POST GRADUATE DEPARTMENT OF PHYSICS
UNIVERSITY OF KASHMIR, SRINAGAR - 190 006

Course Curriculum (Syllabus for Examination)

Semester - I

For the academic years

2018, 2019 and 2020

Semester - I			
Type of Course	**Course Code**	**Title of Course**	**No. of Credits**
Core (CR)	PHY18101CR	Mathematical Physics - I	04
	PHY18102CR	Quantum Mechanics - I	04
	PHY18103CR	Lab. Course	04
Discipline Centric Electives (DCE)	PHY18104DCE	Classical Mechanics	04
	PHY18105DCE	Antenna and Wave Propagation	04
	PHY18106DCE	Electronics	04
Generic Electives (GE)	PHY18107GE	Introduction to Astronomy	02
	PHY18108GE	Environmental Physics	02
Open Electives (OE)	PHY18109OE	Biophysics	02

PHY18101CR **Mathematical Physics - I**

No. of Credits: **04** Max. Marks: **100**

Internal Assessment: **20** External Examination: **80**

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. Infinite series, Convergence tests, Riemann Zeta Functions, Dirac Delta function and its properties

Unit - III

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

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 Books:

1. Mathematical Methods for Physicists (7th Ed.), G. B. Arfken and H. J. Weber and F. E. Harris (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 (2009)

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

PHY18102CR **Quantum Mechanics - I**

No. of Credits: **04** Max. Marks: **100**

Internal Assessment: **20** External Examination: **80**

Unit - I

The Double-Slit Experiment and Stern-Gerlach Experiment. Linear Vector Spaces, Inner Product Spaces and the Dirac Notation. Linear Operators, Matrix Elements of Linear Operators, Active and Passive Transformations, The Eigenvalue Problem, Functions of Operators and Related Concepts, Generalization to Infinite Dimensions. Uncertainity 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. Symmetries and Their Consequences. Parity and time reversal invariance.

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. R. Shankar, Principles of Quantum Mechanics

2. J. J. Sakurai, Modern Quantum Mechanics

Reference Books:

1. L. D. Landau and E. M. Lifshitz , Quantum Mechanics, Pergamon Press

2. K. Gotrified: Quantum Mechanics

PHY18103CR **Lab. Course**

No. of Credits: **04** Max. Marks: **100**

Internal Assessment: **50** External Examination: **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.

List of Experiments

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

PHY18104DCE **Classical Mechanics**

No. of Credits: **04** Max. Marks: **100**

Internal Assessment: **20** External Examination: **80**

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.

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)

PHY18105DCE **Antenna and Wave Propagation**

No. of Credits: **04** Max. Marks: **100**

Internal Assessment: **20** External Examination: **80**

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 Handbook by J. D. Kraus

Reference Books:

1. Bruce R. Albert, The Satellite Communication Applications Handbook, Artech House, Boston, 1997

2. Stutzman and Thiele, Antenna Theory and Design, 2nd Ed. John Wiley and Sons. Inc.

3. C. A. Balanis,Antenna Theory Analysis and Design, 2nd Ed. John Wiley

PHY18106DCE **Electronics**

No. of Credits: **04** Max. Marks: **100**

Internal Assessment: **20** External Examination: **80**

Unit - I

Classification of solids based on energy band theory, Mobility and conductivity, Intrinsic Semiconductors Electrons and Holes in the semiconductors. Extrinsic semiconductors – Donor and Acceptor impurities, PN junction – Open circuited, PN junction Diode – Reverse and Forward bias, VI characteristics, Current components in PN diode-Diode current, Reverse saturation current, Majority carrier current components, Current Equations – Diffusion and Drift current, Switching Characteristics of PN Diode.

Unit - II

BJT: Transistor fundamentals, Transistor configuration, Dc operating point, BJT Characteristics and parameters, fixed bias,emitter bias with and without emitter resistance, variation of operating point and its stability.

JFET: Basic structure and operation of JFET, calculation of pinch off voltage, volt-ampere characteristics of JFET, the FET small signal model, FET Biasing, FET as a voltage variable resistor (VVR). MOS structure – MOSFET working – MOSFET characteristics – width of depletion region –junction capacitance-threshold voltage.

Unit - III

Block diagram of an operational amplifier – Characteristics of an ideal operational amplifier – comparison with 741 – Operational amplifier as a open loop amplifier - Limitations of open loop configuration – Operational amplifier as a feedback amplifier: closed loop gain, input impedance, output impedance of inverting and non-inverting amplifiers - Voltage follower - Differential amplifier: voltage gain. Applications of op-amp: Linear applications – Phase and frequency response of low pass, high pass and band pass filters(first order), summing amplifier – inverting and non-inverting configurations, subtractor, difference summing amplifier, ideal and practical Differentiator, Integrator.

Unit - IV

Metal semiconductor contacts – ohmic and Schottky contacts., Zener diode , Varactor diode, working principles, characteristics and applications of unijunction transistor (UJT), Silicon control rectifier(SCR): basic structure, modes of operation, Silicon Controlled Rectifier Characteristics,

Principle of operation of photoelectronic devices: photoconductor – efficiency, current gain, response time. Effect of light on I-V characteristics of a junction photo device,principle and working of a photodiode, Light emitting devices, principle , working and factors affecting the efficiency of LED, Solar cell: Working Principle of Solar Cell, Characteristics of a Solar Cell and Parameters of a Solar Cell.

Text Books:

1. Donald A Neaman, "Semiconductor Physics and Devices", Third Edition, Tata Mc Graw Hill Inc., 2007.

Reference Books:

1. Semiconductor Devices Physics and Technology, S M Sze, (2007), John Wiley and Sons Inc. Asia.Solid State Electronic Devices, Ben G Streetman, Sanjay Banerjee, (Fifth edition, 2000), Pearson Education, Asia.
2. Semiconductor Optoelectronic Devices, Pallab Bhattacharya, (Second Edition, 1997), Pearson education, Asia.
3. The art of electronics, Paul Horowitz and Winfield Hill, (Second Edition, 1992), Foundation Books, New Delhi.
4. Electronic Principles, A P Malvino, (Sixth Edition, 1999), Tata McGraw Hill, New Delhi.
5. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, (Third Edition, 2004), Eastern Economy Editio

PHY18107GE **Introduction to Astronomy**

No. of Credits: **02** Max. Marks: **50**

Internal Assessment: **10** External Examination: **40**

Unit - I

Geometry of the sphere; Celestial Sphere , The cardinal points and circles on the celestial sphere.The alt-azimuth ,equatorial, ecliptic and galactic coordinate systems; Spherical triangle, Twilight, Seasons, Sidereal, Apparent and Mean solar time and their relations, Equation of time, Ephemeris and Atomic Times, Constellations and nomenclature of stars.

Unit - II

Stellar Distances and Magnitudes; Distances of stars by trigonometric parallax method, 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:

1. W. M. Smart, Textbook of Spherical Astronomy
2. 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. Abhell, Exploration of the Universe
4. A. Unsold, New Cosmos
5. Baidyanath Basu, Introduction to astrophysics

PHY18108GE **Environmental Physics**

No. of Credits: **02** Max. Marks: **50**

Internal Assessment: **10** External Examination: **40**

Unit - I

These subjects include among other; Natural background radiation, radon, the benefits and risks related to radioactive sources and radioactive pollution, the use of ionizing radiation in medicine and research, nuclear power, fusion, fission, biological consequences of ionizing radiation, radiation induced cancer;

Unit - II

Production and destruction of ozone and the ozone layer, the development of the ozone hole, UV radiation, measurements of ozone and UV radiation, biological effects related to too much and too little UV-exposure, D-vitamin deficiency, skin cancer; The atmosphere and its composition, the greenhouse effect, the role of the greenhouse effect for life on earth,
green house gasses, the variations in the global green house effect and its consequences.

Text Books:

1. Radon in the environment by M. Wilkening, Elsevier Publishing Co.
2. Radon Prevalence, measurement , health risks and control byNiren Laxmichand, Nagda Astm Manual Series, Mnl 5 (1994)
3. Nigel Mason and Peter Hughes: Introduction to Environmental Physics: Planet Earth, Life and Climate, Taylor and Francis, 2001

PHY18109OE **Biophysics**

No. of Credits: **02** Max. Marks: **50**

Internal Assessment: **10** External Examination: **40**

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.

Reference Books:

1. Knoll G. E., Radiation Detection and Measurement, John Wiley and Sons