VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

DEPARTMENT OF STUDIES IN

PHYSICS

SYLLUBUS

Master of Science in Physics

(I – II Semester)

Effective From

2024-25

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in Physics

Programme: Master of Science (M.Sc.) in Physics

Programme Overview:

Duration: 2 Years (4 semesters) Programme Code:9111

The Master of Science (M.Sc.) in Physics program is designed to prepare students for careers in teaching, research, or industry by introducing a wide range of physics concepts and training in research techniques. The program aims to provide a foundational understanding of physics principles and concepts through a structured teaching and learning process, as well as experimentation to explore new dimensions of the field.

Programme Educational Objectives (PEOs):

After 3-4 years of completion of the programme the graduates will be able to:

1. Demonstrate competency in physics to solve and analyze contemporary problems.
2. Demonstrate research skills, including laboratory techniques, numerical methods, and computer programming.
3. Qualify for positions in academic, research, or industrial institutions.
4. Exhibit leadership qualities to achieve professional and organizational goals with a commitment to ethical standards and teamwork.

Programme Outcomes (POs):

At the end of the programme the students will be able to:

1. Apply physics knowledge to solve practical problems.
2. Use mathematical techniques to interpret physical systems.
3. Design, execute, and interpret experiments.
4. Propose and ethically conduct research with societal and environmental awareness.
5. Collaborate effectively on projects, contributing individually.
6. Communicate physics concepts and research findings effectively, both written and oral.
7. Pursue lifelong learning by staying updated on scientific advances.

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Distribution of Courses/Papers in Postgraduate Programme I Semester as per Choice Based Credit System (CBCS) Proposed for

PG Program in Physics

M.Sc. I - SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
FIRST	DSC1	24PHY1C1L	Mathematical Methods of Physics	30	70	100	4	-	-	4	3
	DSC2	24PHY1C2L	Classical Mechanics	30	70	100	4	-	-	4	3
	DSC3	24PHY1C3L	Atomic, Molecular & Optical Physics	30	70	100	4	-	-	4	3
	DSC4	24PHY1C4L	Electronics	30	70	100	4	-	-	4	3
	SEC1	24PHY1S1LP	Design of Electrical & Electronics Circuits	20	30	50	1	-	2	2	2
	DSC3P1	24PHY1C3P	Atomic, Molecular & Optical Physics Lab	30	70	100	-	-	4	2	4
	DSC4P2	24PHY1C4P	Electronics Lab	30	70	100	-	-	4	2	4
Total Marks for I Semester						**650**				**22**	

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M.Sc. II-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
SECOND	DSC5	24PHY2C5L	Computational Physics	30	70	100	4	-	-	4	3
	DSC6	24PHY2C6L	Quantum Mechanics	30	70	100	4	-	-	4	3
	DSC7	24PHY2C7L	Condensed Matter Physics	30	70	100	4	-	-	4	3
	DSC8	24PHY2C8L	Nuclear Physics	30	70	100	4	-	-	4	3
	SEC2	24PHY2S2LP	Interfacing of Devices	20	30	50	1	-	2	2	2
	DSC5P3	24PHY2C5P	Computational Physics Lab	30	70	100	-	-	4	2	4
	DSC7P4	24PHY2C7P	Condensed Matter Physics Lab	30	70	100	-	-	4	2	4
	DSC8P5	24PHY2C8P	Nuclear Physics Lab	30	70	100	-	-	4	2	4
Total Marks for II Semester						**750**				**24**	

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M.Sc. III-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
THIRD	DSC9	24PHY3C9L	Thermal and Statistical Physics	30	70	100	4	-	-	4	3
	DSC10	24PHY3C10L	Analytical Techniques & Instrumentation	30	70	100	4	-	-	4	3
	DSE1	24PHY3E1AL	A. Advanced Condensed Matter Physics	30	70	100	4	-	-	4	3
		24PHY3E1BL	B. Advanced Nuclear Physics								
		24PHY3E1CL	C. Optical Spectroscopy								
	DSE2	24PHY3E2AL	A. Materials Science	30	70	100	4	-	-	4	3
		24PHY3E2BL	B. Radiation Physics								
		24PHY3E2CL	C. Renewable Energy Physics								
	GEC1	24PHY3G1AL	A. Nanomaterials	15	35	50	2	-	-	2	1.5
		24PHY3G1BL	B. Astrophysics								
		24PHY3G1CL	C. Biophysics								
	SEC3	24PHY3S3LP	Research Methodology	30	70	100	1	-	2	2	1
	DSC9P6	24PHY3C9P	Thermal and Statistical Physics Lab	30	70	100	-	-	4	2	4
	DSC10P7	24PHY3C10P	Analytical Techniques & Instrumentation Lab	30	70	100	-	-	4	2	4
Total Marks for III Semester						**750**				**24**	

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M.Sc. IV-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
FOURTH	DSC11	24PHY4C11L	Advanced Quantum Mechanics	30	70	100	4	-	-	4	3
	DSC12	24PHY4C12L	Electromagnetics	30	70	100	4	-	-	4	3
	DSE3	24PHY4E3AL	A. Semiconductor Physics	30	70	100	4	-	-	4	3
		24PHY4E3BL	B. Particle Physics								
		24PHY4E3CL	C. Lasers and Optical fibers								
	DSE4	24PHY4E4AL	A. Nanoscience	30	70	100	4	-	-	4	3
		24PHY4E4BL	B. Accelerator Physics								
		24PHY4E4CL	C. Astrophysics								
	GEC2	24PHY4G2AL	A. Physics in Everyday Life	15	35	50	2	-	-	2	1.5
		24PHY4G2BL	B. Space Research Programs in India and Abroad								
		24PHY4G2CL	C. Exciting Inventions in Physics								
	DSC12P8	24PHY4C12P	Electromagnetics Lab	30	70	100	-	-	4	2	4
	Project	24PHY4C1R	Research Project	30	70	100		-	8	4	4
Total Marks for IV Semester						**650**				**24**	

(I-IV semester)- Total Marks: 2800 Total credits: 94

DSC – Department Specific Core, DSE – Discipline Specific Elective, SEC – Skill Enhancement Course, GEC – Generic Elective Course, IA – Internal Assessment, SEE – Semester End Examination, L – Lecture, T – Tutorial, P – Practical.

Semester -I

Course Title: Mathematical Methods of Physics	**Course Code:** 24PHY1C1L
Total Contact Hours: 56 Hours	**No. of Credits:** 04
Formative Assessment Marks: 30	**Duration of ESA/Exam:** 03 Hours
Summative Assessment Marks: 70	**L:T:P::4:0:0**

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Solve differential equations of first & second orders.
2. Apply different transforms to solve mathematical problems of interest in science and engineering.
3. Solve different physical problems which contain complex variables.
4. Formulate and express a physical law in the sense of tensors, and simplify it using coordinate transforms.

DSC1: Mathematical Methods of Physics (24PHY1C1L) Unit wise Syllabus

Unit	Description	Hours
1.	**Differential equations and Special functions** **Differential equations** Ordinary differential equations: First-order homogeneous and non-homogeneous equations with variable coefficients. Second-order homogeneous and non-homogeneous equations with constant and variable coefficients. **Special functions** Legendre functions: Legendre polynomials, Rodrigue's formula, generating function, and recurrence relations. Bessel functions: Bessel functions of first kind, generating function, recurrence relations. Hermite functions: Hermite polynomials, generating function, recurrence relations. Laguerre functions: Laguerre polynomials, generating function, recurrence relations. **(Ref. 1, 2 & 3)**	14
2.	**Fourier series & Integral transforms** **Fourier series** Fourier's theorem, Cosine and Sine series, Change of interval. Complex form of Fourier series. Fourier integral. **Integral transforms** Fourier transforms: Introduction, Properties, Fourier transform of a derivative, Fourier transform of functions of two and three variables, Finite Fourier transforms, Some physical applications. Laplace transforms: Introduction, Properties, Laplace transform of the	14

	derivative of a function, periodic functions, and some special functions, Inverse Laplace Transform - Properties, Convolution Theorem. Some physical applications. (Ref. 1, 2 & 3)	
3.	**Linear Algebra and Matrices** **Linear Algebra**: Scalar Products, real & Complex Vector Space, Metric Spaces, linear operator, algebra of linear operators, Norms, Infinite dimensional Vector Space, Hilbert Space. Matrices: Cayley-Hamiltonian Theorem, matrix representation of operators, orthogonal, unitary & hermatian matrices, diagonalization of matrices, Eigen values & Eigen vectors. (Ref. 1, 5 & 6) **Complex analysis & Vector analysis** **Complex analysis** Complex Numbers, Functions of a complex variable, Properties of analytic functions, Singularities: Taylor and Laurent Series, poles, Cauchy's integral theorem, Cauchy's residue theorem. Some physical applications.(Ref. 1,2& 3) **Vector analysis** Review of vector algebra; vector differentiation and integration; Line, surface, and volume integrations, Gauss and Stoke's theorems. Some physical applications. (Ref. 1, 2 & 3)	14
4.	**Group Theory & Tensors** **Group theory** Groups, subgroups, classes, Homomorphism and isomorphism, Group representation - Reducible and irreducible representations, Character of a representation, character tables. Construction of representations. The three-dimensional rotation group SO(3), The special unitary groups SU(2) and SU(3), The irreducible representations of SU(2), and Representations of SO(3) from those of SU(2). (Ref. 1 & 7) **Tensors** Definition and type of tensors, Contravariant and Covariant tensors, symmetric and antisymmetric tensors, Tensor algebra: Equality, addition and subtraction, tensor multiplication, outer product; contraction of indices, inner product, quotient theorem, Kronecker delta, metric tensor, Christoffel symbols. (Ref. 1 & 8)	14

References:

1. Mathematical Physics by Satya Prakash, S Chand and Sons, NewDelhi, 2019.
2. Advanced Engineering Mathematics by H.K. Dass, S Chand and Company Ltd., 2013.
3. Mathematical Methods for Physicists by George B. Arfken, Hans J Weber, 6th Edi, Elsevier Academic Press, 2005.
4. Mathematical Physics by B. D. Gupta, 3rd Edi, Vikas Publishing House Pvt. Ltd. 2004.
5. T. Lawson, Linear Algebra, John Wiley & Sons, 1996.
6. Linear Algebra – Seymour Lipschutz, Schaum Outlines Series, 4th Edition, 2009.
7. Elements of Group Theory for Physicists by A W Joshi, 3rd Edi, John Wiley & Sons, 1982.
8. Matrices and tensors in Physics by A W Joshi, 4th Edi, New Age International Publishers, 2017.

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Course Title: Classical Mechanics	**Course Code:**21PHY1C2L
Total Contact Hours: 56 Hours	**No. of Credits:** 04
Formative Assessment Marks: 30	**Duration of ESA/Exam:** 03 Hours
Summative Assessment Marks: 70	**L:T:P::4:0:0**

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Solve problems involving particle motion in central force fields.
2. Understand the dynamics of moving and rotating coordinate systems, including the effects of coriolis and centrifugal forces.
3. Apply the principles of rigid body motion and use Euler's equations to solve problems involving rotational dynamics.
4. Utilize Lagrangian and Hamiltonian formulations to describe and solve complex mechanical systems, including understanding the variational Principle.

DSC2: Classical Mechanics (24PHY1C2L)Unit wise Syllabus

Unit	Description	Hours
1	**Motion in a Central Force Field:** Equivalent one body problem (quantitative), Motion in a central force field (quantitative), General features of the motion (qualitative), Motion in an inverse square law force field (qualitative), Equation of the Orbit (quantitative), Nature of the orbits, Kepler's laws of planetary motion (Deduction of third law), Numericals.	14
2	**Moving Coordinate systems:** Coordinate systems with relative translation motions, Rotating coordinate systems (quantitative), Coriolis force, Motion on the Earth (qualitative), Effect of coriolis force on freely falling particle (quantitative), simple applications and numericals.	12
3	**Motion of a Rigid body:** Introduction, Euler's theorem, Angular momentum and kinetic energy (quantitative), Inertia Tensor, Euler's equations of motion (quantitative), Torque free motion (quantitative), Euler's angles (qualitative), motion of symmetric top (quantitative), nutational motion (quantitative). Simple applications and numericals.	14

4	**Lagrangian and Hamilton's Formulation** Constraints and its types, Generalized co-ordinates, D'Alembert's principle (expression for virtual displacement, genealised velocity, virtual work, generalized force), Lagrangian equation of motion (quantitative) and its importance, Symmetries and the laws of conservation, cyclic co-ordinates, velocity dependent potential of electromagnetic field, Rayleigh dissipation function, Configuration space, Basics of variational principle, Hamilton's principle, Hamilton's equations of motion (quantitative) and some applications, Phase space. Simple applications and numericals.	16

References:

1. Classical Mechanics by H Goldstein, Third Edition, Pearson India, 2011.
2. Introduction to Classical Mechanics by R G Takwale and P S Puranik, Tata McGraw-Hill, 1979.
3. Classical Mechanics by N C Rana and P S Joag, Tata McGraw, 1991.
4. Classical Mechanics by J. C. Upadhyaya, Himalaya Publishing House, 2014.
5. Classical Dynamics of particles and systems by J. B. Marian, Academic Press, New York, 1965.

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Course Title: Atomic, Molecular and Laser Physics	**Course Code:**24PHY1C3L
Total Contact Hours: 56 Hours	**No. of Credits:** 04
Formative Assessment Marks: 30	**Duration of ESA/Exam:** 03 Hours
Summative Assessment Marks: 70	**L:T:P::4:0:0**

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Apply the concepts of atomic physics to analyse and interpret spectra of atoms.
2. Apply the concepts of molecular physics to analyse and interpret spectra of molecules.
3. Apply the concepts of laser physics to understand the laser systems and their applications.

DSC3: Atomic, Molecular and Optical Physics (24PHY1C3L) Unit wise Syllabus

Unit	Description	Hours
1.	**Atomic Physics I** Quantum states of an electron in an atom, Spin orbit interaction – Expression for term shift, Quantum mechanical relativity correction for term shift, Hydrogen fine structure, Coupling schemes: LS and jj coupling – Expression for interaction energy, multiplet splitting and Lande interval rule,Spectrum of helium – ortho and para states, Fine structure in alkali spectra, Sodium doublet, Intensity ratio for doublets, Hyperfine structure – Isotope and nuclear spin effects, Width of spectral lines- Natural, Doppler and External effects.(Ref. 1, 2, 3 & 4)	14
2.	**Atomic Physics II** Magnetic moment of a bound electron, Zeeman effect – Types, Magnetic interaction energy, Zeeman splitting in Sodium D-lines, Paschen-Back effect – Magnetic interaction energy, Paschen-Back splitting in Sodium D-lies, Stark effect – Types, Stark effect in hydrogen – weak and strong fields, Chemical Shift in NMR (qualitative).Working Principle of Constant Deviation Spectrometer (CDS) and its uses.Talbot bands, Hartman's formula.(Ref. 1, 2, 3 & 4)	14

3.	**Rotational, Vibrational and Raman spectroscopy** *Rotational/microwave Spectra:* Types of molecules based on rotation, Rotational spectra of rigid diatomic molecule, Intensities of spectral lines, Effect of isotopic substitution, Spectrum of non-rigid rotator (Qualitative), Instrumentation for rotational spectroscopy – Microwave spectrometer, Chemical analysis by microwave spectroscopy. (Ref. 2, 5 & 6) **- 5 Hours** *Vibrational/infrared spectra:* Vibrating molecule as a simple harmonic oscillator, Anharmonic oscillator, Analysis by infrared techniques, (Ref. 2, 5 & 6) **- 4 Hours** *Raman Spectroscopy:*Quantum theory of Raman effect, Pure rotational Raman spectra of linear molecules, Raman activity of vibrations, Rule of mutual exclusion, Vibrational Raman spectra, Comparison of infrared and Raman spectroscopy. Applications of Raman spectroscopy (qualitative). **- 5 Hours**	14
4.	**Electronic Spectroscopy and Laser Physics** Electronic Spectra: Born-Oppenheir approximation, Vibrational coarse structure: progressions, Intensity of Vibrational-Electronic spectra : Franck-Condon principle, Rotational fine structure of Electronic-Vibration transitions, Dissociation and predissociation, Chemical analysis by electronic spectroscopy, (Ref. 2, 5 & 6) **- 6 Hours** *Laser Physics: S*pontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length. Three level lasers versus Four Level lasers with examples, Laser Systems: (a) Nd-YAG Laser (b) Carbon Dioxide Laser, c) Dye Laser, Applications of Laser: (a) Defense – Ranging (b) Eye Surgery: LASIK. C) Isotope separation (Ref.1,2& 7) **- 8 Hours**	14

References:

1. Arthur Beiser, Shobhit Mahajan and S Rai *Choudhury Concepts of Modern Physics* McGraw Hill Education, 7th Edition, 2015.

2. Raj Kumar, KedarNath Ram Nath *Atomic and Molecular Spectra* (KNRN) Publishers, 5th Ed.– Reprint 2019.
3. H.C. White, *Introduction to Atomic Spectra* McGraw-Hill Education / Asia, 1963.
4. S.P. Kuila, *Concepts of Atomic Physics* New Central Book Agency (P) Ltd. (NCBA), Kolkata, 2018.
5. C N. Banwell and E. M. McCash *Fundamentals of Molecular Spectroscopic*, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 5th Ed., 2008.
6. Herzberg Gerhard, D.Van *Molecular Spectra* Nostrand Company Inc., Vol.I, 2005.
7. William T. Silfvast, *Laser Fundamentals* Cambridge University Press, 2nd Ed., 2004.

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Course Title: Electronics	**Course code:** 24PHY1C4L
Total Contact Hours: 56	**Course Credits:** 04
Internal Assessment Marks: 30 marks	**Duration of SEE:** 03 hours
Semester End Examination Marks: 70 marks	**L:T:P::4:0:0**

Course Outcomes:

By the end of this course, students will be able to:

1. Understand semiconductor physics, carrier concentration, p-n junctions, and I-V characteristics.
2. Analyze & design transistor circuits with biasing & frequency response.
3. Design circuits using operational amplifiers for filters and oscillators.
4. Apply Boolean algebra to simplify digital circuits and design sequential, A/D, and D/A conversion systems.

DSC4: Electronics (24PHY1C1L) Unit wise Syllabus

Unit	Description	Hours
1.	**Physics of Devices** Fundamentals of semiconductors. Intrinsic and extrinsic types of semiconductors, their carrier concentrations, Variation with temperature and doping levels. The electrical conduction mechanism in semiconductors Fermi level theory.Theory of p-n junctions, depletion region, current-voltage (V-I) characteristics, junction breakdown, carrier generation-recombination, mobility, and the drift-diffusion current. (Ref. 1, 2.)	**14**
2.	**Transistors and Amplifiers** Transistor action, transistor configurations Common Emitter (CE), Common Base (CB), and Common Collector (CC). BJT transistors using hybrid models, biasing techniques, voltage divider bias and frequency response.operation of Field Effect Transistors (FETs) and MOSFETs, small-signal models, biasing, and amplifier configurations: common drain and common gate. feedback mechanism in oscillators and the criteria for oscillation: Phase-shift and Wein-bridge oscillators.(Ref. 3, 4.)	**14**
3.	**Operational Amplifiers and Applications** Fundamental concepts of operational amplifiers (op-amps), differential amplifiers and the characteristics of ideal op-amps. open-loop and closed-loop	**14**

	op-amp configurations, demonstrate of op-amps to design inverting and non-inverting amplifiers, integrators, and differentiators, design of active filters using op-amps, low-pass, high-pass, band-pass, and band-reject filters, signal generators, phase-shift oscillators and crystal oscillators, (Ref. 5, 6)	
4.	**Digital Electronics and Conversion Circuits** Boolean algebra and its application, designing and simplifying digital circuits. Karnaugh maps to simplify Boolean expressions, logic gate families: AND, OR, NAND, and NOR gates. pulse waveform operations of logic gates Boolean expressions using AND-OR and NAND-NOR logic gates.sequential circuits, flip-flops (RS, JK, D, and T flip-flops), design binary counters and shift registers. A/D and D/A conversion circuits, sampling, quantization, and error analysis. (Ref.7,8)	**14**

References

1. S. M. Sze, *Semiconductor Devices: Physics and Technology*, Wiley
2. Ben G. Streetman, *Solid State Electronic Devices*, Pearson
3. D. Neamen, *Electronic Circuit Analysis and Design*, McGraw-Hill
4. A.S. Sedra and K.C. Smith, *Microelectronic Circuits*, Oxford University Press
5. R. A. Gayakwad, *Op-Amps and Linear Integrated Circuits*, Pearson
6. S. Franco, *Design with Operational Amplifiers and Analog Integrated Circuits*, McGraw-Hill
7. M. Morris Mano, *Digital Logic and Computer Design*, Pearson
8. A. Anand Kumar, *Fundamentals of Digital Circuits*, PHI

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Course Title: Design of Electrical & Electronics Circuits	**Course code:** 24PHY1S1LP
Total Contact Hours: 36	**Course Credits:** 02
Internal Assessment Marks: 20 marks	**Duration of SEE:** 02 hours
Semester End Examination Marks: 30 marks	**L:T:P::1:0:2**

Course Outcomes (COs):

By the end of this course, students will be able to:

1. Understand and apply fundamental principles of electricity and electronics.
2. Design and analyze various electrical circuits, including passive and active components.
3. Utilize modern software tools for circuit simulation and analysis.
4. Gain hands-on experience in building and testing electrical circuits, enhancing problem-solving and practical skills.

SEC1: Design of Electrical & Electronics Circuits (24PHY1S1LP) Unit wise Syllabus

Unit	Description	Hours
1.	**Measurement and Principles of Electricity** Instruments of Measurement: Understanding accuracy, precision, sensitivity, and resolution. Range of measurements, significance of parameters. Errors in Measurements: errors and loading effects. Fundamental Concepts: AC and DC circuits, voltage, current, resistance, capacitance, and inductance. Applications: R, RC, LC, and RLC circuits, passive filters. **Hands-on Sessions:** Analysing circuit configurations and understanding their applications.	**12**
2.	**Electric Motors** Types of Motors: AC and DC motors, working principles, and applications. Basic Design Concepts: construction and functioning of electric motors. Interfacing Techniques: DC or AC sources to control motors. **Hands-on Sessions:** Modelling and controlling a PWM (Pulse Width Modulation) controlled DC motor using Indus coin board.	**12**
3.	**Introduction to Virtual Lab** Open-source Software, introduction to Python, Installation Syntax overview, variables and data types, Basic operations.	**12**

	Open source hardware: ExpEyes Kit, -components, sources, and connectors. **Hands-on Sessions:** Producing sinusoidal waves, V-I characteristic of a diode, Light Dependent Resistors (LDRs), and charging and discharging processes in RC and LCR circuits using ExpEyes Kit.	

Recommended Textbooks and References

1. Floyd, T. L. *Electronic Devices*. Pearson Education.
2. Hayt, W. H., &Kemmerly, J. E. *Engineering Circuit Analysis*. McGraw-Hill.
3. Sen, A. K. *Principles of Electric Machines and Power Electronics*. Wiley.
4. Ghosh, D. &Ghosh, S. *Simulation of Electric and Electronic Circuits*. Springer.
5. S.A.Nasar,Schaum‟soutlineseries *ElectricCircuits*,TataMcGrawHill
6. LabManualpreparedbyIUAC,New Delhi

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Course Title: Atomic, Molecular and Laser Physics Lab	**Course Code:** 24PHY1C3P
Total Contact Hours: 56 Hours	**No. of Credits:** 02
Formative Assessment Marks: 30	**Duration of ESA/Exam:** 4 Hours
Summative Assessment Marks:70	**L:T:P::4:0:0**

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Design experiments to study atomic spectra of atoms.
2. Analyse spectra of molecules.
3. Use laser light to determine properties of light.

DSC3P1:Atomic, Molecular & Optical Physics Lab (24PHY1C3P)

List of Experiments

1. Wavelength of sodium light using Michelson's Interferometer.
2. Determination of doublet separation by using Michelson's Interferometer.
3. Determination of Rydberg constant using diffraction grating and hydrogen discharge tube.
4. Study of absorption spectrum of iodine vapour and determination of force constant.
5. Study of Talbot bands.
6. Constant deviation Spectrometer.
7. Verification of Hartman's formula.
8. Study of Zeeman effect.
9. Study of Stark effect.
10. Analysis of rotational spectrum.
11. Analysis of Vibrational spectrum.
12. Verification of Beer's law.
13. Temporal and spatial coherence of laser light.
14. Wavelength of Laser light by single slit diffraction method.
15. Wavelength of Laser light by double slit interference method.
16. Diffraction halos (Lycopodium powder particle size determination).
17. Ultrasonic velocity in liquids using Spectrometer / spectral shift.

Note:

1. Minimum of EIGHT experiments must be carried out.
2. Experiments may be added as and when required with the approval of BoS.

References:

1. University Practical Physics by D.C. Tayal, Himalaya Publishing House, First Millenium Edition, 2000.
2. Advanced Practical Physics for Students by B.L. Flint and H.T. Worsnop, Asia Publishing House, 1971.
3. A Text Book of Practical Physics, I. Prakash& Ramakrishna, KitabMahal, 11th Edition, 2011.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn,Heinemann Educational Publishers, 4th Edition, 1985.

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Course Title: Electronics Lab	**Course code:** 24PHY1C4P
Total Contact Hours: 56	**Course Credits:** 02
Internal Assessment Marks: 20 marks	**Duration of SEE:** 04 hours
Semester End Examination Marks: 30 marks	**L:T:P::0:0:4**

Course Outcomes (COs)

Upon completing this course, students will be able to:

1. Measure DC/AC voltages and frequencies using a cathode ray oscilloscope.
2. Analyze and evaluate the design of rectifiers and filters for effective signal processing.
3. Design inverting and non-inverting amplifiers and assess their operations & frequency responses.
4. Construct and minimize logic circuits using digital components, including flip-flops and Karnaugh maps.

DSC4P2: Electronics (24PHY2C4P)

List of Experiments

1. Studies on Cathode Ray Oscilloscope: Measure DC/AC voltages and frequencies of sine and square signals; determine unknown frequencies using Lissajous figures.
2. Full-Wave Bridge Rectifier: Using Diodes: Design and study the performance of CR, L, and π-type filters.
3. Study of Bias Configurations for CE Transistor: Analyze fixed bias and voltage divider bias configurations.
4. Study of Astable Multivibrator Using Transistors: Conduct frequency studies.
5. Design of Inverting Amplifier Using Op-Amp (741, 351): Study its mathematical operations.
6. Design of Non-Inverting Amplifier Using Op-Amp (741, 351): Analyze frequency response.
7. Design and Study of Frequency Response of Weinbridge Oscillator Using Op-Amp.
8. Design and Construction of Logic Gates: Create logic gates using diodes and transistors, and verify their truth tables.
9. Construction of Karnaugh Maps: Create Karnaugh maps for three and four variables.
10. Boolean Expressions and Logic Circuits:
    (a) Convert Boolean expressions into logic circuits and design them using logic gate ICs.
    (b) Minimize a given logic circuit.
11. Flip-Flop Design: Design JK & RS flip-flop circuits using IC7412 and study truth tables.
12. Study of A/D and D/A Conversion Circuits.

Note:

1. A minimum of eight experiments must be conducted.
2. Additional experiments may be added as needed, subject to the approval of the BoS.

References:

1. R. Boylestad & L. Nashalsky *Electronic Devices & Circuit Theory*, Pearson, 10th Ed., 2009.
2. A.P. Malvino and D. Leach *Digital Principles and Applications*, TMH, 1991.
3. F. Robert Coughlin and Frederick F. Driscoll *Operational Amplifiers and Linear ICs*.
4. H.H. Willard, L.L. Merrit, J.A. Dean, & F.A. Settle, J.K. Jain *Instrumental Methods of Analysis*(6th Ed.) CBS Publishers, 1986.

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Semester -II

Course Title: Computational Physics	**Course Code:** 24PHY2C5L
Total Contact Hours: 54 Hours	**No. of Credits:** 04
Formative Assessment Marks: 30	**Duration of ESA/Exam:** 03 Hours
Summative Assessment Marks: 70	**L:T:P::4:0:0**

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Write C-Program to simple situations.
2. Solve physical problems using numerical techniques.
3. Apply partial differential equations to physical systems.
4. Explain the basic concepts of probability and statistics.
5. Compute errors in any physical problems and experiments.

DSC5: Computational Physics (24PHY2C5L) Unit wise syllabus

Unit	Description	Hours
1.	**C Programming** Compiler and interpreter, constants and variables, arithmetic expressions, data types, input and output statements, control statements, switch statements,loop statements, format specifications, arrays, algorithms, flowcharts, functions. Simple C programs i) area of a triangle ii) to check the entered letter is an vowel or consonant using switch iii) computing the sum and average of ten numbers using one dimensional arrays iv) to calculate Fibonacci series using while loop v) sorting numbers in ascending and descending order vi) computing the factorial of a number using for loop vii) addition of two matrices using arrays. (Ref. 1 & 2)	14
2.	**Numerical Techniques** Numerical methods. Solutions of algebraic and transcendental equations: Bisection and Newton-Raphson methods. Interpolation: Newton's and Lagrange's methods. Curve fitting: Method of least squares (Linear, Quadratic and Exponential), .Numerical differentiation – Newton's formula, Integration: Trapezodal rule, Simpson's 1/3 and 3/8 rules. Solutionof first order ordinary differential equations: Runge-Kutta methods. (Ref: 3&4).	14

3.	**Partial Differential Equations and applications in Physics** Basic Concepts of PDEs, Modeling: Vibrating String, Wave Equation, Solution by Separating Variables – Discussion of Eigen functions, D'Alembert's Solution of the Wave Equation, Modeling: Heat Flow from a Body in Space - Heat Equation, Heat Equation Solution by Fourier Series -Steady Two-Dimensional Heat Problems, Heat Equation: Modeling Very Long Bars - Solution by Fourier Integrals and Transforms, Laplace's Equation in Cylindrical and Spherical Coordinates. (Ref: 5).	14
4.	**Probability** Introduction, Basic probability theorems, Conditional probability - Theorem, permutations and combinations – Theorems, Random variables – Introduction, Discrete random variables and distributions, Continuous random variables and distributions, mean and variance of a distribution, Transformation of mean and variance, Binomial distribution, Poisson distribution and Normal distribution. (Ref: 5 & 6). **5 Hours** **Mathematical Statistics** Introduction, Concept of random sampling, Point estimation of parameters – Maximum likelihood method, Confidence intervals - Normal distribution with known and unknown σ^2, Chi-square distribution, Central Limit theorem (without proof). (Ref: 5 & 6) **5 Hours** **Experimental measurements and errors** Types and sources of experimental errors, significant digits in measurements, evaluation of errors in derived quantities with more than one variable, propagation of errors, mean and standard deviation, estimation of error, reporting experimental results with error bars. (Ref: 7 & 8). **4 Hours**	14

References:

1. P. B. Kotur, *Computer Concepts & C Programming*Sapna Book House (P) Ltd., Bangalore, 2013.
2. E Balaguruswamy, *Programming in ANSI – C*, 2ndEdition, Tata McGraw Hill, 1992.
3. S.S. Sastry, *Introductory Methods of Numerical Analysis* PHI Learning Pvt. Ltd., 5th Ed., 2019.
4. Mathematical Physics by Satya Prakash, Sultan Chand & Sons, 6th Edition, 2019.

5. Erwin Kreyszig*Advanced Engineering Mathematics*, 10th Ed., John Wiley and Sons, Inc.
6. George Arfken and Hans J.,*Mathematical Methods for Physicist*, Academic press San Diego, 1995
7. Experimental errors and uncertainty, Rochester University notes, Web link: http://www2.ece.rochester.edu/courses/ECE111/error_uncertainty.pdf
8. Introduction to experimental errors, Susan Cartwright, University of Sheffield, weblink: https://www.sheffield.ac.uk/polopoly_fs/1.14221!/file/IntroToExperimentalErrors_y2.pdf

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Course Title: Quantum Mechanics	**Course code:** 24PHY2C6L
Total Contact Hours: 56	**Course Credits:** 04
Internal Assessment Marks: 20 marks	**Duration of SEE:** 03 hours
Semester End Examination Marks: 70 marks	**L:T:P::4:0:0**

Course Outcomes (COs):

Upon completing this course, students will be able to:

1. Develop a strong foundation in quantum mechanics and its experimental background.
2. Solve basic quantum problems like particle motion in potential wells and harmonic oscillators.
3. Grasp the formalism of quantum mechanics, including operators and Dirac notation.
4. Apply approximation methods and representation theory to complex systems and scattering problems.

DSC6: Quantum Mechanics (24PHY2C6L) Unit wise Syllabus

Unit	Description	Hours
1.	**Physical Basis of Quantum Mechanics** Experimental background, inadequacies of classical physics: blackbody radiation, Photoelectric effect and atomic spectra, development of quantum theory: Planck's quantum hypothesis and Bohr's model of the hydrogen atom, Uncertainty and complementarity principle, Correspondence principle, Introduction to the Schrödinger wave equation. interpretation of the wave function, normalization, expectation values, Ehrenfest's theorem. inadequacy of quantum theory.(Ref. 1, 2.)	**14**
2.	**Solvable Eigenvalue Problems** Quantum mechanical problems, one-dimensional potential problems: square well potential: finite and infinite potential well,discrete nature of energy, rectangular step potential: particle encountering a potential step, and barrier potential, harmonic oscillator: Hermite polynomials. three-dimensional case, particle in a box and the hydrogen atom.(Ref. 3, 4)	**14**
3.	**General Formalism** General mathematical framework of quantum mechanics. Hilbert space,	**14**

	observables, and quantum operators, Hermitian and unitary operators. Eigenfunctions and Eigenvalue problem, concept of commuting operators. Introduction to Bra-Ket notation, Dirac formalism. general uncertainty relations and quantum mechanical postulates.(Ref. 5, 6)	
4.	**Representation Theory and Approximation Methods** Introduction to the matrix representation of quantum operators and methods, complex quantum mechanical problems. time-independent perturbation theory, variational method, applying to the anharmonic oscillator, ground state of the helium atom. WKB method and application to barrier penetration.(Ref. 7,8)	**14**

References

1. D.J. Griffiths, *Introduction to Quantum Mechanics*, Pearson
2. P.A.M. Dirac, *The Principles of Quantum Mechanics*, Oxford University Press
3. L.I. Schiff, *Quantum Mechanics*, McGraw-Hill
4. Richard L. Liboff, *Introductory Quantum Mechanics*, Addison-Wesley
5. J.J. Sakurai, *Modern Quantum Mechanics*, Addison-Wesley
6. G Aruldas, *Quantum Mechanics*PHILearningPrivate Ltd.
7. R Shankar, *Principles ofQuantum Mechanics*, Plenum Press
8. V. K. Thankappan, *Quantum Mechanics*, Wiley Eastern,

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Course Title: Condensed Matter Physics	**Course Code:** 24PHY2C7L
Total Contact Hours: 55 Hours	**No. of Credits:** 04
Formative Assessment Marks: 30	**Duration of ESA/Exam:** 03 Hours
Summative Assessment Marks: 70	**L:T:P::4:0:0**

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Explain the fundamental concepts of crystal structure.
2. Apply X-ray diffraction methods and analyze bonding types in solids, including calculating binding energies and understanding crystal structures.
3. Identify different crystal imperfections, describe their impact on material properties, and understand the basics of lattice vibrations and phonons.
4. Explain electrical and thermal conductivity in materials, and understand key concepts in semiconductors and superconductors.

DSC7: Condensed Matter Physics(24PHY2C7L) Unit wise syllabus

Unit	Description	Hours
1	**Crystal Structure** Fundamentals of Crystal structure – Crystal lattice and Translation vectors, Unit Cell, Concept of Weigner-Seitz cell, Basis; Symmetry Operations, Point groups and Space groups, Types of Lattices – Two dimensional and three dimensional lattices; Lattice directions and planes (Miller indices), Interplanar spacing (quantitative), Simple crystal structures – Close-packed structures and Loose-packed structures with examples, Crystal structure of diamond and NaCl. (Ref.1 & 4)	14
2	**X-ray diffraction and Bonding in Solids** Basics of X-ray diffraction, Bragg's treatment- Bragg's law, The Von Laue Treatment – Laue's Equations, X-Ray diffraction methods – The Laue's method, Rotating Crystal method and Powder method; Atomic scattering factor, Geometrical scattering factor, structure factor evaluation for SC, BCC and FCC systems and Extinction rules for cubic crystals. Interatomic forces and types of bonding- Ionic, Covalent, Metallic, Van der Waals and Hydrogen bonds; Binding Energy in ionic	14

	crystals (quantitative), Binding energy of crystals of inert gases. (Ref.1, 2 & 4).	
3	**Imperfections in Crystals and Lattice vibrations** Point imperfections - Schottky and Frenkel defects and their equilibrium concentrations; Line imperfections - Dislocations and their types, Stress fields of dislocations; Planar imperfections - Grain boundary; Colour centres – F Centers and other Centers in alkali halides. (Ref.4 & 5) Vibrations of one dimensional monoatomic and diatomic lattices, Phonons, Momentum of Phonons, Specific heat(qualitative).(Ref.1 & 2)	14
4	**Conductivity in Materials:** **Free Electron Theory of Metals:** Qualitative discussion of Free – Electron Model of Metals; Electrical conductivity(quantitative), Electrical Resistivity versus Temperature, Heat Capacity of Conduction Electrons, Fermi Surface, Electrical Conductivity and Effects of Fermi Surface, Thermal conductivity in Metals. (Ref. 2) **Semiconductors**: Types of semiconductors, Conductivity in intrinsic semiconductors and its variation with temperature, Carrier concentration and Fermi level for intrinsic semiconductors, Hall Effect and its applications (Ref.1 ,3 & 4) **Superconductors:** Meissner effect, Critical field and critical temperature, Type I and Type II superconductors, BCS theory (qualitative), Qualitative discussion on MAGLEV.	14

References:

1. R. K. Puri & V. K. Babbar *Solid State Physics*, S. Chand Publications.
2. M. Ali Omar Elementary *Solid State Physics*, Pearson Education.
3. S .O. Pillai,*Solid State Physics,* New Age International.
4. C. Kittel, *Introduction to Solid State Physics* Wiley Eastern Ltd.
5. J.P Srivastava,*Elements of Solid State Physics*, PHI Learning Pvt. Ltd.

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Course Title: Nuclear Physics	**Course Code:** 24PHY2C8L
Total Contact Hours: 56	**No. of Credits:** 04
Formative Assessment Marks: 30	**Duration of ESA/Exam:** 03 Hours
Summative Assessment Marks: 70	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Explain the basic properties of the nucleus and nuclear forces.
2. Explain fundamental nuclear reactions and nuclear models.
3. Describe nuclear decay types and the fundamental interaction of radiation with matter.
4. Explain the principles and applications of nuclear radiation detectors.
5. Discuss the basics of nuclear energy, fundamental interactions, and elementary particles.

DSC8: Nuclear Physics (24PHY2C8L) Unit wise syllabus

Unit 1	**Basic properties of nucleus** Nuclear constitution. The notion of nuclear radius and its estimation from Rutherford's scattering experiment; the coulomb potential inside the nucleus and the mirror nuclei. The nomenclature of nuclei and nucleon quantum numbers. Nuclear spin and magnetic dipole moment. Nuclear electric moments and shape of the nucleus. **Nuclear forces** General features of nuclear forces. Bound state of deuteron with square well potential, binding energy, and size of deuteron. Deuteron electric and magnetic moments-evidence for non-central nature of nuclear forces. Yukawa's meson theory of nuclear forces.**(Ref. 1,2,5,6)**	14hrs
Unit 2	**Nuclear Reactions** Reaction scheme, types of reactions, and conservation laws. The balance of mass and energy in nuclear reaction: Q-value, and threshold energy. Energetics of exoergic and endoergic reactions. **Nuclear Models** The Shell Model:Introduction, Evidence for magic numbers, energy level, scheme for nuclei with infinite square well potential, the ground state spins, and parity. The Liquid Drop Model: Nuclear Binding Energy, Bethe-Weizsacker's Semi Empirical Mass Formula.**(Ref. 1,2,5,6)**	14hrs
Unit 3	**Nuclear Decays** Alpha decay: Quantum mechanical barrier penetration, Gamow's theory of alpha decay, Half-life systematics. Beta decay: Continuous beta spectrum, Pauli's Neutrino Hypothesis and Fermi's theory of beta decay, Double beta decay, beta comparative half-life systematics. Gamma decay: Qualitative consideration of multipole character of gamma radiation-Selection Rules,	14hrs

	Gamma ray spectra and nuclear energy levels, Nuclear Isomerism, Internal Conversion (Qualitative). **Interaction of Radiation with Matter** Interaction of Charged Particles with Matter, Ionization Energy Loss, Stopping Power and Range Energy Relations for Charged Particles, Interaction of Gamma Rays: Photoelectric Absorption, Compton Scattering, and Pair Production Processes.Nuclear radiation detectors- G M counter and scintillation detector.**(Ref. 1,2,3,5,6)**	
Unit 4	**Nuclear Energy** Fission Process, Fission Chain Reaction, Four Factor Formula and Controlled Fission Chain Reactions, Energetics of Fission Reactions, Fission Reactor. Fusion Process, Energetics of Fusion Reactions, Controlled Thermonuclear Reactions, Fusion Reactor, StellarNucleosynthesis. **Fundamental Interactions and Elementary Particles** Basic fundamental interactions and their characteristic features. Elementary particles, Classification of Elementary particles, Conservation laws in elementary particle decays. Quark model of elementary particles.**(Ref. 2,5,6,7)**	14hrs

References:

1. The Atomic Nucleus: R D Evans, Tata McGraw Hill Edition, 1955.
2. Nuclear Physics: D C Tayal, Himalaya Publishing House, Fifth Edition, 2015.
3. Introduction to Nuclear Physics: S B Patel, New Age International Pvt. Ltd Publishers, Second Edition, 2010.
4. Introductory Nuclear Physics: Kenneth S Krane, John Wiley & Sons, Inc., 1988.
5. Atomic and Nuclear Physics: S N Ghoshal, S. Chand & Company Pvt. Ltd., 2014.
6. Nuclear Physics and Particle Physics by SatyaPrakash, Sultan Chand & Sons., 2005.
7. Modern Physics by R Murugeshan, S Chand & Company Pvt. Ltd., 17th Revised Edi, 2014.

Course Title: Interfacing of Devices	**Course code:** 24PHY2S2LP
Total Contact Hours: 36	**Course Credits:** 02
Internal Assessment Marks: 20 marks	**Duration of SEE:** 02 hours
Semester End Examination Marks: 30 marks	**L:T:P::1:0:2**

Course Outcomes (COs)

By the end of this course, students will be able to:

1. Understand the fundamentals of circuit design, rectifiers, filters, and operational amplifiers.
2. Conduct model-based simulations of electrical and mechanical systems using software.
3. Apply free and open-source tools to simulate and analyze physical systems.
4. Applying AI to solve problems in physics.
5.

SEC2: Interfacing of Devices (24PHY2S2LP) Unit wise Syllabus

Unit	Description	Hours
1.	**Model-Based Simulation of Rectifiers** Review of Physical Devices: Introduction to p-n junction diodes, transistors, and operational amplifiers (Op-amps). Understanding the roles these devices play in circuit design. Rectifier Circuits: Design and simulation of rectifiers, including: Half-wave rectifiers, Full-wave rectifiers, Rectifiers with filters (capacitive and inductive filters) Clipping and Clamping Circuits and their applications in signal processing. (4 h) Hands-on Sessions: Simulation of rectifier circuits. Analysing the performance of rectifiers with filters using ExpEyes on Cell Phone. (8 h)	**12**
2.	**Open-Source Software (FOSS) and Hardware** Introduction to Linux, Installation, Python Libraries for Physics, Interfacing Hardware: PC to CRO Conversion, Model Simulations: Optical Sensors and Radiation Detection using the ExpEyes kit, and building a basic alpha energy spectrometer for radiation detection. (4 h) Hands-on Sessions: Installing and configuring Linux and Python for scientific computing. Python to interface with sensors and perform real-time data collection, Simulation of mechanical and thermal properties using Python and ExpEyes.(8 h)	**12**

3.	**Introduction to Artificial Intelligence in Physics** Foundations of AI: Definition of AI, Machine Learning, and Deep Learning Applications of AI in physics: Basic concepts of algorithms, neural networks, and data processing in AI, AI-driven simulations in classical and quantum physics, AI for solving differential equations and numerical problems, Overview of AI in experimental physics (e.g., particle detection, astronomy) (6 h) Hands-on Training: Introduction to Python and its libraries (NumPy, SciPy, TensorFlow)Basic AI models to predict physical phenomena, Simulating simple physical systems using AI techniques. (6 h)	**12**

References

1. Boylestad, R. &Nashelsky, L. *Electronic Devices and Circuit Theory*. Pearson.
2. Sedra, A. S. & Smith, K. C. *Microelectronic Circuits*. Oxford University Press.
3. Inman, D. J. *Engineering Vibration*. Pearson.
4. Thomson, W. T. *Theory of Vibration with Applications*. Prentice Hall.
5. Downey, A. *Think Python: How to Think Like a Computer Scientist*. O'Reilly.
6. Kumar, A. *Experiments with Python and ExpEYES: A Hands-On Guide*. Open Source Publishing.
7. Melanie Mitchell*Artificial Intelligence: A Guide for Thinking Humans* Farrar, Straus & Giroux, 2019
8. Martin Erdmann*Deep Learning for Physics Research*World Scientific Publishing Co. 2021

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Course Title: Computational Physics Lab	**Course Code:**24PHY2C5P
Total Contact Hours: 56 Hours	**No. of Credits:** 02
Formative Assessment Marks: 30	**Duration of ESA/Exam:** 04 Hours
Summative Assessment Marks: 70	**L:T:P::0:0:4**

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Write a computational program for various numerical techniques.
2. Compute errors in any experimentation.
3. Write a computational program for solution of problems in physics.

DSC5P3: Computational Physics Lab (24PHY2C5P)

List of Computations

1. Solutions of algebraic and transcendental equations: Bisection method.
2. Solutions of algebraic and transcendental equations: Newton-Raphsonmethod.
3. Newton's forward interpolation.
4. Newton's backwardinterpolation.
5. Lagrange's interpolation.
6. Linear least square fitting.
7. Numerical integration by Trapezoidal rule
8. Numerical integration by Simpson's 1/3 rule.
9. Numerical integration by Simpson's 3/8rule.
10. Solution of differential equation by Runge-Kutta Method.
11. Error, Absolute Error, Relative Error and Percentage Error.
12. Programming in C for solution of problems in physics-examples from atomic and molecular physics, nuclear physics, mechanics, electrodynamics, quantum mechanics, solid state physics.

Note:

1. Minimum of EIGHTcomputations must be carried out.
2. Computations may be added as and when required with the approval of BoS.

References:

1. https://www.sanfoundry.com/c-programming-examples-numerical-problems-algorithms/
2. INTRODUCTION TO NUMERICAL ANALYSIS WITH C PROGRAMS by ATTILA M´AT´E, Brooklyn College of the City University of New York, July 2004.

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Course Title: Condensed Matter Physics Lab	**Course Code:** 24PHY2C7P
Total Contact Hours: 56 Hours	**No. of Credits:** 02
Formative Assessment Marks: 30	**Duration of ESA/Exam:** 04 Hours
Summative Assessment Marks: 70	**L:T:P::0:0:4**

Course Outcomes (COs):

At the end of the course, students will be able to:

1.Design experiments to study properties of crystals.

2.Compute parameters of crystalline materials.

3.Design experiments to study electrical and thermal properties of solids.

DSC7P4: Condensed Matter Physics Lab (24PHY2C7P)

List of Experiments

1. Determination of inter-planar spacing using X-ray powder pattern.
2. Analysis of X-ray diffraction pattern.
3. Structure factor determination: Computations.
4. Intensity calculations of X-ray powder pattern: Computations.
5. Fermi energy of metals.
6. Temperature variation of resistivity of a semiconductor: four probe method.
7. Measurement of resistivity of a semiconductor by four probe method (fixed temperature)
8. Energy gap of semiconductor by four probe method.
9. Determination of Debye's temperature of Lead or Tin.
10. Study of Lattice Dynamics.
11. Activation energy of point defects in metals: Experiment/Computation.
12. Acoustic waves in solids – Measurement of Ultrasonic velocity in solids.
13. Magneto-resistance of semiconductors.
14. Study of Hall Effect in semiconductors.
15. Energy gap of PN-junction diode/LED.

Note:

1. Minimum of EIGHTexperiments must be carried out.
2. Experiments may be added as and when required with the approval of BoS.

References:

1. University Practical Physics by D.C. Tayal, Himalaya Publishing House, First Millenium Edition, 2000.
2. Advanced Practical Physics for students by B.L. Flint and H.T. Worsnop, Asia Publishing House, 1971.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, Kitab Mahal, 11^{th} Edition, 2011.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, Heinemann Educational Publishers, 4^{th} Edition, 1985.

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Course Title: Nuclear Physics Lab	**Course Code:** 41PHY2C8P
Total Contact Hours: 56 Hours	**No. of Credits:** 02
Formative Assessment Marks: 30	**Duration of ESA/Exam:** 04 Hours
Summative Assessment Marks: 70	**L:T:P::0:0:4**

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Design experiments to Study the properties of the nucleus.
2. Determine the physical parameters of nuclear radiations/radioactive sources.
3. Compute the half-life of any radioactive materials by various methods.

DSC8P5: Nuclear Physics Lab (24PHY2C8P)

List of Experiments

1. Nuclear counting statistics: Verification of Poisson Distribution.
2. GM Counter characteristics: Determination of Operating voltage.
3. Determination of dead time of GM Counter – single source.
4. Verification of inverse square law for nuclear radiation.
5. Attenuation of β-rays in Aluminium.
6. Attenuation of γ-rays.
7. Half life of K-40.
8. Semi empirical mass formula and binding energy analysis.
9. Nuclear radius calculation.
10. Analysis of β-spectrum and half life systematics.
11, Study of Scintillation Detector (NaI)
12. Gamma-ray spectrum using scintillation detector: multi-channel analysis
13. B-ray spectrum using scintillation detector
14. Study of solar cells

Note:

1. Minimum of EIGHT experiments must be carried out.
2. Experiments may be added as and when required with the approval of BoS.

References:

1. Experiments in Nuclear Science, ORTEC Applications Note. ORTEC (1971).
2. Practical Nucleonics by F. J. Pearson and R. R. Osborne.
3. Experimental Nucleonics by E. Bleuler and G. J. Goldsmith, Rinehart.
4. The Atomic Nucleus by R.D. Evans

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Evaluation Process:

A. Continuous Assessment Scheme (DSC/DSE): Internal

Sl. No.	**Component**	Maximum Marks
01	Two Session Tests with proper record for assessment (10+10 = 20)	20
02	Assessment of Skill development activities/Seminars/Group Discussion etc., with proper record	05
03	Assignment with proper record	05
	TOTAL	**30**

B. a) SEC Courses: Internal

Sl. No.	Component	Maximum Marks
01	One Session written Tests with proper record for assessment	10
02	Practical test with proper record	10
	TOTAL	**20**

b) SEC Courses: SEE (Internal)

Sl. No.	Component	Maximum Marks
01	Circuit Diagram/Ray diagram/Tabular Column with proper labeling and units.	10
02	Skill (proper readings) and result	12
03	Viva voce	08
	TOTAL	**30**

C. Assessment for Practical: Internal

1	Two practical Test with proper record (10+10)	20
2	Record / Journal	10
	Total	**30**

D. GEC Course : Internal

Sl. No.	Component	Maximum Marks
01	Two Session written Tests with proper record (5 + 5)	10
02	Assessment of Skill development activities/Seminars/Group Discussion etc., with proper record	05
	TOTAL	**15**

E. Practical SEE (Duration: 3 Hrs)

No	Component	Maximum Marks
1	Circuit Diagram/Ray diagram/Tabular Column with proper labeling and units.	20
2	Experimental Skill (proper readings)	20
3	Graph/calculations/Result with Accuracy	20
4	Viva	10
	Total Marks	**70**

F. Project Work Assessment during VI semester: Internal

Activities	C1	C2	Total Marks
Review of Literature and Formulation of Research Problem	10	-	**10**
Research Design & Approach	05	-	**05**
Analysis and Findings	-	05	**05**
Pre-submission Presentation	-	10	**10**
Total	**-**		**30**

G. Semester End examination assessment for Project

Activities	Marks
Dissertation/Report	**30**
Presentation	**15**
Viva-Voce	**15**
Novelty of the work *(Fundamental Research, Applied Research, Adding to Existing Knowledge, New Knowledge, Cost effectiveness, Society, Environment)*	**10**
Total	**70**

H. GEC-SEE

CBCS Question Paper pattern for GEC of PG

Paper Code: Paper Title

Time: 1 hour Max Marks: 30

Instruction: Answer all the Sections

Section – A

1. Answer all the following questions, each question carries ONE marks a)
   b)
   c)
   d)
   e)

Section – B

Answer any FIVE of the following question, each question carries TWO marks 2.
3.
4.
5.
6.
7.
8.

Section – C

Answer any THREE of the following questions, each question carries FIVE marks
9.
10.
11.
12.
13.

THEORY EXAMINATION QUESTION PAPER PATTERN FOR DSC/DSE SUBJECTS
(Semesters I –IV)

M.Sc. Degree Examination; 2024-25
(Semester Scheme 2024-25)

SUBJECT: Physics

Course Name: ________________________________ [Course Code]

Time: 3 Hours **Max. Marks: 70**

Instructions to candidates:

1) All sections are compulsory
2) Draw neat and labeled diagrams wherever necessary.

SECTION-A

[1]. Answer **any four** the following questions: **(4×5=20)**

A)
B)
C)
D)
E)
F)

SECTION-B

Answer any **Four** of the following: **(4×10=40)**

[2].
[3].
[4].
[5].
[6].
[7].

SECTION -C

Answer any **Two** of the following: **(2×5=10)**

[8].
[9].
[10].
[11].

Note for paper setters: Set minimum one question from each Unit.

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Department of Studies in Physics

Proceedings of the BoS (Physics) Meeting held on 15.10.2024

The Chairman opened the meeting at 2:30 p.m., on 15.10.2024 welcoming all members and highlighting the significance of finalizing the M.Sc. Physics course code, titles and syllabi along with discussing the evaluation and question paper pattern.

Agenda 1: Finalisation of M.Sc. Physics course title and revise syllabi for 1st and 2nd semesters. Discussions and deliberation were held on Physics Course Titles (1-4th Sem) and Syllabi (1-2nd Sem).

Resolution: With discussion and suggestion of the board, an overall 20% of the syllabi in 1st and 2nd Semester were revised and incorporated. The BoS members approved the changed course code, titles of the Physics subjects (1 – 4th Sem) and Syllabi of 1st and 2nd Semester as annexure-1.

Agenda 2. Evaluation process and Question paper pattern

Resolution: The internal assessment scheme and the Question Paper Pattern of M.Sc. Physics is reviewed and approved.

The Chairman is authorized to make necessary corrections in the title / syllabus with an inform to the BoS members of changes, if any.

The meeting concludes with a vote of thanks proposed by the Chairman in confidence in the successful implementation of the new curriculum.

1.	Khadke Udaykumar Professor VSK University Ballari	Chairman-BoS	[signature]
2.	Dr. Thipperudrappa J. Professor & Chairman VSK University Ballari	Member (Internal)	[signature]
3.	Dr. Basavaraj Angadi Professor Bangalore University Bangalore	Member (External)	[signature]
4.	Dr. Kotresh M. G. Assist. Professor VSK University Ballari	Member (Internal)	[signature]
5.	Dr. Avinash P. Assist. Professor VSK University Ballari	Member (Internal)	[signature]