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: F.Y.B.Sc.

Program Code: (RUSPHY)

(As per the guidelines of National Education Policy 2020-
Academic year 2023-24)

(Choice based Credit System)

Ramnarain Ruia Autonomous College

PROGRAM OUTCOMES

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.

PO	PO Description **A student completing Bachelor's Degree in Science program will be able to:**
PO 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.
PO 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences
PO 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.
PO 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyze results.
PO 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.
PO 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
PO 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.
PO 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

Ramnarain Ruia Autonomous College

PROGRAM SPECIFIC OUTCOMES

PSO	Description **A student completing Bachelor's Degree in Science program in the subject of Physics will be able to:**
PSO 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
PSO 2	To demonstrate comprehensive, quantitative and conceptual understanding of the core areas of physics.
PSO 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.
PSO 4	To explore and deduce quantitative results in the extents of physics.
PSO 5	To use contemporary experimental apparatus and analysis tools to acquire, analyse and interpret scientific data in the extents of physics.
PSO 6	To communicate scientific results effectively in presentations or posters in the extents of physics to both the scientists and public at large.
PSO 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.

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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

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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							

Course Code: RUSPHY.O101

Course Title: Mechanics, Thermodynamics & Quantum Mechanics

Type of Course: Department Specific Course

Academic year 2023-24

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.

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DETAILED SYLLABUS

Course Code	Unit	Course Title	Credits/ Hours
RUSPHY.O101		**Mechanics, Thermodynamics & Quantum Mechanics**	**3 Credit/ 45 Hours**
	Unit I	**Mechanics:** 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 (**HRW**) part I -9.1, 9.2, 9.3, 9.4, 9.5, 9.6,9.7 **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 Numerical from all topics. **HP**: 15.2A, 15.3A, 15.4A, 15.5A, 15.7A	**15 Hours**
	Unit II	**Thermodynamics**	**15 Hours**
		Review-- 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 **BSH**: 2.1 to 2.12, 4.1 to 4.14 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. **(ABG-HR):** 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	**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	

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		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. **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 numerical from chapter 1, 4 and 5 **GA**: 2.1 to 2.10 Analogy between wave equation and Schrodinger's wave equation. (Comparing with optics) Linearity and Superposition, Problems from all topics **MJ**: 4.3, 4.4, 4.5, 5.1, 5.2, 5.3 and numerical from chapter 1, 4 and 5	

References:

1. Fundamental of Physics (extended)Halliday, Resnick & Walker (**HRW**) (6th ed.) part I
2. Mechanics by Hans & Puri **(HP)**
3. Mechanics and thermodynamics-Ghosh and basavraju **(GB)**
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. Mechanics – Concepts of Physics by H. C Verma (Vol. 1) **(HCV)**
2. Classical Dynamics by Thornton & Marion (5th Ed)
3. Basic Quantum Mechanics by Ajoy Ghatak
4. Elements of x-ray diffraction by B. D Cullity.
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)

Practical

Course Code: RUSPHYP.O101	
Sr. No.	**Regular Experiments**
1.	Torsional oscillations
2.	Y by vibration
3.	Surface Tension

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4.	J by Electrical method
5.	Thermistor Characteristics
6.	η by Poiseuille's' s method
7.	Verification of Stefan's law
8.	Falstad stimulation (https://www.falstad.com/qm1dcrystal/)
	Skill Experiments
1.	Graph Plotting
2.	Use of Digital Multimeter
3.	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 6 experiments out of 8 experiments and 2 skill experiments (from each group)** from the list should be completed in the first semester and are to be reported in the Journal
- **Certified Journal is a MUST** for a candidate to be eligible in the **end semester practical examination**.
- **Internal component of Practical examination** Evaluation is based on regular experiments and skill experiments, Journal work

For **External 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**

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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)

Practical Examination Pattern: Total Marks 50

A. **Internal Practical Examination: 40%- 20 Marks**

Question	Options	Marks
1	Journal	**10**
2	Class test	**10**
	Total **(= 1 + 2)**	**20**

B. **External Practical Examination: 60%- 30 Marks**

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	**25**
2	Viva	**5**
	Total **(= 1 + 2)**	**30**

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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							

Course Code: RUSPHY.E111

Course Title: Mathematical Physics and Electricity

Type of Course: Department Specific Course

Academic year 2023-24

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.

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DETAILED SYLLABUS

Course Code	Unit	Course Title	Credits/ Hours
RUSPHY.E111		**Mathematical Physics and Electricity**	**3 Credit/ 45 Hours**
	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 **Ref.-MS: Ch. 1, 2(Omit Reciprocal sets of vectors)** 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-{Introduction, 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 **CR:**14.1, 14.2, 14.3, CH: 5.1, 5.2, 5.2.1 (A, B, C) (Omit D), 5.2.3	

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Unit III	**III**	**Circuit theorems, Rectifier, Alternating Current theory**	**15 Hours**
		Circuit theorems: -Thevenin theorem, Norton theorem, Reciprocity theorem, Maximum power transfer theorem. CR: 7.7, 7.8, 7.9, 7.10, 7.11 Bridge rectifier: Efficiency and Ripple factor of Full wave Rectifier, capacitor filter, LC filter, Pi-Filter, Zener diode as voltage stabilizer **VKM**: 9.10 to 9.20, 9.22, 9.2 **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. **CR: 15.1, 15.2, 15.5, 15.6, 15.7, 15.8, 15.9, 15.11**	

References:

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

Additional References:

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

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Practical

Course Code: RUSPHYP.E111	
Sr. No.	**Regular Experiments**
1.	LR Circuit
2.	CR Circuit
3.	Frequency of A.C. Mains
4.	Thevenin' s Theorem
5.	LDR Characteristics
6.	Norton's Theorem.
	Demo Experiments
1	Conservation of Angular Momentum
2.	Laser Beam Divergence, Intensity
3.	Use of PC for graph Plotting
4.	Clipper & Clamper Circuits

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 6 experiments and 3 demo experiments** from the list should be completed in the first semester and 2 **minimum skill -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**.
- **Internal component of Practical examination** Evaluation is based on regular experiments and skill experiments, Journal work

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

Ramnarain Ruia Autonomous College

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

C) Internal Assessment- 40%- 30 Marks

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

D) External Examination (Semester End)- 60%- 45 Marks
Semester End Theory Examination:

3. Duration – The duration for these examinations shall be of **One hour 30 Minutes**.
4. 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)

Practical Examination Pattern: Total Marks 50

A. Internal Practical Examination: 40%- 20 Marks

Question	Options	Marks
1	Journal	**10**
2	Class test	**10**
	Total **(= 1 + 2)**	**20**

B. External Examination: 60%- 30 Marks
Semester End Practical Examination: - 30 Marks

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

Ramnarain Ruia Autonomous College

Paper Pattern:

Question	Options	Marks
1	Laboratory work	**25**
2	Viva	**5**
	Total **(= 1 + 2)**	**30**

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