AC/I(21-22).2(II).RPS10

S.P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for PG

Program: M.Sc. (Physics) (Electronics I)

Program Code: RPSPHY

(Credit Based Semester and Grading System with effect from the academic year 2022-23)

PROGRAM OUTCOMES

PO	PO Description **A student completing master's degree in Physics (Electronics-I) program will be able to:**
PO 1	Demonstrate in depth understanding in the relevant science discipline. Recall, explain, extrapolate and organize conceptual scientific knowledge for execution and application and also to evaluate its relevance.
PO 2	Critically evaluate, analyze and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary.
PO 3	Access, evaluate, understand and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation.
PO 4	Articulate scientific ideas, put forth a hypothesis, design and execute testing tools and draw relevant inferences. Communicate the research. work in appropriate scientific language.
PO 5	Demonstrate initiative, competence and tenacity at the workplace. Successfully plan and execute tasks independently as well as with team members. Effectively communicate and present complex information accurately and appropriately to different groups.
PO 6	Use an objective, unbiased and non-manipulative approach.in collection and interpretation of scientific data and avoid plagiarism and violation of Intellectual Property Rights. Appreciate and be sensitive to environmental and sustainability issues and understand its scientific significance and global relevance.
PO 7	Translate academic research into innovation and creatively design scientific solutions to problems. Exemplify project plans, use management skills and lead a team for planning and execution of a task.
PO 8	Understand cross disciplinary relevance of scientific developments and relearn and reskill so as to adapt to technological advancements.

PROGRAM SPECIFIC OUTCOMES

PSO	Description A student completing Master's Degree in Physics (Electronics I) program in the subject of Physics will be able to:
PSO 1	To demonstrate procedural knowledge related to different areas of study in Physics including Quantum Mechanics, Nuclear Physics, Electronics, Microprocessor and Microcontroller, Embedded Systems and RTOS.
PSO 2	To demonstrate comprehensive, quantitative and conceptual understanding of the core areas of Physics and keeping update with current developments in the academic field of Physics.
PSO 3	To demonstrate the ability to use analytical skills in Physics and its related areas of technology to solve a wide range of problems including open ended problems associated with Physics.
PSO 4	Utilize contemporary experimental apparatus and analysis tools to acquire, analyze and interpret scientific data in the extents of Physics with reference to Research..
PSO 5	Plan and execute Physics-related experiments or investigations, analyze and interpret data collected using appropriate methods, and report accurately the findings relating to relevant theories of Physics.
PSO 6	Develop skills in areas related to specialization in the subfields of physics- Microprocessor, Microcontroller, VHDL, ARM7 and C++ (OOP).
PSO 7	Demonstrate communication skills, to present complex information in a concise manner and develop personal skills such as the ability to work both independently and in a group.

PROGRAM OUTLINE

YEAR	SEM	COURSE CODE	Course	COURSE TITLE	CREDITS
2022-23	**I**	RPSPHY101	Core I	Mathematical Methods	**4**
		RPSPHY102	Core II	Classical Mechanics	**4**
		RPSPHY103	Core III	Quantum Mechanics-I	**4**
		RPSPHY104	DSE 1	Microprocessor 8085 and Microcontroller 8051 and Instrumentation	**4**
		RPSPHY105	AECC 1	Emotional Well Being through Logic Based Thinking.	**2**
		RPSPHYP101		Lab Course -1	**2**
		RPSPHYP102		Lab Course -2	**2**
		RPSPHYP103		Lab Course -3	**2**
		RPSPHYP104		DSE-1 Lab Course	**2**
				TOTAL	**26**
2022-23	**II**	RPSPHY201	Core I	Solid State Physics	**4**
		RPSPHY202	Core II	Electrodynamics	**4**
		RPSPHY203	Core III	Quantum Mechanics-II	**4**
		RPSPHY204	DSE 2	8086 Microprocessor and C++ Programming	**4**
		RPSPHY205	AECC 2	Research Methodology	**2**
		RPSPHYP201		Lab Course -4	**2**
		RPSPHYP202		Lab Course -5	**2**
		RPSPHYP203		Lab Course -6	**2**
		RPSPHYP204		DSE-2 Lab Course	**2**
				TOTAL	**26**

YEAR	SEM	COURSE CODE		COURSE TITLE	CREDITS
2022-23	III	RPSPHY301	Core I	Microcontroller 8051(II) PIC and Embedded System	4
		RPSPHY302	Core II	Statistical Mechanics	4
		RPSPHY303	DSE 3	ARM 7 processor and VHDL	4
				Practical Lab Course	
		RPSPHYP301		Project -A	6
		RPSPHYP302		LabCourse-7	2
		RPSPHYP303		LabCourse-8	2
		RPSPHYP304		DSE-3 Lab Course	2
				TOTAL	24
2022-23	IV	RPSPHY401	Core I	Nuclear Physics	4
		RPSPHY402	Core II	Atomic and Molecular Physics	4
		RPSPHY403	Core III	Solid State Devices	4
				Practical Lab Course	
		RPSPHYP401		Project -B	6
		RPSPHYP402		LabCourse-9	2
		RPSPHYP403		LabCourse-10	2
		RPSPHYP404		LabCourse-11	2
				TOTAL	24

AC/I (21-22).2(II).RPS10

S.P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for MSc-Part I-SEM-I & II

Program: M.Sc. (Physics) (Electronics I)

Program Code: RPSPHY

(Credit Based Semester and Grading System with effect from the academic year 2022-23)

Course Code: RPSPHY101

Course Title: Mathematical Methods

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Learn the concepts of complex variables and analytic functions, and evaluate some improper integrals involving sine and cosine terms.
CO 2	Learn the basic properties of matrices, different types of matrices and its application to physical problems and also have the ability to find Eigen values and Eigen vectors of Matrices.
CO3	Learn some basic properties of tensors, their symmetric and antisymmetric nature, the Cartesian tensors, covariant, contra-variant and mixed tensors.
CO 4	Learn some basic Levi-Civita symbols which is used in various other courses.
CO 5	Learn the general treatment of second order differential equations with non-constant coefficients, and Power series solutions.
CO 6	Learn the four basic polynomials – Legendre, Bessel, Hermite and Lagaurre polynomials.
CO7	Understand Integral transforms, Fourier transforms and its applications, Laplace transforms and its applications.

DETAILED SYLLABUS

Course Code	Unit	Title	Credits
RPSPHY101		**Mathematical Methods**	**04**
Unit I	I	Complex Variables, Limits, Continuity, Derivatives, Cauchy-Riemann Equations, Analytic functions, Harmonic functions, Elementary functions: Exponential and Trigonometric, Taylor and Laurent series, Residues, Residue theorem, Principal part of the functions, Residues at poles, zeroes and poles of order m, Contour Integrals, Evaluation of improper real integrals, improper integral involving Sines and Cosines, Definite integrals involving sine and cosine functions.	**15 lectures**
Unit II	II	Matrices, Eigenvalues and Eigen vectors, orthogonal, unitary and hermitian matrices, Diagonalization of Matrices, Applications to Physics problems. Introduction to Tensor Analysis, Addition and Subtraction of Tensors, summation convention, Contraction, Direct Product, Levi-Civita Symbol.	**15 lectures**
Unit III	III	General treatment of second order linear differential equations with non-constant coefficients, Power series solutions, Frobenius method, Legendre, Hermite and Laguerre polynomials, Bessel equations, Non-homogeneous equation, Green's function, Sturm-Liouville theory.	**15 lectures**
Unit IV	IV	Integral transforms: three dimensional Fourier transforms and its applications to PDEs (Green function of Poisson's PDE), convolution theorem, Parseval's relation, Laplace transforms, Laplace transform of derivatives, Inverse Laplace transform and Convolution theorem, use of Laplace's transform in solving differential equations.	**15 lectures**

Main references:

1. S. D .Joglekar, Mathematical Physics:TheBasics,UniversitiesPress2005
2. S.D. Joglekar, Mathematical Physics:AdvancedTopics,CRCPress2007
3. M.L. Boas, Mathematical methods in the Physical Sciences,WileyIndia2006
4. G. Arfken and H. J. Weber, Mathematical Methods for Physicists, Academic Press 2005

Additional references:

1. A.K. Ghatak, I.C. Goyal and S.J. Ch.ua, Mathematical Physics, McMillan
1. A.C.Bajpai, L.R.Mustoe and D.Walker, Advanced Engineering Mathematics, J Wiley
2. E.Butkov, Mathematical Methods, Addison-Wesley
3. J.Mathews and R.L.Walker, Mathematical Methods of physics
4. P.Dennery and A.Krzywicki, Mathematics for physicists
5. T.Das and S.K.Sharma, Mathematical methods in Classical and Quantum Mechanics
6. R.V.Churchill and J.W.Brown, Complex variables and applications, VEd.McGraw.Hill
7. A.W.Joshi, Matrices and Tensors in Physics, Wiley India

Course Code: RPSPHY102

Course Title: Classical Mechanics

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand formalism of Lagrange equation and D' Alembert's Principle, Hamilton's principle, variation principle. Its application to mechanics of particles.
CO 2	Comprehend Conservation theorems, Two-Body Central Force Problem, Scattering in a central force field.
CO3	Application of the differential equation to the problem of the orbit, The Kepler's problem: Inverse square law of force.
CO 4	Evaluate Legendre transformations and the Hamilton equations of motion
CO 5	Analysis of Small Oscillations using Eigen function and Eigen value
CO 6	Analysis of Equations of motion using concepts of Canonical Transformations and Poisson brackets.
CO7	Demonstrate problem solving skills in all above areas

DETAILED SYLLABUS

Course Code	Unit	Title	Credits
RPSPHY102		**Classical Mechanics**	**04**
Unit I	I	Review of Newton's laws, Mechanics of a particle, Mechanics of a system of particles, Frames of references, rotating frames, Centrifugal and Coriolis force, Constraints, D'Alembert's principle and Lagrange's equations, Velocity-dependent potentials and the dissipation function, Simple applications of the Lagrangian formulation. Hamilton's principle, Calculus of variations, Derivation of Lagrange's equations from Hamilton's principle, Lagrange Multipliers and constraint exterimization Problems, Extension of Hamilton's principle to non-holonomic systems, Advantages of a variational principle formulation,	**15 lectures**
Unit II	II	Conservation theorems and symmetry properties, Energy Function and the conservation of energy. The Two-Body Central Force Problem**:** Reduction to the equivalent one body problem, The equations of motion and first integrals, The equivalent one-dimensional problem and classification of orbits, The virial theorem, The differential equation for the orbit and integrable power-law potentials, The Kepler problem: Inverse square law of force, The motion in time in the Kepler problem, Scattering in a central force field, Transformation of the scattering problem to laboratory coordinates.	**15 lectures**
Unit III	III	Small Oscillations: Formulation of the problem, The eigenvalue equation and the principal axis transformation, Frequencies of free vibration and normal co-ordinates, Forced and damped oscillations, Resonance and beats. Legendre transformations and the Hamilton equations of motion, Cyclic coordinates and conservation theorems, Derivation of Hamilton's equations from a Variational principle.	**15 lectures**
Unit IV	IV	Canonical Transformations, Examples of canonical transformations, The symplectic approach to canonical transformations, Poissson brackets and other canonical invariants, Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation, The angular momentum Poisson bracket relations.	**15 lectures**

Main Text: Classical Mechanics, H. Goldstein, Poole and Safco, 3rd Edition, Narosa Publication(2001)

Additional References:

1. Classical Mechanics, N. C. Rana and P. S. Joag. Tata McGraw Hill Publication.
2. Classical Mechanics, S. N. Biswas, Allied Publishers (Calcutta).
3. Classical Mechanics, V. B. Bhatia, Narosa Publishing (1997).
4. Mechanics, Landau and Lifshitz, Butterworth, Heinemann.
5. The Action Principle in Physics, R. V. Kamat, New Age Intnl. (1995).
6. Classical Mechanics, Vol I and II, E. A. Deslougue, John Wiley (1982).
7. Theory and Problems of Lagrangian Dynamics, Schaum Series, McGraw (1967).
8. Classical Mechanics of Particles and Rigid Bodies, K. C. Gupta, Wiley Eastern (2001)

Course Code: RPSPHY103

Course Title: Quantum Mechanics-I

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand the theory of quantum measurements, wave packets and uncertainty principle.
CO 2	Understand the concepts of quantum mechanics like wave - function, momentum and energy operators, the Schrodinger equation, time dependent and time independent cases, probability density and the normalization techniques, Commutator algebra, their connection to uncertainty principle, solution to the eigen value problems, etc.
CO3	Develop skills on problem solving for One dimensional rigid box, three-dimensional rigid box and Harmonic oscillator.
CO 4	Understand the formalism of modern quantum mechanics, Dirac notation, Hilbert space and matrix mechanisms.
CO 5	Learn the Schrodinger equation solutions for Hydrogen atom, determine its eigen value and radial eigen functions, degeneracy, etc.
CO 6	Understand the angular momentum operators, its Commutator relations, ladder operators, their eigen functions and eigen values, learn spin eigen functions, Pauli Spin matrices, and understand the addition of angular momentum.
CO7	Understand the Clebsch.-Gordon coefficients

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY103	**Unit**	**Quantum Mechanics – I**	**04**
Unit I	I	**1. Review of concepts:** Postulates of quantum mechanics, observables and operators, measurements, state function and expectation values, the time-dependent Schrodinger equation, time development of state functions, solution to the initial value problem. The Superposition principle, Commutator relations, their connection to the uncertainty principle, complete set of commuting observables. Time development of expectation values, conservation theorems and parity. **2. Formalism:** Linear Vector Spaces and operators, Dirac notation, Hilbert space, Hermitian operators and their properties, Matrix mechanics: Basis and representations, unitary transformations, the energy representation. Schrodinger, Heisenberg and interaction picture.	**15 lectures**
Unit II	II	1. **Wavepacket:** Gaussian wave packet, Fourier transform. **2. Schrodinger equation solutions: one dimensional problems:** General properties of one dimensional Schrodinger equation, Particle in a box, Harmonic oscillator by raising and lowering operators and Frobenius method, unbound states, one dimensional barrier problems, finite potential well.	**15 lectures**
Unit III	III	**Schrodinger equation solutions: Three dimensional problems:** Orbital angular momentum operators in Cartesian and spherical polar coordinates, commutation and uncertainty relations, spherical harmonics, two particle problem-coordinates relative to centre of mass, radial equation for a spherically symmetric central potential, hydrogen atom, eigen-values and radial eigen-functions, degeneracy, probability distribution.	**15 lectures**

Unit IV	IV	**Angular Momentum:** 1. Ladder operators, eigen-values and eigen-functions of L^2 and L_z using spherical harmonics, angular momentum and rotations. 2. Total angular momentum J; L-S coupling; eigen-values of J^2 and J_z. 3. Addition of angular momentum, coupled and uncoupled representation of eigen-functions, Clebsch-Gordan coefficient for $j_1=j_2=½$ and $j_1=1$ and $j_2=½$. 4. Angular momentum matrices, Pauli spin matrices, spin eigen-functions, free particle wave function including spin, addition of two spins.	**15 lectures**

Main references:

1. Richard Liboff, Introductory Quantum Mechanics, 4th edition, Pearson.
2. D J Griffiths, Introduction to Quantum Mechanics 4th edition.
3. A.Ghatak and S.Lokanathan, Quantum Mechanics: Theory and Applications, 5th edition.
4. N.Zettili, Quantum Mechanics: Concepts and Applications, 2nd edition, Wiley.

Additional References

1. W.Greiner, Quantum Mechanics: An introduction, Springer, 2004.
2. R.Shankar, Principles of Quantum Mechanics, Springer, 1994.
3. P.M.Mathews and K.Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill (1977).
4. J.J.Sakurai Modern Quantum Mechanics, Addison-Wesley (1994).

Course Code: RPSPHY104

DSE-1 Title: Microprocessor 8085 and Microcontroller 8051 and Instrumentation

Academic year 2022-23

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY104	Unit	**Microprocessor 8085 and Microcontroller 8051 and Instrumentation**	04
Unit I	I	**Microprocessor 8085** Counters and Time Delays, Stack and Sub-routines. 8085 Interrupts**:** The 8085 Interrupt, 8085 Vectored Interrupts, Restart as Software Instructions, Additional I/O Concepts and Processes. **Programmable Peripheral and Interface Devices:** The 8255A Programmable Peripheral Interface.	15 lectures
Unit II	II	the 8259A Programmable Interrupt Controller, Direct Memory Access(DMA) and 8237 DMA Controller, the 8279 Programmable Keyboard/Display Interface RSG - Ch 15: 15.1, 15.2, 15.5, 15.6 &Ch 14: only 14.3 **Serial I/O and Data Communication**: Basic Concepts in Serial I/O, Software Controlled Asynchronous Serial I/O, The 8085 Serial I/O lines: SOD and SID RSG - Ch 16: 16.1, 16.2, 16.3,	15 lectures
Unit III		**8051 Microcontrollers:** Introduction, MCS–51 Architecture, Registers in MCS-51, 8051 Pin Description, Connections,8051 Parallel I/O Ports and Memory Organization. **8051 Instruction set and Programming:** MCS-51 Addressing Modes and Instruction set. 8051 Instructions and Simple programs using Stack Pointer.	15 lectures
Unit IV		**Instrumentation Circuits and Designs:** Microprocessors/ Microcontrollers based D C motor speed controller. Microprocessors /Microcontrollers based temperature controller. Electronic weighing single pan balance using strain gauge/ load cell. Optical analog communication system using fiber link. Electronic intensity meter using optical sensor. IR remote controlled ON/OFF switch.	15 lectures

References:

1. Microprocessor Architecture, Programming and Applications with the 8085 by Ramesh S. Gaonkar, Fifth Edition Penram International Publication (India) Pvt Ltd (RSG)
2. Advanced Microprocessors and Peripherals by a K.Rayand K.M.Bhurchandi Second Edition TataMcGraw– Hill Publishing Company Ltd. (AB)
3. Microprocessors and interfacing, programming and hardware, By Douglas V.Hall (TMH)
4. The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, Second Edition, Pearson(MMM)
5. Introduction to embedded systems by ShibuK.V.,Sixth Reprint 2012,Tata McGrawHill (SKV)
6. Embedded Systems Architecture, Programming and Design, by RajKamal, Second Edition, The McGraw-Hill Companies(RK)
7. 8086 Microprocessor: Programming and Interfacing K.J.Ayala, Penram International
8. ARM System-on-Chip Architecture, by Steve Furber, Second Edition, Pearson (SF)

Course Code: RPSPHY105

AECC: Ability Enhancement Compulsory Course: Emotional Well Being through Logic Based Thinking.

Academic year 2022-23

Course Outcomes:

1. Understand the connection between thinking patterns, emotions, and behavior.
2. Identify one's faulty thinking patterns (fallacies) and methods for refuting them.
3. Replace faulty thinking patterns with positive and rational thinking patterns.
4. Using philosophical antidotes to promote a healthy state of mind.

DETAILED SYLLABUS

Unit 1	**Relation between Emotions and Thinking**	**Credits 2**
	a. Fundamentals of emotional well-being. b. Tracing the thoughts behind an emotional problem. c. Some prominent faulty thinking patterns/fallacies causing harm to oneself and others: o Demanding perfection o World Revolves Around Me o Damnation o Awfulizing o Can'tstipation.	**15 lectures**
Unit 2	**Strengthening rational thinking patterns**	**15 lectures**
	a. How to refute the fallacies o Fallacy-Antidotes-Virtues framework b. Some uplifting Antidotal reasoning to overcome the fallacies c. Corresponding Guiding virtues for the fallacies: o Demanding perfection- Metaphysical security o World Revolves Around Me- Empathy o Damnation- Respect o Awfulizing- Courage o Can'tstipation- Temperance.	

M.Sc. (Physics) Practical Lab Course

Semester –I

RPSPHYP101- LAB COURSE -1—LASER

1.	Michelson Interferometer
2.	Study of He-Ne laser- Measurement of divergence and wavelength
3.	Determination of particle size of lycopodium particles by laser diffraction method

RPSPHYP102- LAB COURSE -2—POWER SUPPLY

1.	Regulated power supply using IC LM-317 voltage regulator IC
2.	Regulated dual power supply using IC LM-317 & IC LM-337 voltage regulator ICs
3.	Constant current supply using IC 741 and LM-317

RPSPHYP103- LAB COURSE -3-OP-AMP Advanced

1.	Waveform Generator using ICs
2.	Instrumentation amplifier and its applications
3.	Active filter circuits (second order)

RPSPHYP104 DSE 1 LAB COURSE-8085 and 8051

1.	Study of 8085 interrupts (Vector Interrupt7.5).
2.	Study of PPI8255 as Handshake I/O (mode1): interfacing switches, LED's
3.	8031/51 assembly language programming: Simple data manipulation programs (8/16-bit addition, subtraction, multiplication)
4.	Study of IN and OUT port of 8031/51 by Interfacing LEDs to display bit pattern on LED's,
5.	Study of IN and OUT port of 8031/51 by Interfacing -To count the number of "ON" switches and display on LED's, to trip a relay depending on the logic condition of switches,

Note _1:
Number of experiments to be performed and reported in the journal from LAB course 1, LAB courses 2, and LAB courses 3 = 09. (3 from each Lab course)

Note _2:
Number of experiments to be performed from DSE-1 LAB course 5 experiments.

Note _3:
Minimum 9 +3 (DSE LAB course) =12 experiments should be reported in the journal, for appearing at the practical examination.

PRACTICAL BOOK/JOURNAL

The candidate shall prepare and submit for practical examination a certified Journal based on the practical course carried out under the guidance of a faculty member with minimum number of experiments as specified in the syllabus for each group.

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/ Coordinator / In-charge of the department on the basis of presenting record of lab readings in rough journal; failing which the student will not be allowed to appear for the practical examination.

MODALITY OF ASSESSMENT

Theory Examination Pattern:

A) Internal Assessment - 40% = 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.	10
	TOTAL	40

B) External examination - 60 %
Semester End Theory Assessment - 60 marks

i. Duration - These examinations shall be of **2- & 1/2-hours** duration.

ii. Paper Pattern:

1. There shall be 4 questions each of 15 marks. On each unit there will be one question.
2. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q. 1	Any 1 out of 2	8	Unit I
Q.2	Any 1 out of 2	7	
Q.3	Any 1 out of 2	8	Unit II
Q.4	Any 1 out of 2	7	
Q.5	Any 1 out of 2	8	Unit III
Q.6	Any 1 out of 2	7	
Q.7	Any 1 out of 2	8	Unit IV
Q.8	Any 1 out of 2	7	
	TOTAL	60	

Practical Examination Pattern:

External (Semester End Practical Examination):

Course Code	Experiment from LAB course	Time duration(hrs.)	Marks
RPSPHYP101	LAB course 1	2	50
RPSPHYP102	LAB course 2	2	50
RPSPHYP103	LAB course 3	2	50
RPSPHYP104	DSE 1 LAB course	2	50
	Total marks for practical examination	8	200

Overall Examination and Marks Distribution Pattern

Course	RPSPHY101 (Marks)			RPSPHY102 (Marks)			RPSPHY103 (Marks)			RPSPHY104 (Marks)			RPSPHY 105	Total (Marks
	Int.	Ext.	Total	I	E	T	I	E	T	I	E	T	E	
Theory	40	60	**100**	40	60	**100**	40	60	**100**	40	60	**100**	**50**	**450**

LAB Course	RPSPHYP101 (Marks)	RPSPHYP102 (Marks)	RPSPHYP103 (Marks)	RPSPHYP104 (Marks)	Total (Marks)
Practical	**50**	**50**	**50**	**50**	**200**

(GRAND TOTAL MARKS: 650)

Course Code: RPSPHY201

Course Title: Solid State Physics

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Get a brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, and concept of Brillouin zones and diffraction of x-rays by different crystalline materials.
CO 2	Gain knowledge of lattice vibrations the basics of the optical and acoustic phonons in crystals.
CO3	Understand about different types of magnetism like diamagnetism and paramagnetism. Quantum mechanical formulation of magnetism and application of Langevin diamagnetic equation.
CO 4	Learn about magnetic ordering: Ferromagnetic and Antiferromagnetic orders and Ferromagnetic domains.
CO 5	Carry out the experiments based on the theory that they have learned to measure carrier lifetime, magnetic susceptibility, and dielectric constant. They will also employ to four probe methods to determine electrical conductivity and the Hall setup to determine the hall coefficient of semiconductor.
CO 6	Demonstrate cautious problem solving skills in all above areas.

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY201	**Unit**	**Solid State Physics**	**04**
Unit I	I	Diffraction of Waves by Crystals and Reciprocal Lattice Bragg law, Scattered Wave Amplitude – Fourier analysis, Reciprocal Lattice Vectors, Diffraction Conditions, Brillouin Zones, Reciprocal Lattice to SC, BCC and FCC lattice. Interference of Waves, Atomic Form Factor, Elastic Scattering by crystal, Ewald Construction, Structure Factor, Temperature Dependence of the Reflection Lines Experimental Techniques (Laue Method, Rotating Crystal Method, Powder Method) Scattering from Surfaces, Elastic Scattering by amorphous solids.	15 lectures
Unit II	II	Lattice Vibrations and thermal properties: Vibrations of Monoatomic Lattice, normal mode frequencies, dispersion relation. Lattice with two atoms per unit cell, normal mode frequencies, dispersion relation, Quanization of lattice vibrations, phonon momentum, Inelastic scattering of neutrons by phonons, Surface vibrations, Inelastic Neutron scattering. Anharmonic Crystal Interaction. Thermal conductivity–Lattice Thermal Resistivity, Umklapp Process, Imperfections.	15 lectures
Unit III	III	Diamagnetism and Paramagnetism: Langevin diamagnetic equation, diamagnetic response, Quantum mechanical formulation, core diamagnetism. Quantum Theory of Paramagnetism, Rare Earth Ions, Hund's Rule, Iron Group ions, Crystal Field Splitting and Quenching of orbital angular momentum; Adiabatic Demagnetisation of a paramagnetic Salt, Paramagnetic susceptibility of conduction electrons.	15 lectures
Unit IV	IV	Magnetic Ordering: Ferromagnetic order- Exchange Integral, Saturation	15 lectures

		magnetisation Magnons, neutron magnetic scattering; Ferrimagnetic order, spinels, Yttrium Iron Garnets, Anti Ferromagnetic order. Ferromagnetic Domains – Anisotropy energy, origin of domains, transition region between domains, Blochwall, Coercive force and hysteresis.	

Main References:-

1. Charles Kittel, “Introduction to Solid State Physics”, 7th edition John Wiley & sons.
2. J.Richard Christman, “Fundamentals of Solid State Physics”, John Wiley & sons.
3. M.A.Wahab, “Solid State Physics –Structure and properties of Materials”, Narosa Publications 1999.
4. M.Ali Omar, “Elementary Solid State Physics”, Addison Wesley (LPE).
5. H.Ibach and H.Luth, 3rd edition “Solid State Physics–An Introduction to Principles of Materials Science”, Springer International Edition (2004)

Course Code: RPSPHY202

Course Title: Electrodynamics

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand formalism of Maxwell's equations, Pointing vector. Its application to Lorentz Transformations.
CO 2	Comprehend concept of Four Vectors and Four Tensors.
CO3	Developing formalism of electromagnetic waves propagation and its application in wave guide and resonant cavity –related to fiber optics and laser
CO 4	Evaluate moving charges in vacuum and application of Leinard-Wiechert fields to fields-radiation from a charged particle, Antennas
CO 5	Analysis of moving charges with application to dipole radiation-electric and magnetic
CO 6	Application of relativity concepts to electrodynamics
CO7	Demonstrate problem solving skills in all above areas

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY202	**Unit**	**Electrodynamics**	**04**
Unit I	I	Maxwell's equations, The Pointing vector, The Maxwellian stress tensor, Lorentz Transformations, Four Vectors and Four Tensors, The field equations and the field tensor, Maxwell equations in covariant notation.	**15 lectures**
Unit II	II	Electromagnetic waves in vacuum, Polarization of plane waves. Electromagnetic waves in matter, frequency dependence of conductivity, frequency dependence of polarizability, frequency dependence of refractive index. Wave guides, boundary conditions, classification of fields in wave guides, phase velocity and group velocity, resonant cavities.	**15 lectures**
Unit III	III	Moving charges in vacuum, gauge transformation, The time dependent Green function, The Lienard-Wiechert potentials, Leinard-Wiechert fields, application to fields-radiation from a charged particle, Antennas, Radiation by multipole moments, Electric dipole radiation, Complete fields of a time dependent electric dipole, Magnetic dipole radiation	**15 lectures**
Unit IV	IV	Relativistic covariant Lagrangian formalism: Covariant Lagrangian formalism for relativistic point charges, The energy-momentum tensor, Conservation laws.	**15 lectures**

Main Reference:

1. W.Greiner, Classical Electrodynamics (Springer-Verlag,2000)(WG).
2. M.A.Heald and J.B.Marion, Classical Electromagnetic Radiation, 3rd edition (Saunders,1983)(HM)

Additional references:

1. J.D.Jackson, Classical Electrodynamics, 4Th edition, (JohnWiley&sons) 2005 (JDJ)
2. W.K.H.Panofsky and M.Phillips, Classical Electricity and Magnetism, 2nd edition, (Addison-Wesley)1962.
3. D.J.Griffiths, Introduction to Electrodynamics, 2nd Ed., Prentice Hall,India,1989.
4. J.R.Reitz,E.J.Milford and R.W.Christy, Foundation of Electromagnetic Theory, 4th ed., Addison-Wesley,1993

Course Code: RPSPHY203

Course Title: Quantum Mechanics-II

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand the Perturbation theory and the first and second order energy corrections, first order correction to wave function.
CO 2	Learn the degenerate perturbation theory, Fermi's Golden rule and their applications.
CO3	Learn other approximation methods like Variational Principle and WKB approximations, quantization conditions and their applications.
CO 4	Learn the Scattering theory – semi-classical theory, differential scattering cross section, scattering amplitude, partial wave analysis, etc.
CO 5	Understand the spherical attractive and repulsive potential wells, Born Approximation for One wall, Two walls and no walls.
CO 6	Understand the Identical Particles, the difference between energy levels for Bosons and Fermions, Pauli's exclusion principle, and the wave functions corresponding to Bosons and Fermions.
CO7	Learn Relativistic Quantum Mechanics, Klein Gordon coefficients and Dirac equations.

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY203	**Unit**	**Quantum Mechanics – II**	**04**
Unit I	**I**	**Perturbation Theory:** Time independent perturbation theory: First order and second order corrections to the energy eigen-values and eigen-functions. Degenerate perturbation Theory: first order correction to energy. Time dependent perturbation theory: Harmonic perturbation, Fermi's Golden Rule, sudden and adiabatic approximations, applications.	**15 lectures**
Unit II	II	**Approximation Methods** 1. Variation Method: Basic principle, applications to simple potential problems, He- atom. 2. WKB Approximation: WKB approximation, turning points, connection formulas, Quantization conditions, applications.	**15 lectures**
Unit III	III	**Scattering Theory** Laboratory and centre of mass frames, differential and total scattering cross-sections, scattering amplitude, Partial wave analysis and phase shifts, optical theorem, S-wave scattering from finite spherical attractive and repulsive potential wells, Born approximation.	**15 lectures**
Unit IV		1. Identical Particles: Symmetric and anti-symmetric wave functions, Bosons and Fermions, Pauli Exclusion Principle, slater determinant. 2. Relativistic Quantum Mechanics 3. The Klein Gordon and Dirac equations. Dirac matrices, spinors, positive and negative energy solutions physical interpretation. Non-relativistic limit of the Dirac equation.	**15 lectures**

Main references:

1. Richard Liboff, Introductory Quantum Mechanics,4th edition,Pearson.
2. D J Griffiths, Introduction to Quantum Mechanics4th edition
3. A Ghatak and S Lokanathan, Quantum Mechanics: Theory and Applications, 5th edition.

4. N Zettili, Quantum Mechanics: Concepts and Applications,2nd edition,Wiley.
5. J. Bjorken and S. Drell, Relativistic Quantum Mechanics, McGraw-Hill(1965).

Additional References

1. WGreiner,QuantumMechanics:Anintroduction,Springer,2004
2. RShankar,PrinciplesofQuantumMechanics,Springer,1994
3. P. M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill(1977).
4. J. J. Sakurai Modern Quantum Mechanics, Addison-Wessley (1994).

Course Code: RPSPHY204

DSE 2 Title: 8086 Microprocessor and C++ Programming

Academic year 2022-23

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY204	Unit	8086 Microprocessor and C++ Programming	02
Unit I	I	**8086 microprocessor:** Register organization of 8086, Architecture, Signal Descriptions of 8086, Physical Memory Organization, General Bus operation, I/O Addressing Capability, Special Processor Activities, Minimum mode 8086 system and timings, Maximum mode of 8086 system and timings. AB - Ch 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9. **8086 Instruction set and assembler directives:** Machine Language Instructions Formats, Addressing modes of 8086, Instruction set of 8086. AB-Ch 2:2.1,2.2,2.3.	15 lectures
Unit II	II	**The Art of Assembly Language Programming with 8086:** A few machine level programs, Machine coding the programs, Programming with an assembler (only using Debug), Assembly language example programs. AB - Ch 3: 3.1, 3.2, 3.3.4 & 3.4 **Special architectural features and related programming:** Introduction to Stack, Stack structure of 8086, Interrupts and Interrupt Service Routines, Interrupt cycle of 8086, Non-maskable interrupt, Maskable interrupt (INTR). AB - Ch 4: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 (Note: Also refer Intel's 8086 Data Sheet)	15 lectures
Unit III	III	**Programming Using C++:** Introduction to Computers	15

		and programming, Introduction to C++, Expressions and interactivity, Making decisions, Looping, Functions, Arrays, Sorting arrays, Pointers. TGCh.1:1.3to1.7,Ch.2:2.1to2.14,Ch.3:3.1to3.11,Ch. 4:41to4.15,Ch.5:5.1to5.13, Ch. 6: 6.1 to 6.14, Ch. 7: 7.1 to 7.9 ,Ch.8: 8.3 ,Ch.9-9.1 to 9.7	**lectures**
Unit IV	**IV**	**Introduction to classes:** More about classes, Inheritance, polymorphism, virtual functions. TGCh.13:13.1to13.11,Ch.14:14.1to14.5,Ch.15:15.1to15.6	**15 lectures**

Reference:

9. Advanced Microprocessors and Peripherals by a K.Ray and K.M. Bhurchandi Second Edition Tata McGraw– Hill Publishing Company Ltd. (AB)
10. 8086 Microprocessor: Programming and Interfacing K.J. Ayala, Penram International

---

1. Starting out with C++ from Control structures through objects, by Tony Gaddis, Sixth edition Penram International Publications, India (TG)
2. Object Oriented Programming with C++, By E.Balagurusamy, 2nd ed. TMH.
3. OOPS with C++ from the Foundation, By N.R. Parsa, Dream Tech. Press India Ltd.

Course Code: RPSPH205

AECC: Research Methodology

Academic year 2022-23

Course Code		Title – Research Methodology	Credits
RPSPH205	Unit		02
Unit I	I	**Data Analysis for Physical Sciences:** Population and Sample, Data distributions Probability, Probability Distribution, Distribution of Real Data, The normal distribution, The normal distribution, From area under a normal curve to an interval, Distribution of sample means, The central limit theorem, The t-distribution, The log-normal distribution, Assessing the normality of data, Population mean and continuous distributions, Population mean and expectation value, The binomial distribution The Poisson distribution, Experimental Error, Measurement, error and uncertainty, The process of measurement, True value and error, Precision and accuracy, Random and systematic errors, Random errors, Uncertainty in measurement.	15 lectures
Unit II	II	**Characterization techniques for materials analysis:** Spectroscopy: XRD, XRF, XPS, EDAX, Raman, UV Visible spectroscopy, FTIR spectroscopy. Microscopy: SEM, TEM, AFM, STM,SQUID, magneto resistance measurement device.	15 lectures

M.Sc. (Physics) Practical Lab Course

Semester – II

RPSPHYP201 LAB COURSE -4—sound and optics

1.	Ultrasonic Interferometry-Velocity measurements in different Fluids
2.	Measurement of Refractive Index of Liquids using Laser
3.	Double slit- Fraunhofer diffraction (missing order etc.)

RPSPHYP202 LAB COURSE -5--Electronics

1.	Study of Presettable counters- 74190 and 74193
2.	TTL characteristics of Totem pole, Open collector and tristate devices
3.	Study of sample and hold circuit

RPSPHYP203 LAB COURSE -6--- digital electronics

1.	Shift registers IC 7495.
2.	Wave form generation using 8085
3.	SID & SOD using 8085

RPSPHYP204 DSE 2 LAB COURSE –8086 and C++

1.	8086 assembly language programming: Simple data manipulation programs (8/16-bit addition, subtraction, multiplication/division) *<u>Please note</u>: Assembly language programming of 8086 may be done by operating PC in real mode by using 'Debug' program. Separate 8086 study kit not needed.*
2.	8086 assembly language programming 8/16-bit data transfer, Any 2{finding greatest/smallest number, finding positive/negative numbers, finding odd/even numbers, ascending/descending of numbers}
3.	8086 assembly language programming converting BCD nos. into Binary using INT20 OR displaying a string of characters using INT20
4.	C++ Program (Program on mean, variance, standard deviation for a set of numbers
5.	C++ Program (Sorting of data in ascending or descending order).
6.	C++ experiment (Programs on class, traffic lights)

Note _1:

Number of experiments to be performed and reported in the journal from LAB course 4, LAB course 5, and LAB course 6 = 09. (3 from each Lab course)

Note _2:

Number of experiments to be performed from DSE-2 LAB course 5 experiments.

Note _3:

Minimum 9 +3 (DSE 2 LAB course) =12 experiments should be reported in the journal, for appearing at the practical examination.

PRACTICAL BOOK/JOURNAL

The candidate shall prepare and submit for practical examination a certified Journal based on the practical course carried out under the guidance of a faculty member with minimum number of experiments as specified in the syllabus for each group.

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/ Coordinator / In-charge of the department on the basis of presenting record of lab readings in rough journal; failing which the student will not be allowed to appear for the practical examination.

MODALITY OF ASSESSMENT

Theory Examination Pattern:

B) Internal Assessment - 40% = 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.	10
	TOTAL	40

B) External examination - 60 %
Semester End Theory Assessment - 60 marks

iii. Duration - These examinations shall be of **2- & 1/2-hours** duration.

iv. Paper Pattern:

3. There shall be 4 questions each of 15 marks. On each unit there will be one question.
4. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q. 1	Any 1 out of 2	8	Unit I
Q.2	Any 1 out of 2	7	
Q.3	Any 1 out of 2	8	Unit II
Q.4	Any 1 out of 2	7	
Q.5	Any 1 out of 2	8	Unit III
Q.6	Any 1 out of 2	7	
Q.7	Any 1 out of 2	8	Unit IV
Q.8	Any 1 out of 2	7	
	TOTAL	60	

Practical Examination Pattern:

External (Semester End Practical Examination):

Course Code	Experiment from LAB course	Time duration(hrs.)	Marks
RPSPHYP201	LAB course 4	2	50
RPSPHYP202	LAB course 5	2	50
RPSPHYP203	LAB course 6	2	50
RPSPHYP204	DSE 2 LAB course	2	50
	Total marks for practical examination	8	200

Overall Examination and Marks Distribution Pattern

Course	RPSPHY201 (Marks)			RPSPHY202 (Marks)			RPSPHY203 (Marks)			RPSPHY204 (Marks)			RPSPHY 205	Total (Marks
	Int.	Ext.	Total	I	E	T	I	E	T	I	E	T	E	
Theory	40	60	**100**	40	60	**100**	40	60	**100**	40	60	**100**	**50**	**450**

LAB Course	RPSPHYP201 (Marks)	RPSPHYP202 (Marks)	RPSPHYP203 (Marks)	RPSPHYP204 (Marks)	Total (Marks)
Practical	**50**	**50**	**50**	**50**	**200**

(GRAND TOTAL MARKS: 650)

S.P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for PG

Program: M.Sc. (Physics) (Electronics I)

Program Code: RPSPHY

(Credit Based Semester and Grading System with effect from the academic year 2024-25)

Course Code: RPSPHY301

Course Title:

Academic year 2022-23

Course Code	Title	Credits
RPSPHY301	**Microcontroller 8051, PIC and Embedded System**	**04**
Unit I	**8051 microcontroller:** (Review of 8051), Timer /Counters, Interrupts, Serial communication. Programming 8051 Timers, Counter Programming Basics of Serial Communication, 8051 Connection to RS232, 8051 Serial Port Programming in assembly. 8051 Interrupts, Programming. Timer interrupts Programming External hardware Interrupts, Programming the Serial Communication Interrupt, Interrupt Priority in 8051/52.	15 lectures
Unit II	**16C61/71 PIC Microcontrollers:** Overview and Features, PIC 16C6X/7X, PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organization, PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter.	15 lectures
Unit III	**PIC 16F8XX Flash Microcontrollers**: Introduction, Pin Diagram, STATUS Register, Power Control Register (PCON), OPTION Register, Program memory, Data memory, I/O Ports Capture/Compare/PWM (CCP) Modules in PIC 16F877, Analog-to-Digital Converter. AVD – Ch. 10: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.10	15 lectures
Unit IV	**Embedded systems** Introduction to Embedded Systems: What is an embedded system, Embedded System v/s General Computing System, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, Smart Running Shoes.	

	SKV – Ch. 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7 A Typical Embedded system: Core of the embedded system SKV–Ch.2:2.1 Characteristics and quality Attributes of Embedded Systems: Characteristics of an Embedded System, Quality Attributes of Embedded Systems SKV – Ch. 3: 3.1, 3.2 Embedded Systems-Application and Domain–Specific: Washing Machine, Automatic- Domain, Specific examples of embedded system SKV – Ch. 4: 4.1, 4.2 Design Process and design Examples: Automatic Chocolate Vending machine (ACVM), Smart Card, Digital Camera, Mobile Phone, A Set of Robots	

Main References:

1. The 8051 Microcontroller and Embedded Systems, Dr.Rajiv Kapadia, Jaico Publishing House.
2. The 8051 Microcontroller & Embedded Systems by M.A.Mazidi,J.G.Mazidi and R.D. Mckinlay
3. The 8051 Microcontroller: K.J.Ayala: Penram International.
4. Microcontrollers by Ajay V. Deshmukh, Tata-McGraw Hill Publication (AVD)
5. Introduction to embedded systems by ShibuK.V.,Sixth Reprint 2012,Tata McGraw-Hill (SKV)
6. Embedded Systems Architecture, Programming and Design, by RajKamal, Second Edition, The McGraw-Hill Companies(RK)

Course Code: RPSPHY302

Course Title: Statistical Mechanics

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand Statistical Basis of Thermodynamics, in particular ensemble Theory.
CO 2	Developing formalism of Canonical Ensemble, analysis with partition function
CO3	Comprehend concept of statistics of Para-magnetism, thermodynamics of magnetic systems..
CO 4	Developing formalism of Grand Canonical Ensemble
CO 5	Exploring physical significance of statistical quantities-Density and energy fluctuations
CO 6	Formulation of Quantum Statistics- Statistics of the various ensembles
CO7	Demonstrate problem solving skills in all above areas

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY302	Unit	**Statistical Mechanics**	04
Unit I	I	The Statistical Basis of Thermodynamics-The macroscopic and the microscopic states, contact between statistics and thermodynamics, the classical ideal gas, The entropy of mixing and the Gibbs paradox, the enumeration of the microstates. Elements of Ensemble Theory-Phasespace of a classical system, Liouville's theorem and its consequences. The micro-canonical ensemble - Examples Quantum states and the phase space	**15 lectures**
Unit II	II	The Canonical Ensemble-Equilibrium between a system and a heat reservoir, a system in the canonical ensemble, physical significance of the various statistical quantities in the canonical ensemble, expressions of the partition function, the classical systems, energy fluctuations in the canonical ensemble, correspondence with the microcanonical ensemble, the equipartition theorem and the virial theorem, system of harmonic oscillators, statistics of paramagnetism, thermodynamics of magnetic systems.	**15 lectures**
Unit III	III	The Grand Canonical Ensemble-Equilibrium between a system and a particle-energy reservoir, a system in the grand canonical ensemble, physical significance of the various statistical quantities, Examples, Density and energy fluctuations in the grand canonical ensemble, correspondence with other ensembles.	**15 lectures**
Unit IV	IV	Formulation of Quantum Statistics-Quantum-mechanical ensemble theory: the density matrix, Statistics of the various ensembles, Examples, systems composed of indistinguishable particles, the density matrix and the partition function of a system of free particles. **Note:** 50% of time allotted for lectures to be spent in solving problems.	**15 lectures**

Main Reference:

Statistical Mechanics- R.K. Pathria & Paul D.Beale (ThirdEdition), Elsevier 2011–Chapter 1 to 5

Additional References:

1. Thermodynamics and Statistical Mechanics, Greiner, Neise and Stocker, Springer 1995.
2. Introduction to Statistical Physics, Kerson Huang,Taylor and Francis 2001.
3. Thermal and Statistical Physics, F Reif.
4. Statistical Physics, D Amit and Walecka.
5. Statistical Mechanics, Kerson Huang.
6. Statistical Mechanics, J.K.Bhattacharjee.
7. Non-equilibrium Statistical Mechanics, J.K.Bhattacharjee.
8. Statistical Mechanics, Richard Feynman.
9. Statistical Mechanics, Landau and Lifshitz.
10. Thermodynamics, H.B.Callen

Course Code: RPSPHY303

DSE 3 Title: ARM 7 processor and VHDL

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand the basic of architecture of ARM7.
CO 2	Understand the basic assembly programming of ARM7.
CO3	Understand the basic programming of the microcontroller with and without the interrupt service request.
CO 4	Acquire knowledge of microcontrollers and their role in I/0 port programming and their interface with peripherals.
CO 5	Understand the basic Architecture of VHDL
CO 6	Understand the basic of VHDL programming with examples.
CO7	Acquire knowledge on how to simulate and implement combinational and sequential circuits using VHDL systems.

DETAILED SYLLABUS

Course Code	Title	Credits
RPSPHY303	**ARM 7 processor and VHDL**	**02**
Unit I	**The ARM Architecture:** The Acorn RISC Machine, Architectural inheritance, The ARM Programmer's model, ARM development tools. SF - Ch 2: 2.1, 2.2, 2.3, 2.4 **ARM Organization and Implementation:** 3–stage Pipeline ARM organization, ARM instruction execution, ARM implementation. SF - Ch 4: 4.1, 4.3, 4.4 **ARM Processor Cores**: ARM7TDMI SF – Ch 9: 9.1 only **ARM Assembly language Programming**: Data processing instructions, Data transfer instructions, Control flow instructions, Writing simple assembly	**15 lectures**

	language programs. SF – Ch 3: 3.1, 3.2, 3.3, 3.4	
Unit II	**The ARM Instruction Set**: Introduction, Exceptions, Condition execution, Branch and Branch with Link (B,BL), Branch, Branch with Link and exchange (BX,BLX), Software Interrupt (SWI), Data processing instructions, Multiply instructions, Count leading zeros (CLZ), Single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions, Multiple register transfer instructions, Swap memory and register instructions (SWP), Status register to general register transfer instructions, General register to Status register transfer instructions SF–Ch 5:5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12,5.13,5.14,5.15 **The Thumb Instruction Set**: the Thumb bit in the CPSR, The Thumb programmer's model, Thumb branch instructions, Thumb software interrupt instruction, Thumb data processing instructions, Thumb single register data transfer instructions, Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation, Thumb applications, Example and exercises.	**15 lectures**
III	**VHDL-I:** **Introduction to VHDL**: VHDL Terms, Describing Hardware in VHDL, Entity, Architectures, Concurrent Signal Assignment, Event Scheduling, Statement concurrency, Structural Designs, Sequential Behavior, Process Statements, Process Declarative Region, Process Statement Part, Process Execution, Sequential Statements, Architecture Selection, Configuration Statements, Power of Configurations. **DLP -Ch 1** **Behavioral Modeling**: Introduction to Behavioral Modeling, Transport Versus Inertial Delay, Inertial Delay, Transport Delay, Inertial Delay Model, Transport Delay Model, Simulation Deltas, Drivers, Driver Creation, Bad Multiple Driver Model, Generics, Block Statements, Guarded Blocks. **DLP -Ch 2**	**15 lectures**

IV	**Sequential Processing**: Process Statement, Sensitivity List, Process Example, Signal Assignment Versus Variable Assignment, Incorrect Mux Example, Correct Mux Example, Sequential Statements, IF Statements, CASE Statements, LOOP statements, NEXT Statement, EXIT Statement, ASSERT Statement, Assertion BNF, WAIT Statements, WAIT ON Signal, WAIT UNTIL Expression, WAIT FOR time_expression, Multiple WAIT Conditions, WAIT Time-Out, Sensitivity List Versus WAIT Statement, Concurrent Assignment Problem, Passive Processes. **DLP -Ch 3**	

References :

1. The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, Second Edition, Pearson(MMM)
2. Microcontrollers by Ajay V. Deshmukh, Tata-Mcgraw Hill Publication (AVD)

M.Sc. (Physics) Practical Lab Course
Semester –III- RPSPHYP301-PROJECT

Semesters III and IV
Project guidelines and evaluation

1. Every student will have to complete one long project for both semesters- Semester III and Semester IV with six credits (150 marks) in each semester, in subject –Electronics, / Solid state electronics,/ solid state Physics,/ Material Science,/ Nanotechnology,/ Nuclear Physics.
2. Students have to submit two separate project reports of one long project for two semesters (III and IV)
3. **In each semester, project will be of 150 marks with 50% by internal evaluation and 50% by external evaluation.**
4. **In Semester III**- student will complete theoretical aspects of the project- consisting of the problem definition, literature survey, current status, objectives, and methodology.
5. **In semester IV**-student will complete experimental part related to Project –actual experimental work, results and analysis.
6. In case of electronic projects, use of readymade electronic kits available in the market should be avoided. The electronics project / models should be demonstrated during presentation of the project.
7. Maximum three students can do a joint project. Each one of them will submit a separate project report with details of the part only he/she has done. However, he/she can in brief (in a page one or two) mention in Introduction section of project report, what other group members have done.
8. **The project report should be file bound/spiral bound/hard bound and should have following format-**

Title Page/Cover page
Certificate endorsed by Project Supervisor and Head of Department
Declaration
Abstract of the project
Table of Contents
List of Figures
List of Tables
Chapters of Content –
Introduction and Objectives of the project
Experimental/Theoretical Methodology/Circuit/Model etc. details
Results and Discussion if any
Conclusions
References

Evaluation of Project by External/Internal examiner will be based on following criteria:
Semester-III - RPSPHYP301- Project-part-A

Assessment Criteria	Maximum marks
Defining the Problem	10
Literature Survey	10
Plan of the project/ Research design	15
Theoretical methodology	15
Significance and originality of the study/Society application	10
Conclusion	05
Presentation	10
Maximum marks by External examiner	**75**
Maximum marks by internal examiner/guide	**75**
Total marks	**150**

Sem-IV – RPSPHYP401Project-part-II

Assessment Criteria	Maximum marks
Introduction to experimental part of the project	10
Experimental procedure details	10
weekly progress of project work	15
results and discussion	20
Conclusion	05
Presentation	15
Maximum marks by External examiner	**75**
Maximum marks by internal examiner/guide	**75**
Total marks	**150**

M.Sc. (Physics) Practical Lab Course

Semester – III

RPSPHYP302 LAB COURSE 7— Digital Electronics

1.	Adder-subtractor circuits using ICs
2.	Study of 8 bit DAC
3.	8/16 channel digital multiplexer

RPSPHYP303 LAB COURSE 8-- Interfacing real world

1.	Temperature on-off controller using IC
2.	Study of IN and OUT port of 8031/51 by Interfacing -Event counter (using LDR and light source).
3.	Interfacing TTL with buzzers, relays, motors and solenoids

RPSPHYP304 DSE 3 LAB COURSE –ARM 7 and VHDL programming

1.	ARM 7 processor - Simple data manipulation programs (addition, subtraction, multiplication, division etc.)
2.	ARM 7 processor - Study of IN and OUT port of ARM7 by Interfacing switches, LEDs etc.
3.	ARM 7 processor -Study of Timer
4.	VHDL program to realize logic gates (AND,OR,NOT,NOR,NAND), half adder / full adder
5.	VHDL program to realize the following combinational designs: 2 to 4 decoder (OR 8 to 3 encoder without priority), 4 to 1 multiplexer (OR 1 to 4 de- multiplexer)
6.	VHDL program to realize the following: SR–Flip Flop / JK–Flip Flop / T – Flip Flop

Note _1:
Number of experiments to be performed and reported in the journal from LAB course7, and LAB courses 8 = 06. (3 from each Lab course)

Note _2:
Number of experiments to be performed from DSE-3 LAB course 5 experiments.

Note _3:
Minimum 9 +3 (DSE LAB course) =12 experiments should be reported in the journal, for appearing at the practical examination.

PRACTICAL BOOK/JOURNAL

The candidate shall prepare and submit for practical examination a certified Journal based on the practical course carried out under the guidance of a faculty member with minimum number of experiments as specified in the syllabus for each group.

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/ Coordinator / In-charge of the department on the basis of presenting record of lab readings in rough journal; failing which the student will not be allowed to appear for the practical examination.

MODALITY OF ASSESSMENT

Theory Examination Pattern:

C) Internal Assessment - 40% = 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.	10
	TOTAL	40

B) External examination - 60 %
Semester End Theory Assessment - 60 marks

v. Duration - These examinations shall be of **2- & 1/2-hours** duration.

vi. Paper Pattern:

5. There shall be 4 questions each of 15 marks. On each unit there will be one question.
6. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q. 1	Any 1 out of 2	8	Unit I
Q.2	Any 1 out of 2	7	
Q.3	Any 1 out of 2	8	Unit II
Q.4	Any 1 out of 2	7	
Q.5	Any 1 out of 2	8	Unit III
Q.6	Any 1 out of 2	7	
Q.7	Any 1 out of 2	8	Unit IV
Q.8	Any 1 out of 2	7	
	TOTAL	60	

Semester III end Practical Examination Pattern:

RPSPHYP301	Project -External	75	
	Project -Internal	75	
	Total marks for Project Examination		**150**
RPSPHYP302	LAB COURSE 7	50	
RPSPHYP303	LAB COURSE 8	50	
RPSPHYP304	DSE 3 LAB course	50	
	Total marks for LAB course Examination		**150**
	Total marks for SEM end Practical examination		**300**

Overall Examination and Marks Distribution Pattern

Course	**RPSPHY301**			**RPSPHY302**			**RPSPHY303**			**Total**
	Int.	Ext.	Total	I	E	T	I	E	T	
Theory	40	60	**100**	40	60	**100**	40	60	**100**	**300**

Course	**RPSPHYP301**	**RPSPHYP302**	**Total**
Practicals	**150**	**150**	**300**

(GRAND TOTAL MARKS: 600)

Course Code: RPSPHY401

Course Title: Nuclear Physics

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand all static properties of nuclei
CO 2	Formulate an expression for nuclear size, Deuteron problem and Fermi golden rule.
CO3	Acquire knowledge about the spin orbit interaction and selection rules.
CO 4	Differentiate between elementary particle and properties of neutrino.
CO 5	Compare and study of different nuclear models and nuclear reactions.
CO 6	Understand the basics of Quantum Electrodynamics and Quantum Chromodynamics.
CO7	Demonstrate quantitative problem-solving skills in all the topics covered.

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY401	**Unit**	**Nuclear Physics**	**04**
Unit I	I	All static properties of nuclei (charge, mass, binding energy, size, shape, angular momentum, magnetic dipole momentum, electric quadrupole momentum, statistics, parity, isospin), Measurement of Nuclear size and estimation of R_0(mirror nuclei and mesonic atom method) Q-value equation, energy release in fusion and fission reaction. Deuteron Problem and its ground state properties, Estimate the depth and size of (assume)square well potential, Tensor for ceasan example of non-central force, nucleon-nucleon scattering-qualitative discussion on results, Spin-orbit strong interaction between nucleon, double scattering experiment. *Tutorials should include 3 problem solving session based on above mentioned topics	**15 lectures**
Unit II	II	(11 Lectures + 4 Tutorials) Review of alpha decay, Introduction to Beta decay and its energetic, Fermi theory: derivation of Fermi's Golden rule, Information from Fermi–curie plots, Comparative half- lives, selection rules for Fermi and G-T transitions. Gamma decay: Multipole radiation, Selection rules for gamma ray transitions, Gamma ray interaction with matter, and Charge-particle interaction with matter. *Tutorials should include 4 problem solving session based on above mentioned topics	**15 lectures**
Unit III	III	(11 Lectures + 4 Tutorials) 1. Nuclear Models: Shell Model (extreme single particle): Introduction, Assumptions, Evidences, Spin-orbit interactions, Predictions including Schmidt lines, limitations, Collective model- Introduction to Nilsson Model. 2. Nuclear Reactions: Kinematics, scattering and reaction cross sections, Compound nuclear reaction, direct nuclear reaction.	**15 lectures**

		*Tutorials should include 4 problem solving session based on above mentioned topics	
Unit IV	IV	(11 Lectures + 4 Tutorials) Introduction to the elementary particle Physics, The Eight fold way, the Quark Model, the November revolution and aftermath, The standard Model, Revision of the four forces, cross sections, decays and resonances, Introduction to Quantum Eletrodynamics, Introduction to Quantum Chromodynamics. Weak interactions and Unification Schemes (qualitative description), Revision of Lorentz transformations, Four-vectors, Energy and Momentum. Properties of Neutrino, helicity of Neutrino, Parity, Qualitative discussion on Parity violation in beta decay and Wu's Experiment, Charge conjugation, Time reversal, Qualitative introduction to CP violation and TCP theorem. *Tutorials should include 4 problem solving session based on above mentioned topics	**15** **lectures**

Main References:

1. Introductory Nuclear Physics, Kenneth Krane, Wiley India Pvt. Ltd.
2. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, Robert Eisberg and Robert Resnick, Wiley(2006)
3. Introduction to Elementary Particles, DavidGriffith, John Wiley and sons.

Other References:

1. Introduction to Nuclear Physics, H.A.Enge, Eddison Wesley
2. Nuclei and Particles, E.Segre, W.A.Benjamin
3. Concepts of Nuclear Physics, B.L.Cohen
4. Subatomic Particles, H.Fraunfelder and E.Henley, PrenticeHall
1. Nuclear Physics: Experimental and Theoretical, H.S.Hans, New Age International
2. Introduction to Nuclear and Particle Physics, A.Das & T.Ferbel, World Scientific
3. Introduction to high energy physics, D.H.Perkins, Addis on Wesley
4. Nuclear and Particle Physics, W.E.Burcham and M.Jones, Addison Wesley
5. Introductory Nuclear Physics, S.M.Wong, Prentice Hall.
6. Nuclear Physics: An Introduction, S.B.Patel, New Age International.
7. Nuclear Physics: S.N.Ghoshal
8. Nuclear Physics: Roy and Nigam

Course Code: RPSPHY402

Course Title: Atomic and Molecular Physics
Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand the different effects and the Exclusion principle.
CO 2	Formulate an expression for Einstein coefficients, dipole approximations with selection rules.
CO3	Acquire knowledge about the Central field and different coupling approximations.
CO 4	Differentiate between energy levels and orbital theories.
CO 5	Compare and study of different electronic spectra and molecule rotations.
CO 6	Explore and understand the basics of Raman, ESR and NMR Spectrometer. .
CO7	Demonstrate quantitative problem solving skills in all the topics covered.

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY402	**Unit**	**Atomic & Molecular Physics**	**04**
Unit I	**I**	**Review***of one-electron eigen functions and energy levels of bound states, Probability density, Virial theorem. Fine structure of hydrogen atoms, Lamb shift. Hyper fine structure and isotope shift. (ER8-6) Linear and quadratic Stark effect in spherical polar coordinates. Zeeman effect in strong and weak fields, Paschen-Back effect.(BJ,GW) Schrodinger equation for two electron atoms: Identical particles, The Exclusion Principle. Exchange forces and the helium atom (ER), independent particle model, ground and excited states of two electron atoms.(BJ)	**15 lectures**
Unit II	II	The central field, Thomas-Fermi potential, the gross structure of alkalis (GW). The Hartree theory, ground state of multi-electron atoms and the periodic table (ER), The L-S coupling approximation, allowed terms in L-S coupling, fine structure in L-S coupling, relative intensities in LS coupling, j-j coupling approximation and other types of coupling(GW)	**15 lectures**
Unit III	III	Interaction of one electron atoms with electromagnetic radiation: Electromagnetic radiation and its interaction with charged particles, absorption and emission transition rates, dipole approximation. Einstein coefficients, selection rules. Line intensities and lifetimes of excited state, line shapes and line widths. X-ray spectra. (BJ)	**15 lectures**
Unit IV	IV	Born-Oppenheimer approximation - rotational, vibrational and electronic energy levels of diatomic molecules, Linear combination of atomic orbitals (LCAO) and Valence bond (VB) approximations, comparison of valence bond and molecular orbital theories (GA,IL) **A)** Rotation of molecules: rotational energy levels of rigid and non-rigid diatomic molecules, classification of molecules, linear, spherical, symmetric and asymmetric tops. **B)** Vibration of molecules: vibrational energy levels of	**15 lectures**

		diatomic molecules, simple harmonic and anharmonic oscillators, diatomic vibrating rotator and vibrational-rotational spectra. **C)** Electronic spectra of diatomic molecules: vibrational and rotational structure of electronic spectra. (GA,IL) Quantum theory of Raman effect, Pure rotational Raman spectra, Vibrational Raman spectra, Polarization of light and the Raman effect, Applications General theory of Nuclear Magnetic Resonance (NMR). NMR spectrometer, Principle of Electron spin resonance ESR. ESR spectrometer.(GA,IL) (*Mathematical details can be found in BJ. The students are expected to be acquainted with them but not examined in these.)	

Reference:

1. Robert Eisberg and Robert Resnick, Quantum physics of Atoms, Molecules, Solids, Nuclei and Particles, John Wiley & Sons, 2nd ed, (ER)
2. B.H. Bransden and G. J. Joachain, Physics of atoms and molecules, Pearson Education 2nd ed, 2004 (BJ)
3. G. K. Woodgate, Elementary Atomic Structure, Oxford university press, 2nd ed, (GW).
4. G. Aruldhas, Molecular structure and spectroscopy, Prentice Hall of India 2nd ed, 2002 (GA)
5. Ira N. Levine, Quantum Chemistry, Pearson Education, 5th edition, 2003 (IL)

Additional reference:

1. Leighton, Principals of Modern Physics, McGraw hill
2. Igor I. Sobelman, Theory of Atomic Spectra, Alpha Science International Ltd. 2006
3. C. N. Banwell, Fundamentals of molecular spectroscopy, Tata McGraw-Hill, 3rd ed
4. Wolfgang Demtröder, Atoms, molecules & photons, Springer-Verlag 2006
5. SuneSvanberg, Atomic and Molecular Spectroscopy Springer, 3rd ed 2004
6. C.J. Foot, Atomic Physics, Oxford University Press, 2005 (CF)

Course Code: RPSPHYP403

Course Title: Solid State Devices

Academic year 2022-23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Understand crystal structures of different intrinsic semiconductors their energy band diagrams, importance of Fermi level in Direct and indirect bandgap semiconductors.
CO 2	Study about P-N junction diodes its fabrication by different processes. Characteristics like I-V and C-V characteristics and evaluate the dependence of reverse saturation current on minority carrier concentration and forward diffusion current on potential barrier.
CO3	Learn about Metal- Semiconductor contacts like Schottky and Ohmic Contacts and its I-V and C-V characteristics
CO 4	Describe the principle and analyze the operation of Bipolar Junction Transistors, MOSFETs, MODFETs, MESFETs and study its I-V and C-V characteristics.
CO 5	Demonstrate cautious problem solving skills in all above areas.
CO 6	Carry out the experiments based on the theory that they have learnt to measure I-V, C-V characteristics on semiconductor specimen, carrier mobility by conductivity, barrier capacitance of a junction diode and Energy band gap.

DETAILED SYLLABUS

Course Code		Title	Credits
RPSPHY403	**Unit**	**Solid State Devices**	**04**
Unit I	I	Classification of Semiconductors; Crystal structure with examples of Si, Ge & GaAs semiconductors; Energy band structure of Si, Ge & GaAs; Extrinsic and compensated Semiconductors; Temperature dependence of Fermi-energy and carrier concentration. Drift, diffusion and injection of carriers; Carrier generation and recombination processes- Direct recombination, Indirect recombination, Surface recombination, Auger recombination; Applications of continuity equation-Steady state injection from one side, Minority carrier surface, Haynes Shockley experiment, High field effects. Hall Effect; Four–point probe resistivity measurement; Carrier life time measurement by light pulse technique.	**15 lectures**
Unit II	II	**Semiconductor Devices: - I** p-n junction: Fabrication of p-n junction by diffusion and ion-implantation; Abrupt and linearly graded junctions; Thermal equilibrium conditions; Depletion regions; Depletion capacitance, Capacitance – voltage (C-V) characteristics, Evaluation of impurity distribution, Varactor; Ideal and Practical Current-voltage(I-V) characteristics; Tunneling and avalanche reverse junction breakdown mechanisms; Minority carrier storage, diffusion capacitance, transient behavior; Ideality factor and carrier concentration measurements; Carrier life time measurement by reverse recovery of junction diode; p- i-n diode; Tunnel diode, Introduction to p-n junction solar cell and semiconductor laser diode.	**15 lectures**
Unit III	III	**Semiconductor Devices - II** Metal–Semiconductor Contacts: Schottky barrier–Energy band relation, Capacitance- voltage (C-V) characteristics, Current-voltage(I-V) characteristics; Ideality factor, Barrier height and carrier concentration measurements; Ohmic contacts. Bipolar Junction Transistor (BJT): Static Characteristics; Frequency Response and Switching. Semiconductor hetero-junctions, Hetero-junction bipolar transistors, Quantum well structures.	**15 lectures**

Unit IV	IV	**Semiconductor Devices III:** Metal-semiconductor field effect transistor (MESFET)- Device structure, Principles of operation, Current voltage (I-V) characteristics, High frequency performance. Modulation doped field effect transistor (MODFET); Introduction to ideal MOS device; MOSFET fundamentals, Measurement of mobility, channel conductance etc. from I_{ds} vs V_{ds} and I_{ds} vs V_g characteristics. Introduction to Integrated circuits.	**15 lectures**

Main References:

1. S.M.Sze; Semiconductor Devices: Physics and Technology, 2nd edition, John Wiley, New York, 2002.
2. B.G.Streetman and S.Benerjee; Solid State Electronic Devices, 5th edition, Prentice Hall of India, NJ, 2000.
3. W.R. Runyan; Semiconductor Measurements and Instrumentation, McGraw Hill, Tokyo,1975.
4. Adir Bar-Lev: Semiconductors and Electronic devices, 2nd edition, Prentice Hall, EnglewoodCliffs,N.J.,1984.

Additional References:

1. Jasprit Singh; Semiconductor Devices: Basic Principles, John Wiley, New York, 2001.
2. Donald A.Neamen; Semiconductor Physics and Devices: Basic Principles, 3rd edition, TataMcGraw-Hill,NewDelhi,2002.
3. M.Shur; Physics of Semiconductor Devices, Prentice Hall of India, New Delhi, 1995.
4. Pallab Bhattacharya; Semiconductor Optoelectronic Devices, Prentice Hall of India, New Delhi,1995.
5. S.M.Sze; Physics of Semiconductor Devices, 2nd edition, Wiley Eastern Ltd., New Delhi,1985.

M.Sc. (Physics) Practical Lab Course
Semester –IV- RPSPHYP401-PROJECT

Sem-IV – RPSPHYP401Project-part-II

Assessment Criteria	Maximum marks
Introduction to experimental part of the project	10
Experimental procedure details	10
weekly progress of project work	15
results and discussion	20
Conclusion	05
Presentation	15
Maximum marks by External examiner	**75**
Maximum marks by internal examiner/guide	**75**
Total marks	**150**

M.Sc. (Physics) Practical Lab Course

Semester – IV

RPSPHYP402 LAB COURSE 9-Semiconductor

1.	Resistivity / Energy band gap by four probe method
2.	DC Hall effect
3.	Carrier lifetime by pulsed reverse method

RPSPHYP403 LAB COURSE -10- Physics

1.	h/e by vacuum photocell
2.	Curie Weiss law
3.	Thermal diffusivity

RPSPHYP404 LAB COURSE -11- Control circuits

1.	Ambient Light control power switch.
2.	Diac-Triac phase control circuit
3.	Delayed linear sweep using 1C 555

Note _1:

Number of experiments to be performed and reported in the journal from LAB course 9, LAB course 10, and LAB course 11 = 09. (3 from each Lab course) Total 9 experiments should be reported in the journal, for appearing at the practical examination.

PRACTICAL BOOK/JOURNAL

The candidate shall prepare and submit for practical examination a certified Journal based on the practical course carried out under the guidance of a faculty member with minimum number of experiments as specified in the syllabus for each group.

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/ Coordinator / In-charge of the department on the basis of presenting record of lab readings in rough journal; failing which the student will not be allowed to appear for the practical examination.

MODALITY OF ASSESSMENT

Theory Examination Pattern:

D) Internal Assessment - 40% = 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.	10
	TOTAL	40

B) External examination - 60 %
Semester End Theory Assessment - 60 marks

vii. Duration - These examinations shall be of **2- & 1/2-hours** duration.

viii. Paper Pattern:

7. There shall be 4 questions each of 15 marks. On each unit there will be one question.
8. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q. 1	Any 1 out of 2	8	Unit I
Q.2	Any 1 out of 2	7	
Q.3	Any 1 out of 2	8	Unit II
Q.4	Any 1 out of 2	7	
Q.5	Any 1 out of 2	8	Unit III
Q.6	Any 1 out of 2	7	
Q.7	Any 1 out of 2	8	Unit IV
Q.8	Any 1 out of 2	7	
	TOTAL	60	

Practical Examination Pattern:

RPSPHYP401	Project -External	75	
	Project -Internal	75	
	Total marks for Project Examination		**150**
RPSPHYP402	LAB COURSE 9	50	
RPSPHYP403	LAB COURSE 10	50	
RPSPHYP404	LAB COURSE 11	50	
	Total marks for LAB course Examination		**150**
	Total marks for SEM end Practical examination		**300**

Overall Examination and Marks Distribution Pattern

Course	**RPSPHY401 (Marks)**			**RPSPHY402 (Marks)**			**RPSPHY403 (Marks)**			**Total (Marks)**
	Int.	Ext.	Total	I	E	T	I	E	T	
Theory	40	60	**100**	40	60	**100**	40	60	**100**	**300**

LAB Course	**RPSPHYP401 (Marks)**	**RPSPHYP402 (Marks)**	**RPSPHYP403 (Marks)**	**RPSPHYP404 (Marks)**	**Total (Marks)**
Practical	**150**	**50**	**50**	**50**	**300**

(GRAND TOTAL MARKS: 600)