Revised Syllabus to be implemented from 2015-16 Choice Based Credit System (CBCS) …

M.Sc.Part -I,

SEMESTER- I

Paper 1 (Core- 1) 1T1, Mathematical Physics:

Learning Outcomes:

- **Mathematical physics is** the field as the application of mathematics to problems in physics and the development of mathematical methods suitable for such applications and for the formulation of physical theories
- It includes matrices which are used in physics related application Matrices are applied in the study of electrical circuits, quantum mechanics, and optics; it is used for solving Kirchhoff's laws of current and voltage.
- Fourier series simplify the analysis of periodic, real valued functions. Specifically, it can break up a periodic function into an infinite series of sine and cosine waves. This property makes Fourier series very useful in many applications. Fourier transform of a signal tells you what frequencies are present in your signal and in what proportions.
- Bessel functions are used in Acoustics (such as drum or other membrane of phone), Signal processing, heat conduction, cylindrical waveguide. Laguerre polynomials are used to solve Laguerre equations.
- Laplace transforms are useful for solving electrical circuit problems.

Paper 2 (Core 2) 1T2, Complex Analysis and Numerical Methods:

Learning Outcomes:

- Paper includes two parts i.e Complex analysis and Numerical techniques. Complex analysis has great applications not only in mathematics but in electrical engineering, fluid dynamics, in conformal mapping to solve boundary value problems, in control theory, field theory and in wave guide study. One can solve real integrals using complex analysis without tedious calculations.
- Numerical method to solve a problem gives an easy to use method that gives a quick result as compared to the analytic methods. Numerical methods are useful to solve the problems where analytic methods fail.

Semester I Paper 3 (Core 3) 1T3 Electronics:

Learning Outcomes:

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

- Understand the basic concepts, mainly characteristic curves and physics of p-n junction of different solid state electronics devices:
    a) Special purpose diodes- Schottky, Tunnel and MOS diodes
    b) BJT, JFET, MOSFET
    c) UJT, SCR
    d) Opto-electronic devices: Photodiodes, Solar cells, LED, LCD and Photo transistor
    e) Some processes for manufacturing ICs: diffusion of impurities in Silicon, growth of oxides

- Use the semiconductor devices in linear and digital circuits:
    a) Use of zener diode to make a regulated dc power supply
    b) Making amplifier circuits using BJT, JFET and MOSFETs
    c) Cascading of amplifier stages to increase the gain of the amplifier using RC coupling, transformer coupling and direct coupling
    d) Understand the concept of negative feedback in amplifiers: voltage [series, shunt], current [series, shunt]
    e) Use of positive feedback to understand the working of different oscillator circuits like Phase shift oscillators, Hartley, Colpitts, and Crystal control oscillator circuits
    f) Cutting the unwanted signal by using clippers and to raise or decrease the signal voltage level by clampers
    g) How to use the transistor as a switch and understand the universal TTL and Complimentary MOS gates

- Understand the digital integrated circuits:

a) Understand the basic working of different logic gates and laws of Boolean algebra, De Morgan theorem, NOR & NAND logic for simplification of circuits. Understand and design different controlling circuits used in digital electronics
b) Use of transistor as multivibrators
c) Analyze the relationship between analogue and digital circuits.
d) Understand different digital storage devices, memory, and their classification with expansion.
e) Understand and describe 8085 microprocessor
f) Analyze the different parameters of OP-AMP
g) Understand the applications of OP-AMP for positive and negative feedback concept

- Understand the basics of electronics communication and types of communication
  a) Describe different propagation modes of signals
  b) Understand the concept of digital communication
  c) Understand fiber optics communication system and concept of modern communication system
  d) Understand the working of different microwave oscillators, resonators and standing wave detector

Paper 4 (Core 4) 1T4, Electrodynamics-I:

Learning Outcomes

On completion of the course the student shall be able to:

- Apply vector calculus to static electric-magnetic fields in different situations.
- Formulate potential problems within electrostatics, magnetostatics and stationary current distributions in linear, isotropic media.
- Interpret the deeper meaning of the Maxwellian field equations and account for their symmetry and transformation properties.
- Define and derive expressions for the energy both for the electrostatic and magneto statics fields, interpret Poyntings theorem derived from Maxwell's equations.
- To make a detailed account for gauge transformations and their use.

SEMESTER- II

Paper 5 (Core 5) 2T1, Quantum Mechanics I:

Learning Outcomes:

- The students can gain the knowledge of the time-dependent and time-independent Schrödinger equation for simple potentials like, the harmonic oscillator and hydrogen like atoms.
- Students will understand the central concepts and principles in quantum mechanics, such as the Schrödinger equation, the wave function and its statistical interpretation, the uncertainty principle,
- Students will be able to solve the Schrödinger equation on their own for simple systems in one to three dimensions. Also they will be able to use these solutions to calculate their time evolution, associated probabilities, expectation values, and uncertainties.
- Students will have mastered the concepts of angular momentum and spin, as well as the rules for quantization
- Identify and relate the Eigen value problems for energy, momentum, angular momentum and central potentials and explain the idea of spin.

Paper 6 (Core 6) 2T2 Statistical Physics:

Learning Outcomes:

- The students are able explain fundamentals of statistical physics and thermodynamics as logical consequences of the postulates. The students able to elaborate the BE, FD and BE statistics.
- Able to explain Fermi function, Fermi energy, ideal Fermi gas at absolute zero and below Fermi temperature, Fermionic condensation and fermions in metals.
- The students can understand and explain the importance of Phase transition of first and second order, Landau theory of phase transition, Ising model, Brownian motion, Langevin theory, Fokker-Planck equation. Weiss theory of ferromagnetism.

Paper 7 (Core 7) 2T3 Classical Mechanics:

Learning Outcomes:

- The students will be able to understand and describe mechanics of a particle, and the motion of a mechanical system using Lagrange-Hamilton formalism.
- Able to describe conservation theorems and symmetry properties, Hamiltonian formalism, conservation laws, Poisson theorems and Hamilton-Jacobi theory.
- Able to describe and understand planar and spatial motion of a rigid body, two body collisions, Rutherford scattering in laboratory and centre-of-mass frames
- The students are able to explain Rigid body dynamics, Euler's angles, Euler's theorem, moment of inertia tensor, eigen values, Periodic motion, oscillations.

Paper 8 (Core 8), 2T4 Electrodynamics II:

Learning Outcomes:

- Examine the phenomena of wave propagation in different media and its interfaces and applications.
- Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.
- Calculate the electromagnetic radiation from localised charges which move arbitrarily in time and space, taking into account retardation effects.
- Formulate and solve electrodynamic problems in relativistically covariant form in four-dimensional space time.

M.Sc.Part -II,

SEMESTER- III

Paper 9 (Core 9) 3T1 Quantum Mechanics II:

Learning Outcomes:

Quantum mechanics (QM) is important because

- It plays a fundamental role in explaining how the world works. It is almost essentials part of our Modern Life.
- QM governs the behavior of microscopic systems that is it governs the behavior of all physical systems, regardless of their size.
- QM tells us a lot about the structure of reality that is all physical systems exist in multiple versions. Information can flow in the multiverse in ways that can't happen in classical physics, such as single particle interference and entanglement.
- QM is also important for the theory of computation. According to QM it is possible to build a universal quantum computer that can simulate any physical system. This means we can test theories about physical systems by simulating them and then checking the results of the simulations against reality.
- It is successful in explaining microscopic phenomenon in all branches of Physics

Quantum mechanics (QM) has several potentials applications as bellow

- Most electronic devices use quantum effects or require QM to understand their properties in order to make rational design considerations.
- Used in Electron Microscope, MRI Scanner, STM, Atomic Clocks, Lasers and telecommunications etc.
- Have the applications in Computers and Smart-phones, GPS, X rays, etc.

Paper 10 (Core 10) 3T2 Solid State Physics and Spectroscopy:

Learning Outcomes:

- The syllabus covers crystal arrangement, parameter determination and its defects in first two units. Over all study is gate way to research in material science. And last two units' covers study of atomic and molecular spectra al so including NMR and ESR. The quantum study of microscopic bodies and interaction of light to matter covers in this syllabus.

Paper 11 (Core Elective E1.1) 3T3 Materials Science I:

Learning Outcomes:

- Materials science is a branch of Physics which with properties & characteristics of materials Developments of new materials and their applications. It is an applied branch of Physics and has got tremendous potential for job as researcher and as technician.

Paper 11 (Core Elective E1.4) 3T3 Atomic and Molecular Physics I:

Learning Outcomes:

On completion of the course, the student shall have advanced knowledge of modern atomic and molecular physics including quantum mechanical computational techniques in order to:-

- Master both experimental and theoretical working methods in atomic and molecular physics for making correct evaluation and judgments.
- Developing analytical, laboratory and computing skills through problem solving, laboratory & computer based exercises which involve the applications of atomic and molecular physics.
- Carry out experimental and theoretical studies on atomic and molecular physics with focus on structure & dynamics of atoms and molecules.
- Account for theoretical models, terminology & working methods used in atomic and molecular physics.
- To successfully apply the theoretical techniques presented in course to practical problems.

(Subject Centric Core Course S1.2) 3T4 Nanoscience and Nanotechnology:

Learning Outcomes:

- Nanoscience and Nanotechnology are now become the buzz words all over the world.
- Nanoscience is related to synthesis and characterization of nanomaterials. The use of nanomaterials is gaining impetus in the present century as they possess defined chemical, optical and mechanical properties.

SEMESTER IV

Paper 13 (Core 11) 4T1 Nuclear and Particle Physics:

Learning Outcomes:

- The core paper Nuclear & Particle Physics deals with the detailed study of the structure and energetic of atom and the nucleus viz. protons and neutrons. In order to study the properties of a material, one should be familiar with the properties of atom of that material. Nuclear physics solved the fundamental puzzle of the existence of strong nuclear force. Nuclear and particle Physics include various interesting branches such as radioactivity, fission and fusion reactions nuclear reactors, nuclear power plants, particle physics etc. that has huge applications for the benefits of society.

IV Paper 14 (Core 12) 4T2 Solid State Physics:

Learning Outcomes:

- The student will understand the band formation in solids by using different models along with electron behavior in solid. Also gain knowledge of magnetic properties of materials.
- The student will able to understand and explain interaction of lattice in solids through different theories and temperature effect on solids.
- Students Able to elaborate electron in potential wells, degeneracy state, density of states, thermal and electrical conductivity of metals, and thermoelectric power.
- The students will know Semiconductor properties and carrier concentration, effect of temperature on mobility, electrical conductivity and Hall Effect in conductors and semiconductors.
- Students able to understand and elaborate superconductors, types along with their properties and applications.

Paper 15 (Core Elective E2.1) 4T3 Materials Science II:

Learning Outcomes:

- The students will know the Mechanical response of Materials under applied load such as elastic response, stress-strain curve, viscoelasticity, Plastic deformation.
- Students able to understand and explain Corrosion and degradation of materials and corrosion inhibition. Also the Spintronics and Photonics properties of materials.
- The students will understand the synthesis and processing of materials for better applications.
- Students will able to explain the importance of microscopic study of material with different experimental techniques.

Paper 15 (Core Elective E2.4) 4T3 Atomic and Molecular Physics II:

Learning Outcomes:

After completion of course the student should be able to:

- Describe in oral and written form the observations in atomic and molecular physics which led to the modern quantum physics.
- Motivate the necessity of using quantum mechanics calculations for describing atomic and molecular processes.
- Explain how signatures of the quantum physics are seen in atomic- and molecular physics experiments.
- Understand the basic concepts of most of the commercially available lasers.
- To design experimental setups in order to characterize a laser in the time or the frequency domain.
- Know the basic principles of nonlinear optics.
- Carry out numerical calculations of simpler processer for free atoms and molecules and their interactions with electric and magnetic fields.
- Read and understand the literature on a subject not developed during the lecture but related tolaser Optogalvanic spectroscopy or applications of lasers, fluorescence spectroscopy and Microwave Spectroscopy.
- Describe, in oral and written form, and analyze example of experiments which could answer a given scientific question within the basic atomic and molecular physics.

(Subject Centric Core Course S 2.2) 4T4 Experimental Techniques in Physics:

Learning Outcomes:

- Physics is an exact science and its real home is laboratory .The test of the all knowledge is experiment. Experiment is the soul judge of scientific truth. The real understanding of physics cannot be acquired without lab experience. The purpose of this paper is to introduce the basic knowledge of instruments (recent technology) used for structural, optical, mechanical, electrical, etc. characterization of all types of materials. The purpose is to provide experimental foundation for the theoretical concepts. The content of this paper is very important to develop the research in material science and particularly in nanomaterials.

B. SC. FIRST YEAR
SEMESTER –I

Paper - I (101) Properties of Matter and Mechanics:

Learning Outcomes:

- The syllabus covers general properties of matter includes solid and liquid out of these elasticity is the property of solid which gives the idea about material strength in three forms , Viscosity of liquid and importance of Surface tension in geometrical shape of liquid.
- Mechanics covers basics Newton's laws of motion and their applications. Geometrical description of laws improves students' imagination and study of constraints generate branch of physics known as classical mechanics. Rotational motion gives relation between M.I.and motions of body.

Paper-II (102) Electrostatics, Time varying fields & Electric Currents:

Learning Outcomes:

After completing this course students will be:

- Able to state and express Coulombs law in vector form and use it to solve for E due to stationary charges, Electric potential due to point charge, due to dipole, field due to dipole at any point.
- Able to state that potential is force per unit charge, and give a conceptual description of V and its relationship to energy.
- Able to describe similarities and differences between a conductor and dielectric, effect of electric field, polarization in dielectrics, polar and non-polar molecules, solving Classius-Mossoti equation.
- Able to calculate the E field inside a dielectric when given epsilon and the free charge on the dielectrics.
- Able to learn basic ideas of parallel plate capacitor, derivation of capacity with or without dielectrics and solve the numerical problems.
- Able to state and express Faradays laws of electromagnetic induction, self and mutual induction, transformer and its working , losses and uses of transformer, Kirchhoffs laws.
- Able to learn series resonance, derivation of frequency of resonance, power in ac circuit, solve the the mathematical problems.

SEMESTER- II

Paper-I (201): Oscillations, Kinetic theory of gases and Thermodynamics:

Learning Outcomes:

- The students able to understand linear and angular S.H.M., differential equation of S.H.M. and its solution. Also able to elaborate differential equations of damped oscillations and energy dissipation by damped oscillations.
- The students will know the fundamentals and applications of forced vibrations, resonance, and its energy and quality factor. Also gas laws with their applications.
- Students will understand phenomenon in gas transportation and thermodynamics behind the gas transportation. Also laws of thermodynamics and its importance in engines efficiency.

Paper-II (202): Gravitation, Astrophysics, Magnetism and Magneto statics:

Learning Outcomes:

- The students gets the idea about basic fundamental laws of classical mechanics, it enhance knowledge about planetary motion and their interaction.
- Start-up study of astrophysics increases student interest about space science.
- Microscopic study of atomic magnets increases intellectual skill of students in material research also it gives idea about the relation between electric and magnetic field as future key of power consumption.

B. Sc. Second Year
Semester-III

Paper-I (301): Sound waves, Applied acoustic, Ultrasonic and Power supply

Learning Outcomes:

- Students comes to know about types of waves, their characteristics, Students can understand about Harmonics, Quality of sound, human ear and its response and its audibility to sound. Student can learn about measurement of intensity, effect of temperature on sound.
- Students know about different sound measuring devices like transducers, recording and reproduction of sound.
- Students come to know about Ultrasonic waves, their properties, Methods of generation ultrasonic waves and their applications in research.
- Students learn about Power supply, conversion of A.C. to D. C., importance of voltage, current and load regulation.

PHYSICS - Paper-II (302): Physical optics and Electromagnetic waves:

Learning Outcomes:

- Students able to elaborate the wave nature of light.
- Analyze the intensity variation of light due to, interference and diffraction.
- Know the Application of Michelson and Fabry-Parot Interferometer
- Analyze the polarization and its applications.
- Interpret the Electromagnetic wave, the Maxwell's field equations, and transverse nature of electromagnetic wave.
- Interpret Poyntings theorem and its importance.

Semester IV
PHYSICS - Paper-I (401): Solid state physics, X-ray and Laser:

Learning Outcomes:

- The students will have a basic knowledge of crystal systems and spatial symmetries, Miller indices, able to understand how crystalline materials are studied using different diffraction techniques.
- Understand the concept of reciprocal space lattice and know the significance of Brillouin zones.
- The students able to know the types, properties and production of X-rays with their applications.
- Students elaborate fundamental concepts of LASER and their production along with applications.

PHYSICS - Paper-II (402): Solid state electronics, and Molecular physics:

Learning Outcomes:

- Students will understand fundamental, fabrication along with their applications in day to day life of LED, Solar Cell and BJT.
- Students will also know basics along with applications of FET, JFET and MOSFET and their special features.
- Students able understand and elaborate Quantization of vibrational and rotational energies, types of molecules, Diatomic molecules as harmonic and anharmonic oscillator, Rotational-vibrational spectra, Born Oppenheimer approximation.
- Students able to know the importance and applications of Raman spectroscopy in molecular physics also know the Frank-Condon principle, Elementary ideas of NMR and ESR and their applications in spectroscopy.

B. Sc. Final Year
Semester –V

Paper-I (501): Atomic physics, free electron theory and Statistical physics:

Learning Outcomes:

- Students understand the different theories of atomic model, different quantum numbers. Student also studies, how the momentums and magnetic moments associated with different motion of electron are oriented and their interaction with each other.
- Students learn about electrical and thermal conduction of electron. Fermi Energy, Fermi temperature band. Different theorems, models and experiments regarding free electron theory. Also Classification of materials.
- Student gets idea about μ- space, Gamma space, probability distribution, and thermodynamic probability, Principle of a priori probability, Boltzmann's entropy relation, different states, Maxwell-Boltzmann distribution law, and its application. Students also learn Bose-Einstein statistics, Fermi-Dirac distribution and its application.

Paper-II (502): Quantum mechanics, Nanomaterials and Nanotechnology:

Learning Outcomes:

After completing this course students will able to :

- Be familiar with the main aspects of the historical development of quantum mechanics of quantum mechanics, wave properties of matter.
- Able to correlate the classical mechanics with quantum mechanics,.
- Able solve Schrodinger equation in one to three dimensions and their physical interpretation.
- Able to familiar with basic aspects of Nanoscience and nanotechnology and their importance in day to day life.

Semester VI

Paper-I (601): Relativity, Nuclear physics and Bio Physics:

Learning Outcomes:

- Students understand the concept of Frame of references, Postulates of the special theory of relativity and relativistic variation in, Length, Time, mass, Velocity addition, and Mass energy equivalence.
- They are able to elaborate detectors of radiation, charge accelerators, nuclear reaction along with types of nuclear reactions and their importance in recent technology.
- The students understand and able to explain fundamental concepts of decay particles.
- Students able to know bio physics, and their importance in medical field.

Paper-II (602): Electronics, Fiber optics, Communication and Digital electronics:

Learning Outcomes:

- Students will know the fabrication and working principles of Amplifiers and oscillators and their applications.
- Students will able know the basic principle and working of Fiber optics, Importance of optical fiber, Propagation of light waves in optical fiber and its importance in communication .
- They will also know the Communication types like AM, FM their fundamental theory along with how the broadcasting of television is done by these means.
- The students will able know how the huge data is stored in modern days by using digitalization like Number Systems and theory behind this.