Department of Physics
University of Kashmir, Srinagar

Summary of the courses for Semester – I

	Course Type	Course Code	Course Name	No. of Credits	Total
Semester – I	**Core (CR) Courses**	PHY14101CR	Mathematical Physics – I	04	**12**
		PHY14102CR	Quantum Mechanics – I	04	
		PHY14103CR	Lab. Course	04	
	Allied Elective (EA) Courses	PHY14104EA	Classical Mechanics	04	**16**
		PHY14105EA	Antenna and Wave Propagation	04	
		PHY14106EA	Methods of Experimental Physics	02	
		PHY14107EA	Physics Education	02	
		PHY14108EA	Introduction to Astronomy	02	
		PHY14109EA	Philosophical foundations of Quantum Mechanics	02	
	Open Elective (OA) Courses	PHY14110OA	Biophysics	02	**02**

Semester I

Mathematical Physics - I

Course No:	**PHY14101CR**	Max. Marks:	100
Duration of Examination: 2:30 Hrs.		External Examination:	80
No. of credits: **04**		Internal Assessment:	20

UNIT – I

Complex functions, Analytic functions, Cauchy - Riemann conditions, Cauchy's Integral Theorem, Multiply connected regions, Singularities, Cauchy's Integral formula, Derivatives, Taylor and Laurent expansion, Analytic continuation, Poles and Branch Points, Calculus of Residues, Residue theorem, Cauchy principal value, Evaluation of Definite Integral using Cauchy's residues.

UNIT – II

The Gamma Function: Definitions, Simple Properties, Factorial and Double factorial, Digamma and Polygamma Functions, Stirling's Series; The Beta Function, Legendre duplication formula.

Partial Differential Equations, Classes and Characteristics, Boundary Conditions, First-order, Separable variables, Solution of linear first-order ODEs; Seperation of variables in cartesian, Spherical Polar and Cylindrical Coordinates.

UNIT – III

Singular points, Solution of Second order Differential Equations using Frobenius Method, Limitations of series approach; Second solution, Linear independence of solutions.

Orthogonal Functions, Self-Adjoint ODEs, Hermitian Operators, Gram–Schmidt Orthogonalization, Orthogonal Polynomials, Completeness of Eigenfunctions.

UNIT – IV

Bessel Functions of First kind, Orthogonality, Neuman Functions, Henkel Functions, Modified Bessel Functions, Spherical Bessel Function; Legendre Function, Orthogonality, Associated Legendre Function, Spherical Harmonics, Hermite Functions; Laguerre Functions.

Text Book:

1. Mathematical Methods for Physicists (6th Ed.), G. B. Arfken and H. J. Weber, Academic Press

Reference Books:

1. Mathematical Methods For Students of Physics and Related Fields, Sadri Hassani, Springer (2009)
2. Mathematical Physics: A Modern Introduction to Its Foundations, Sadri Hassani, Springer (2002)
3. Advanced Engineering Mathematics by Michel D, Greenberg
4. Mathematical Methods for Physics and Engineering (3rd Ed.), Riley, Hobson and Bence, Cambridge
5. Advanced Engineering Mathematics, E Kreyzig (8th Ed.), Wiley
6. Complex Analysis by E. C. Tichmersh
7. Differential Equations by H. J. H. Piagin

Semester I

Quantum Mechanics - I

Course No:	**PHY14102CR**	Max. Marks:	100
Duration of Examination: 2:30 Hrs.		External Examination:	80
No. of credits: **04**		Internal Assessment:	20

UNIT – I

Principle of superposition and uncertainty principle, Operators, Addition and multiplication of operators, Continuous spectrum, Passage to the limiting case of classical mechanics, Wave function and the measurement

Hamiltonian operator, Differentiation of operator with time, Stationary States, Transformation of matrices, Heisenberg representation of operators, Density matrix, Momentum representation and uncertainty relations

UNIT – II

Schrodinger's equation, Fundamental properties, Current density, General Properties of motion in one dimension, Potential well, Linear oscillator, Motion in a homogeneous field, Transmission coefficient and applications

Angular momentum, Eigenvalues and eigenfunctions of angular momentum, Matrix elements of vectors, Parity of a state.

UNIT – III

Addition of angular momentum, Clebsch-Gordon Coefficients, Symmetry Relations of CG coefficients, Evaluation of CG coefficients.
Matrix representation of the rotation operators, CG series, Determination of the rotation matrices, orthogonality and normalization of the rotation matrices.

UNIT – IV

Motion in a centrally symmetric field, Spherical waves, Three dimensional oscillator, Resolution of a plane wave
Fall of a particle to the Centre, Motion in a coulomb field (spherical polar coordinates), Discrete and continuous spectrum, Coulomb problem in parabolic coordinate system

Text Books:

1. L. D. Landau and E. M. Lifshitz , Quantum Mechanics, Pergamon Press
2. M.E. Rose. Elementary theory of Angular Momentum.

Reference Books:

1. R. Liboff: Quantum mechanics

2. R.S. Shankar: Quantum mechanics
3. David Bohm: Quantum Mechanics.

Semester I

Lab. Course

Course No: **PHY14103CR**	Max. Marks: 100
Duration of Examination: 2:30 Hrs.	External Examination: 50
No. of credits: **04**	Internal Assessment: 50

Description

There shall be about 20 experiments available in the lab out of which the student shall have to complete at least 06 experiments in this semester.

The list of experiments presently available is as follows:

- To determine the wave length of a laser with a diffraction grating.
- To determine the energy gap of a semiconductor using Four probe method.
- To determine the curie temperature of an electrical material BaTio3
- To determine the dead time and absorption Co-efficient using G.M. Counter.
- ESR: Electron Spin Resonance.
- To determine the velocity of ultrasound in a given liquid medium (kerosene)
- To determine the Hall coefficient for a semiconductor sample.
- Designing and studying RC filters Active and Passive.
- To Determination of e/m ratio of electron by J.J. Thomson's method.
- To Determination of e/m ratio of electron by Helical method
- To determine the velocity of sound using Lissajous figures.
- Determination of Plank's constant using Photoelectric Effect.
- Antenna measurements
- Michelson Interferometer
- Fabry-Perot Interferometer
- Study of Regulated Power Supply
- Study sinusoidal steady-state response of a resonant circuit in the phasor domain.
- To determine the characteristics of a Solar Cell.
- Study Digital Fiber Optical Transmitter and Receiver.
- Fast Fourier Transform (FFT) in Excel

Semester I

Classical Mechanics

Course No:	**PHY14104EA**	Max. Marks:	100
Duration of Examination: 2:30 Hrs.		External Examination:	80
No. of credits: **04**		Internal Assessment:	20

UNIT – I

The Lagrangian Approach to Mechanics: degrees of freedom, constraints and generalized coordinates, virtual displacement, virtual work and generalized force, d'Alembert's principle and the generalized equation of motion, the Lagrangian and the Euler Lagrange equation of motion, the Hamiltonian, cyclic coordinates and canonical momenta, applications; double pendulum, spherical pendulum, particle in electromagnetic field.

UNIT – II

Variational calculus and Hamiltonian dynamics: the variational calculus and the Euler equation, the principle of least action and the Euler Lagrange equation, constraints in variational dynamics.

Hamiltonian dynamics: Legendre transformations, Hamilton's equations, conservation laws, phase space and Liouville's theorem.

UNIT – III

Theoretical Mechanics: canonical transformations and generating functions, symplectic notation, Poisson Brackets (PB); the angular momentum PB relations, invariance of PBs under canonical transformations, action-angle variables and adiabatic invariance, the Hamilton Jacobi (HJ) Equation; HJ equation for Hamilton's characteristic function, separation of variables, particle motion under central force.

UNIT – IV

Oscillations: the simple harmonic oscillator; the damped harmonic oscillator, the damped simple and damped harmonic oscillator, coupled simple harmonic oscillators; couple pendulum, general method of solution.

Lagrangian and Hamiltonian of continuous systems: transition from discrete to continuous systems, the Hamiltonian formulation, Noether's theorem

Text Books:

1. Classical Mechanics by Goldstein, Poole and Safko (Pearson Education).
2. Mechanics by Landau and Lifshitz

Reference Books:

1. Analytical Mechanics by L. N. Hand and J. D. Finch (Cambridge University Press)

Semester I

Antenna and Wave Propagation

Course No:	**PHY14105EA**	Max. Marks:	100
Duration of Examination: 2:30 Hrs.		External Examination:	80
No. of credits: **04**		Internal Assessment:	20

UNIT – I

Antenna Fundamentals and Definitions: Radiation mechanism - over view, Electromagnetic Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Radiation Patterns, Directivity and Gain, Antenna Impedance, Radiation Efficiency. Antenna Polarization Resonant Antennas: Wires and Patches, Dipole antennas, Yagi - Uda Antennas, Micro strip Antenna

UNIT – II

Arrays: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited - equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques, perspective on arrays. Broad band Antennas: Traveling-wave antennas, Helical antennas, Biconical antennas; Principles of frequency - independent Antennas, spiral antennas, and Log - Periodic Antennas

UNIT – III

Aperture Antennas: Techniques for evaluating Gain, reflector antennas - Parabolic reflector antenna principles, Axi -symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model, feed antennas used in practice

UNIT – IV

INTELSAT Series, INSAT, VSAT, Remote sensing, Mobile satellite service: GSM. GPS, INMARSAT, Satellite Navigation System, Direct to Home service (DTH), Special services, E-mail, Video conferencing and Internet connectivity

Text Books:

1. Antenna Hand book by J. D. Kraus

Reference Books:

1. Bruce R. Elbert," The Satellite Communication Applications Hand Book, Artech House Boston, 1997

2. Stutzman and Thiele, "Antenna Theory and Design", 2ndEd, John Wiley and Sons nc
3. C. A. Balanis: "Antenna Theory Analysis and Design", John Wiley, 2nd Edition, 1997

Semester I

Methods of Experimental Physics

Course No:	**PHY14106EA**	Max. Marks:	50
Duration of Examination: 1:30 Hrs.		External Examination:	40
No. of credits: **02**		Internal Assessment:	10

UNIT – I

Familiarization: The Electricity & Electronics, Prototype Board,, Discrete components; Resistors, capacitors, transistors, etc.
Analogue or digital Power components; Thyristors and power transistors. Electronic Instruments, CRO, Electronic Measurement using CRO, multimeter, power supplies**,** Function Generators. Digital oscilloscope as a measuring instrument through experiments looking at the output of a signal generator.
Studying Miscellaneous semiconductor devices: Photodiode; LED; LDR, SCR; Uni-junction transistor (UJT).

UNIT – II

Laboratory Procedures and Reports, Transistor Switching Circuits, Operational Amplifier Circuits Unregulated and Regulated Power Supply: Three Terminal IC regulators; Plots ,Curve-Fitting, and Data Modeling in Excel:

Text Books:

1. Experimental Physics: Modern Methods by R A Dunlap
2. An Advanced Course in Practical Physics, D. Chattopadhyay and P.C. Rakshit.
3. Procedures in Experimental Physics by John Strong.

References Books:

1. Methods in Experimental Physics Academic Press
2. An Introduction to Experimental Physics by Colin Cooke

Course content:

The course treats the experimental methods in physics and contains a theoretical and an experimental part. Because of the importance of electronic instrumentation in today's physics experiments. The use of digital , analog

computer instrumentation will be dealt through experiments. The handling and analysis of data will be done using microsft Excel.

Forms of examination:

The student's knowledge will be tested by a written and/or oral exam in combination with written and/or oral presentations of the laboratory exercises.

Semester I

Physics Education

Course No:	**PHY14107EA**	Max. Marks:	50
Duration of Examination: 1:30 Hrs.		External Examination:	40
No. of credits:	02	Internal Assessment:	10

UNIT – I

Basic aim of Physics Education,
Physics Education through master texts: ideas of communicating physics.
Physics Education through Experimentation: understanding physics through our day-to-day observations.
Physics Education through Problem Solving: physics understanding through curiosity.

UNIT – II

Physics Education through master awareness and misconceptions: Going through daily life physics and its interpretation.
Physics Education through proto-research: solving problems of physics related to human life.
Physics Education through Qualitative Overview:

Reference Book.

1. A cultural history of physics by Karoli Simonyi, CRC Press.

Semester I

Introduction to Astronomy

Course No:	**PHY14108EA**	Max. Marks:	50
Duration of Examination: 1:30 Hrs.		External Examination:	40
No. of credits: **02**		Internal Assessment:	10

UNIT – I

Celestial Sphere and Time; Constellations and nomenclature of stars. The cardinal points and circles on the celestial sphere. Equatorial, ecliptic and galactic system of co-ordinates. Spherical triangle and related problems. Aspects of sky from different places on the earth. Twilight, Seasons, Sidereal. Apparent and Mean solar time and their relations. Equation of time. Ephemeris and Atomic Times. Calendar. Julian date and heliocentric correction.

UNIT – II

Stellar Distances and Magnitudes; Distances of stars from the trigonometric, statistical and moving cluster parallax. Stellar motions. Magnitude scale and magnitude systems. Atmospheric extinction. Absolute magnitudes and distance modulus. Stellar Classification, H-R Diagram, Black-body approximation to the continuous radiation and temperatures of stars. Variable stars as distance indicators.

Text Books.

2. W.M.Smart: Text book of Spherical Astronomy
3. K.D.Abhyankar: Astrophysics: Stars and Galaxies.Tata McGraw Hill Publication

Reference Books:

1. A.E.Roy: Orbital Motion.
2. McCusky: Introduction to Celestial Mechanics
3. G.Abell: Exploration of the Universe.
4. A. Unsold: New Cosmos. Baidyanath Basu: Introduction to Astrophysics.
5. Baidyanath Basic: Introduction to Physics

Semester I

Philosophical foundations of Quantum Mechanics

Course No: **PHY14109EA**	Max. Marks:	50
Duration of Examination: 1:30 Hrs.	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Formalism and Interpretations , Early Semiclassical Interpretations , The conceptual situation in 1926/ 1927 . Schrodinger's electromagnetic interpretation , Hydrodynamic interpretations ,Born's original probabilistic interpretation ,De Broglie's double-solution interpretation ,Later semiclassical interpretations , The Indeterminacy Relations , The early history of the indeterminacy relations , Heisenberg's reasoning , Subsequent derivations of the indeterminacy relations , Philosophical implications , Later developments , Early Versions of the Complementarity Interpretation , Bohr's Como lecture , Critical remarks , "Parallel" and "circular" complementarity , Historical precedents

UNIT – II

The Bohr-Einstein Debate , The Fifth Solvay Congress , Early discussions between Bohr and Einstein

The Sixth Solvay Congress , Later discussions on the photon-box experiment , and the time-energy relation , Some evaluations of the Bohr-Einstein debate ,The Incompleteness Objection and Later Versions of the Complementarity Interpretation, The interactionality conception of microphysical attributes , The prehistory of the EPR argument , The EPR incompleteness argument ,Early reactions to the EPR argument , The relational conception of quantum states , Mathematical elaborations , Further reactions to the EPR argument , The acceptance of the complementarity interpretation , Hidden-Variable Theories .

Text Books.

4. Max Jammer: The Philosophy of Quantum Mechanics; The interpretation of Quantum Mechanics in historical perspective.

Reference Books:

6. Michael Redhead: *Incompleteness, Nonlocality, and Realism: A Prolegomenon to the Philosophy of Quantum Mechanics*
7. A. Patrick., S. J Heelan: *Quantum Mechanics and Objectivity: A Study of the Physical Philosophy of Werner Heisenberg*

   Michel Bitbol: *Schrödinger's Philosophy of Quantum Mechanics*

Semester I

Biophysics

Course No: **PHY14110OA**	Max. Marks:	50
Duration of Examination: 1:30 Hrs.	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Radiological Physics

Properties of Electromagnetic Radiation, Radiation Units, Exposure and Dose, Dose equivalent Unit, Particle flux, X Rays and Gamma Rays, their interaction with matter, Photoelectric and Compton effect, Ion pair production, Principles of Radiation detection and measurements, General requirement of dosimeters, Telegamma Unit (Cobalt Unit), Radio Isotopes in Biology, Agriculture plant breeding, soil plant relationship and plant physiology, Medicine and diagnosis.

UNIT – II

Radiation Safety measures

Natural and manmade Radiation exposure or principle of Dose Equivalent limit (DEL), Maximum permissible Dose (MPD), Evaluation of External and internal Radiation hazards, Radiation protection measures in Industrial establishment, Radio Isotope labs, Diagnostics and therapeutic installations during transportation of Radioactive substances, Disposal of Radioactive waste, Administrative and Legislative aspect of Radiation protection

Text Books:

1. Casarett A.P. (1968), Radiation Biology, Prentice-hall Inc.
2. Clause W.D. (1958), Radiation Biology and Medicine, Addison- Wesley.
3. Grosch D.S. (1979), Biological effects of Radiation, Academic Press.
4. Howard L. A. (1974), Radiation Biophysics, Prentice Hall Inc.

References Books:

1. Knoll G.E.(1979), Radiation detection and measurement, John Wiley and sons.