Resolution No. AC/I/(23-24).2.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. (DSC) (Major)

Program Code: (RUSPHY)

2024-25

(As per the guidelines of National Education Policy 2020)

(Choice based Credit System for the Academic year 2024-25)

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 analyze 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 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 Digital and Analog Circuits	2
S.Y.B.Sc.	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	2

Course Code-Department Specific Course (DSC-1): RUSMJPHYO201

Title: Vector Calculus, Mechanics and Thermodynamics

Academic year 2024-25

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	Understand the dynamics behind the Compound Pendula and Study the Lagrange equations of motions for different systems.
CO 4	Comprehend the basic concepts of thermodynamics & its applications in physical situation
CO 5	Learn about situations at low temperature
CO 6	Demonstrate cautious problem-solving skills in all above areas

DETAILED SYLLABUS (DSC -1)

Course Code	Unit	Course Title	Credits/ Hours
RUSMJPHYO201		**Vector Calculus, Mechanics and Thermodynamics**	**3 Credit**
	Unit I	**Vector Calculus**	
		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**	**12 Hours**
	Unit II	**Mechanics**	
		Compound pendulum: Expression for period, maximum and minimum time period, centers of suspension and oscillations, reversible compound pendulum. Kater's reversible pendulum, Advantages of	**12 Hours**

		a compound pendulum over a simple pendulum; Problems from all topics-4 lectures **HP: 9.1.1 (pages 279 to 289)** **Lagrange's equations**, Lagrange's equations: -- D'Alembert's principle, generalized coordinates, Lagrange's equations using D'Alembert's principle, Examples. --- 5 lectures KRS: Art. 9.1 to 9.6; G:1.4	
	Unit III	**Thermodynamics**	
		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, Rankin 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** Liquefaction of helium, properties and uses of liquid Helium **ABG: 10.2, 10.2.2, 10.6,10.6.1**	**12 Hours**

References:

1. Introduction to Electrodynamics 3rd Ed by D.J. Griffith **(DG)**
2. Mechanics – H. S. Hans and S. P. Puri, Tata McGraw Hill (2nd ED.) **(HP)**
3. Thermal Physics, AB Gupta and H. Roy, Book and Allied (P) Ltd, Reprint 2008, 2009. **(ABG)**
4. Heat thermodynamics and Statistical Physics, Brijlal, N. Subramanyam, P. S. Hemne, S. Chand, edition 2007. **(BS)**
5. Mechanics by Keith R. Symon **(KRS)**

Practical: (DSC-1)

No.	Course Code: RUSMJPHYPO201 (1 Credit)
1.	Young's Modulus by Flat Spiral Spring .
2.	Optical Lever: Determination of refractive index (μ) of a glass slab.
3.	Y by bending (Metal beam)
4.	Determination of thermal conductivity of bad conductor by Lee's Method
5.	Determination of Modulus of Rigidity (η) of a Flat Spiral Spring
6.	Surface Tension of Biological Fluid.
7.	Young's Modulus by Koenig's Method.

- 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 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 **External practical examination**, student will be **examined in 1 regular experiment**.

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)

A. Internal Assessment- NA
B. External Examination (Semester End)- 25 Marks
Semester End Practical Examination:

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

Paper Pattern:

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

Course Code-Department Specific Course (DSC-2): RUSMJPHYO202

Course Title: Laser, Nuclear Physics, Material Properties

Academic year 2024-25

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 (DSC-2)

Course Code	Unit	Course Title	Credits/ Hours
RUSMJPHYO202		**Laser, Nuclear Physics, Material Properties**	**3 Credit**
	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. **Reference**: -—SP-9.1 to 9.6, 9.10, 9.11 **Fiber Optics**: Light propagation through Fibers, Fiber Geometry, Internal reflection, Numerical Aperture, Step-Index and Graded-Index Fibers, Applications of Fibers. **Reference**: SP— 13.3, 13.5, 13.9	**12 Hours**
	Unit II	**Nuclear Physics**	
		Rutherford's α-scattering experiment for estimation of nuclear size, Measurement of Nuclear radius – Hofstadter's experiment. **SBP**: 4.1.1, 4.1.2 **(Review** -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	**12 Hours**

		Isotopes and its applications in Medicine, Food & Agriculture, Industry, Archaeological Field. **SBP**: 2.1, 2.2, 2.3, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13 **IK:** 10.1, 10.2 **AB**: 12.1, 12.2 Interaction between particles and matter-Compton Effect, 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	
	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. **KK: CHAPTER 1(3 TO 9) KK CHAPTER 3 (1 TO 18, 33)**	**12 Hours**

References:

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

Additional References:

1. Nuclear Physics by S. N Ghoshal
2. Atomic and Nuclear Physics - A. B. Gupta and Deepak Ghosh

Practical: (DSC-2)

No.	Course Code: RUSMJPHYPO202 (1 Credit)
1	Optical Fiber.
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

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

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

Internal Assessment- 40%- 30 Marks

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

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 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)

A. Internal Assessment- NA
B. External Examination (Semester End)- 25 Marks

Semester End Practical Examination:

Duration – The duration for these examinations shall be of **90 minutes.**

Practical question paper pattern:

Paper Pattern:

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

Course Code-Minor Course (DSC-2): RUSMIPHYO202

Course Title: Laser, Nuclear Physics, Material Properties

Academic year 2024-25

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 MINOR PAPER (RUSMIPHYO202)

Course Code	Unit	Course Title	Credits/ Hours
RUSMIPHYO202		**Laser, Nuclear Physics, Material Properties**	3 Credit
	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. **Reference**: -—SP-9.1 to 9.6, 9.10, 9.11 **Fiber Optics**: Light propagation through Fibers, Fiber Geometry, Internal reflection, Numerical Aperture, Step-Index and Graded-Index Fibers, Applications of Fibers. **Reference**: SP— 13.3, 13.5, 13.9	12 Hours
	Unit II	**Nuclear Physics**	
		Rutherford's α-scattering experiment for estimation of nuclear size, Measurement of Nuclear radius – Hofstadter's experiment. **SBP**: 4.1.1, 4.1.2 **(Review** -Radioactive Decay, Laws of Radioactive growth & decay, half-life, mean life, units of radioactivity).	12 Hours

		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. **SBP**: 2.1, 2.2, 2.3, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13 **IK:** 10.1, 10.2 **AB**: 12.1, 12.2 Interaction between particles and matter-Compton Effect, 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	
	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. **KK: CHAPTER 1(3 TO 9) KK CHAPTER 3 (1 TO 18, 33)**	**12 Hours**

References:

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

Additional References:

3. Nuclear Physics by S. N Ghoshal
4. Atomic and Nuclear Physics - A. B. Gupta and Deepak Ghosh

No.	Course Code: RUSMIPHYPO202 (1 Credit)
1	Optical Fiber.
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

Any one out of the following 7 experiments:

- 1. Student doing **mini-project** up to the satisfaction of the Professor or In-Charge of the Practical.

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

Modality of Assessment: Minor Course (DSC-2): RUSMIPHYO202

(3 Credit Theory Course for BSc)

Internal Assessment- 40%- 30 Marks

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

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 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)

Internal Assessment- NA

External Examination (Semester End)- 25 Marks

Semester End Practical Examination:

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

Paper Pattern:

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

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

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for

Program: S.Y.B.Sc. (DSC) (Major)

Program Code: (RUSPHY)

2024-25

(As per the guidelines of National Education Policy 2020)

(Choice based Credit System for the Academic year 2024-25)

Course Code-Department Specific Course (DSC-1): RUSMJPHYE211

Course Title: Optics, Applied Optics

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Acquire knowledge of diffraction optical phenomenon and diffraction categories-Fresnel and Fraunhofer. Understand the concept of Huygens's half period zone and apply it for diffraction caused in various situations. Analyse mathematically diffraction patterns created by different optical devices.
CO 2	Understand the basics of polarization, different methods of its production.
CO 3	Demonstrate application of Polarisation in practical devices as half wave plate and quarter wave plate. Work out analysis of polarised light using polariser and wave plates and evaluate polarisation status of light beam
CO 4	Understand concept of interference and its application in Michelson interferometers. And exploring evaluation of thickness of thin optical plate, refractive index change.
CO 5	Principles of optics applied to develop fiber optic sensors, non–reflecting and high reflecting thin films, grating structure in optical fiber which are of immense use both in Research and Industry

DETAILED SYLLABUS (DSC-1)

Course Code	Unit	Course Title	Credits/ Hours
RUSMJPHYE211		**Optics, Applied optics**	**3 Credit**
	Unit I	**Diffraction- Fraunhofer and Resolving Power**	
		Review of Fresnel Diffraction- diffraction due to a narrow slit, Fraunhofer diffraction: introduction, Fraunhofer diffraction at a single slit, intensity distribution in diffraction pattern due to single slit, Fraunhofer 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) Resolving Power of Optical Instruments Rayleigh's criterion, Limit of resolution of the Eye, Criterion of resolution, R, P.-telescope, Microscope, Prism, Diffraction Transmission Grating and Numerical SBA- 19. 1,2, 3, 6,7, 8, 11, 12	**12 Hours**

	Unit II	**Polarization**	
		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.	**12 Hours**
	Unit III	**Applied Optics**	
		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: AG	**12 Hours**

References:

1. A textbook of Optics –Subramanyam, Brijlal, Avadhanulu (SBA)
2. Optics by Ajoy Ghatak-3rd edition, McGraw-Hill publications.

Additional References:

1. Fundamentals of Optics – Jenkins and White. (4th Ed)
2. Optics by C. L Arora

Practical: (DSC-1)

Sr. No.	Practical Based on DSC-1 (RUSMJPHYPE211)
1.	Brewster's law verification.
2.	Cylindrical obstacle: determination of λ.
3.	Double Refraction.
4.	Determination of Cauchy's Constants.
5.	Edser's "A" pattern: Diffraction of Light
6.	Polarizer and Analyzer.
7.	Malus's law verification.

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 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**.

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

Internal Assessment- 40%- 30 Marks

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

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

Semester End Theory Examination:

5. Duration – The duration for these examinations shall be of **One hour 30 Minutes**.
6. 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)

Internal Assessment- NA

External Examination (Semester End)- 25 Marks

Semester End Practical Examination:

Duration – The duration for these examinations shall be of **90 minutes.**

Practical question paper pattern:

Paper Pattern:

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

Course Code-Department Specific Course (DSC-2): RUSMJPHYE212

Course Title: Introduction to Quantum Mechanics

Academic year 2024-25

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 (DSC-2)

Course Code	Unit	Course Title	Credits/ Hours
RUSMJPHYE212		**Introduction to Quantum Mechanics**	3 Credits
	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. Reference: SPS: 4.9 MJ: 6.1 to 6.8	12 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 **References:**	12 Hours

		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	
	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. PTM: 5.2; AB: 8.7 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. AB_2: 9.1 to 9.9	**12 Hours**

References:

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 Das
4. Quantum Mechanics (2nd edition) by H. C Verma - Additional Reference
5. Quantum Mechanics by S. P Singh, M. K Bagade, Kamal Singh
6. Quantum Mechanics: A text book for undergraduates by Mahesh Jain
7. Introduction to Quantum mechanics – P. T Mathews (**PTM**)
8. Perspectives of modern physics by Arthur Beiser (AB_2)

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.

Practical: (DSC-2)

Sr. No.	Practical Based on DSC 2 (RUSMJPHYPE212)
1	Photoelectric Effect.
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

- Student doing **mini-project** up to the satisfaction of the Professor or In-Charge of the Practical.

  Or Study Tour: Students participated in study tour must submit a **study tour report.**

- **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 **External practical examination**, student will be **examined in 1 regular experiment**.

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

Internal Assessment- 40%- 30 Marks

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

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

Semester End Theory Examination:

7. Duration – The duration for these examinations shall be of **One hour 30 Minutes**.
8. 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)

Internal Assessment- NA

External Examination (Semester End)- 25 Marks

Semester End Practical Examination:

Duration – The duration for these examinations shall be of **90 minutes.**

Practical question paper pattern:

Paper Pattern:

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

Course Code- Minor Course (DSC-2): RUSMIPHYE212

Course Title: Introduction to Quantum Mechanics

Academic year 2024-25

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 MINOR PAPER- RUSMIPHYE212

Course Code	Unit	Course Title	Credits/ Hours
RUSMIPHYE212		Introduction to Quantum Mechanics	3 Credits
	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. Reference: SPS: 4.9 MJ: 6.1 to 6.8	12 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 **References:**	12 Hours

		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	
	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. PTM: 5.2; AB: 8.7 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. AB_2: 9.1 to 9.9	**12 Hours**

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10. Quantum Mechanics: A text book for undergraduates by Mahesh Jain (MJ)
11. Quantum Mechanics by G. Arul Das
12. Quantum Mechanics (2nd edition) by H. C Verma - Additional Reference
13. Quantum Mechanics by S. P Singh, M. K Bagade, Kamal Singh
14. Quantum Mechanics: A text book for undergraduates by Mahesh Jain
15. Introduction to Quantum mechanics – P. T Mathews (**PTM**)
16. Perspectives of modern physics by Arthur Beiser (AB_2)

Additional References:

7. Basic Quantum Mechanics – Ajoy Ghatak
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9. Introductory Quantum Mechanics (4th Edition) by R. Liboff.
10. ***The Feynman Lectures on Physics, Volume III*** by Leighton, Feynman, and Sands (transcribed from a lecture series given by Richard Feynman at Caltech)
11. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles 2nd Edition by Robert Eisberg, Robert Resnick
12. For problems of all units: 500 problems on Quantum Mechanics by G Aruldhas - chapters 1, 2, 3, 4.

Practical: (DSC-2)

Sr. No.	Practical Based on DSC 2 (RUSMIPHYPE212)
1	Photoelectric Effect.
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

- Student doing **mini-project** up to the satisfaction of the Professor or In-Charge of the Practical.

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- **Certified Journal is a MUST** for a candidate to be eligible in the **end semester practical examination**.

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

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

C. Internal Assessment- 40%- 30 Marks

Sr. No.	Evaluation type	Marks
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2	Assignment	10
TOTAL		**30**

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

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

Paper Pattern:

Questions	Options	Marks	Questions based on:
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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)

Internal Assessment- NA
External Examination (Semester End)- 25 Marks
Semester End Practical Examination:

Duration – The duration for these examinations shall be of **90 minutes.**

Practical question paper pattern:

Paper Pattern:

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

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