction to tensor Analysis – **Murray Spiegel (MS)**
4. Schaum's outline of Theory and problems of Vector Analysis – Murray Spiegel **(MS)**
5. Ultrasonics- Methods and Applications by Blitz **(B)**

Additional References:

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

Practical

Course Code: RUSPHYPE111	
Sr. No.	**Regular Experiments**
1.	To determine value of Inductance using LR Circuit
2.	To determine value of Capacitance using CR Circuit
3.	To determine the frequency of A.C. Mains
4.	To verify Thevenin' s Theorem
5.	To study the dependence of light on resistance using LDR.
6.	To verify Norton's Theorem.
	Skill Experiments
1.	To study the use of Cathode Ray Oscilloscope (or Digital Storage Oscilloscope)
2.	To study conservation of Angular Momentum.
3.	Laser Beam Divergence, Intensity
4.	To understand the Charging Discharging of a Capacitor
5.	To use of Softwares (Origin, Excel) for graph Plotting
6.	To study working of Light Dependent Switch
7.	To study Clipper & Clamper Circuits

Any one out of the following 8 experiments

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  2. Study Tour: Students participated in study tour must submit a **study tour report**
- **Minimum 4 experiments out of 6 experiments and 2 skill experiments (from each group)** from the list should be completed in the first semester and 2 **minimum demo-experiments** are to be reported in the Journal
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Q.1) B)	**Any 1 out of 2 (Numerical)**	**05**	
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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)

A) End Semester Practical Examination Pattern: Total Marks 25

1. Duration – The duration for these examinations shall be of **90 minutes.**
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Paper Pattern:

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	Total **(= 1 + 2)**	**25**