SRI RAMAKRISHNA MISSION VIDYALAYA
COLLEGE OF ARTS AND SCIENCE, COIMBTORE-20

DEPARTMENT OF PHYSICS
M. Sc Physics (Batch 2021-2022 onwards)
ACTION TAKEN REPORT BASED ON THE STAKEHOLDERS' FEEDBACK AND BOS MEETING-2021

- Depth of course outcomes are lucidly synchronized (strong, medium and low) with the Programme Specific outcomes and Programme Outcomes which have relevance to the local, regional and global developmental needs.
- Courses were sequentially enriched with vigour and enthusiasm.
- Members accepted to use vital ICT tools and enrich the course content through ICT tools.
- Swift action to induct virtual instrumentation exposure.
- Due weightage is offered to the noteworthy OP-AMP electronics experiments.
- Value-added courses-IoT, "CCTV installation & services", and Mobile phone servicing were inducted for UG and PG students admitted from 2021-2022.
- Barrier-free permission for the summer training programme with on-duty.
- Internship and summer training programmes are also been treated as a course of project work, approved in the BoS meeting as well.
- Significant attention on Physics core experiments.
- Core topics were coherently integrated into the respective courses.
- Explicit layout for the interim intrusion of the inborn topics, and easy reference for the enriched contents.

Layout of M.Sc (Physics) Syllabus Revision 2021-22

S. No.	Course Title	Course Code	Semester	Unit	Existing Content	Modified Content	% of revision	Course Focus on
1	Classical, Statistical and Rel		I	I	Generalized Coordinates – Mechanics of a Particle and System of Particles (Momentum and Energy) D'Alemberts Principle – Lagrange's Equations – Applications (Linear Harmonic Oscillator, Simple pendulum, Isotropic oscillator and Electric circuit) – Hamilton's Equations – Applications (Simple Pendulum, Compound Pendulum and 2D Harmonic Oscillator) – Deduction of Hamilton's Principle – Hamilton's Variational Principle – Principle of Least Action.	Generalized Coordinates - Mechanics of a Particle and System of Particles (Momentum and Energy) D'Alemberts Principle - Lagrange's Equations - Applications (Linear Harmonic Oscillator, Simple pendulum, Isotropic oscillator and Electric circuit) - Hamilton's Equations - Applications (Simple Pendulum, Compound Pendulum and 2D Harmonic Oscillator) - ***Single particle in space - *Atwood's machine** - Deduction of Hamilton's Principle - Hamilton's Variational Principle - Principle of Least Action.	4	Skill Development

	ativistic Mechanics			**II**	Equation of Canonical Transformations – Infinitesimal Contact Transformations – Lagrange and Poisson Brackets as Canonical Invariants – Equations of Motion in Poisson Bracket form – Jacobi's Identity – Relation between Lagrange and Poisson Brackets – Action Angle Variables – Euler's Angles – Angular Velocity of a Rigid Body – Euler's Equation of Motion.	Equation of Canonical Transformations - Infinitesimal Contact Transformations - Lagrange and Poisson Brackets as Canonical Invariants - Equations of Motion in Poisson Bracket form - Interpretation in terms of Poisson brackets - Angular momentum and Poisson brackets - Jacobi's Identity - infinitesimal contact transformation - ***Relation between Lagrange and Poisson Brackets** - ***Action Angle Variables** - Euler's Angles - Angular Velocity of a Rigid Body - Euler's Equation of Motion.	**10**	
				III	Basic Elements of Statistical Mechanics – Concept of Ensemble – Gibb's Canonical Ensemble – Grand Canonical Ensemble – Phase Space Entropy – Partition Function – Thermo dynamical Potentials – Internal Energy – Helmholtz Function – Gibb's Function – Free Energy – Maxwell Boltzmann Distribution – Evaluations of Multipliers of Alpha and Beta – Doppler Broadening – Applications of MB Distribution Law - Total Internal Energy and Specific heat at Constant Volume of an Ideal Gas – MB Speed Distribution Law – Most Probable, Average and Root Mean Square Speeds – Entropy of an Ideal Gas.	Basic Elements of Statistical Mechanics - Concept of Ensemble - Gibb's Canonical Ensemble - Grand Canonical Ensemble - Phase Space Entropy - Partition Function - Thermo dynamical Potentials - Internal Energy - Helmholtz Function - Gibb's Function - Free Energy - Maxwell Boltzmann Distribution - ***Evaluations of Multipliers of Alpha and Beta** - MB law for an Ideal gas - Doppler Broadening - Applications of MB Distribution Law - limitations of MB method - Solved examples - Total Internal Energy and Specific heat at Constant Volume of an Ideal Gas - MB Speed Distribution Law - Most Probable, Average and Root Mean Square Speeds - Entropy of an Ideal Gas.	**5**	
				IV	Bose Einstein Distribution – Determination of e^{α} – Planck's Law of Radiation – Rayleigh – Jeans Law – Wien's Displacement Law – BE Condensation - Fermi Dirac Distribution –Fermi Energy – Fermi Temperature – Fermi Velocity – Mean K.E. – Thermionic Emission – Pauli's Spin Paramagnetism – Comparison of MB, BE and FD Statistics.	Bose Einstein Distribution - Determination of e^{α} - Planck's Law of Radiation – Rayleigh-Jeans Law - Wien's Displacement Law - BE Condensation - Fermi Dirac Distribution - Statistical count - Condition for most probable distribution - Fermi Energy - Energy distribution curve - Fermi Temperature - Fermi Velocity - Mean K.E - ***Thermionic Emission and Pauli's Spin Paramagnetism** - Comparison of MB, BE and FD Statistics.	**8**	
						Total	**27%**	
2	Mathematical Phys		**I**	**III**	Analytic function - Cauchy Riemann differential equations - CR equations in polar form - Laplace's equation - Examples - Cauchy's integral theorem - Cauchy's integral formula - Taylor's series - Laurent's Series - Singularities of an analysis function - Residues and their evaluation - Cauchy residue theorem - Evaluation	Analytic function - Cauchy Riemann differential equations - CR equations in polar form - Laplace's equation - Examples - Cauchy's integral theorem - Cauchy's integral formula - Taylor's series - Laurent's Series - Singularities of an analysis function - Residues and their evaluation - Cauchy residue theorem - ***Evaluation of definite**	**20**	Skill Develop

	ics				of definite integrals (Trigonometric functions of cos θ and sin θ only).	**integrals** - Evaluation of improper real integrals, Evaluation of infinite integrals by Jordan's Lemma, Evaluation of infinite integrals when integrant has poles on real axis.		me nt
Total							**20%**	
3	Electronics		**I**	**III**	Monolithic IC process – Refining and growth of silicon crystals- Silicon wafer preparation-Diffusion of dopant impurity systems-Ion implantation –Thermal oxidation – Photolithography-Fine line lithography-Plasma etching Chemical Vapour Deposition (CVD) –Silicon insulators -Metallization – Monolithic components-ResistorsCapacitors – Diodes – Transistor.	Flip-Flops - SR, JK, JK Master Slave - Counters - Scale of two to ten counter - Shift Registers - Serial and Parallel - Shift left and Shift right operations - Multiplexers and De-multiplexers **D/A Conversion:** Binary weighted resistor D/A converter - R-2R resistive adder D/A converter - **A/D Conversion:** Counter type A/D converter successive approximation A/D converter - Dual slope A/D converter- Sample and hold circuits.	**20**	Em plo yab ility and Ent repr ene urs hip
				IV	Characteristics of Ideal and Practical OP AMP – Analysis of 741 – Parameters of OP AMP – Theory of Inverting Amplifier – Virtual Ground – Theory of Non Inverting Amplifier –Solutions of Simultaneous Equations – Solutions of Differential Equations - Sinusoidal oscillators – Phase shift oscillator – Wien Bridge Oscillator-Multi vibrator- Schmitt Trigger- Square wave and Triangular wave generators.	Characteristics of Ideal and Practical OP AMP - Analysis of 741 - Parameters of OP AMP - Theory of Inverting Amplifier - Virtual Ground - Sign changer - Phase inverter - Scale changer - Theory of Non Inverting Amplifier - Inverting summing amplifier - Unity gain amplifier - Differentiator - Integrator - Solutions of Simultaneous Equations - Sinusoidal oscillators - Phase shift oscillator - Wien Bridge Oscillator-Multi vibrator- Astable multi vibrator - Schmitt Trigger.	**6**	
				V	Number Systems- Binary codes – 8421 Code-Excess 3 code – Grey code- ASCII code – Logic circuits - Sum of Product and Product of Sum - Boolean Algebra-De Morgan's Theorems – Arithmetic Circuits (Half and Full adder – Half and Full subtractor)– Simplification using Karnaugh's Map (2,3 and 4 variables).	Number Systems - Binary codes - BCD Codes - 8421 Code-Excess 3 code - Grey code - ASCII code - EBCDIC Code - Logic circuits - Sum of Product and Product of Sum - Boolean Algebra & Laws - De Morgan's Theorems - Arithmetic Circuits - Half and Full adder - Half and Full subtractor - 4-bit Adder - Simplification using Karnaugh's Map 2,3 and 4 variables (pairs, quarts, octets).	**4**	
Total							**30%**	
4	Program			**I**	Basic Concepts of OOP - Structure of C++ Programme - Tokens, Expressions and Control structures - Basic data types - Symbolic Constants - Operators in C++ -	Basic Concepts of OOP - Structure of C++ Programme - Tokens, Expressions and Control structures - Basic data types - Symbolic Constants - Operators in C++ - Manipulators -	**4**	Em plo yab

	ming in C++ and MATLAB				Manipulators - Type Casting - Expressions and their Types - Control structure: if, else, nested if, switch case, while, do while, for, nested for- break - continue and goto statement – Types Functions - Function Prototyping - Call by reference - Return by Reference - Inline Functions - Default Arguments.	Type Casting - Expressions and their Types - C++ basic input/output programs - Control structure: if, else, nested if, switch case, while, do while, for, nested for- break - continue and goto statement – Types Functions - Function Prototyping - Call by reference - Return by Reference - Inline Functions - Default Arguments.		ility
				II	Specifying a Class - Defining Member Functions - Static Data Members - Static Member Functions - Arrays of Objects - Objects as Function Arguments - Friend Functions - Returning Objects - Constant Member Functions - Pointers to Members. **Constructors and Destructors:** Constructors - Parameterized Constructors - Copy Constructor - Dynamic Constructor - Constant Objects - Destructors.	Specifying a Class - Defining Member Functions - Static Data Members - Static Member Functions - Arrays of Objects - Objects as Function Arguments - C++ Class & Object programs - Friend Functions - Returning Objects - Constant Member Functions - Pointers to Members. Constructors and Destructors: Constructors - Parameterized Constructors - Copy Constructor - Dynamic Constructor - Constant Objects - Destructors.	**4**	
				III	Operator Overloading - Function Overloading - Single Inheritance - Multiple Inheritance - Hierarchical Inheritance - Multi Level Inheritance - Hybrid Inheritance.Classes for File Stream Operations - Opening and Closing a File - Text File Operations - Binary File Operations - Function Templates - Class Templates - Member Function Templates.	Operator Overloading – C++ Function Overloading - Single Inheritance - Multiple Inheritance - Hierarchical Inheritance - Multi Level Inheritance - Hybrid Inheritance.Classes for File Stream Operations - Opening and Closing a File - Text File Operations - Binary File Operations - Function Templates - Class Templates - Member Function Templates.	**4**	
				IV	Basics of MATLAB - MATLAB windows - On-line help - Input - Output - File types – Interactive Computation: Matrices and vectors - Input - Indexing - Matrix manipulation - Creating vectors - Matrix array operations - Arithmetic operations - Relational operations - Logical operations - Elementary math function - Matrix function - Character strings - Manipulating character strings - Eval function - Array operations - Command line functions - Inline function - Anonymous function - Plotting simple graphs.	Basics of MATLAB - MATLAB windows - On-line help - Input - Output - File types - Interactive Computation: Matrices and vectors - Input - Indexing - Matrix manipulation - Creating vectors - Matrix array operations - Arithmetic operations - Relational operations - Logical operations - Elementary math function - Matrix function - Character strings - Manipulating character strings - Eval function - Array operations - Command line functions - Inline	**4**	

						function - Anonymous function - Plotting simple graphs - Solving first-order ODEs with example.		
				V	Scripts and functions - Script files - Function files - Executing a function - Sub functions - Nested functions - Language specific features - Use on comments to create online help - Continuation - Global variables - Loops branches and control flow - Interactive input- Application: Linear algebra - Solving a linear system - Gaussian elimination - Eigen values and Eigen vectors - Matrix factorization	Scripts and functions - Script files - Function files - Executing a function - Sub functions - Nested functions - Language specific features - Use on comments to create online help - Continuation - Global variables - Loops branches and control flow - Interactive input- Application: Linear algebra - Solving a linear system - Gaussian elimination - Eigen values and Eigen vectors - Matrix factorization - Simple program in Plot 3-D graph.	**4**	
							Total	**20%**
5	Electromagnetic Theory and Electrodynamics		II	III	Propagation of Electromagnetic Waves in Free Space – Isotropic Dielectrics – Anisotropic Dielectric – Conducting Media – Ionized Gases. Oscillating Electric Dipole - Radiation from an Oscillating Dipole - Vector Potential – Scalar Potential – Magnetic Induction – Electric Intensity.	Propagation of Electromagnetic Waves in Free Space - Isotropic Dielectrics - Anisotropic Dielectric -Conducting Media - Ionized Gases Boundary Conditions - Reflection and refraction of electromagnetic waves - Kinematic Properties & Dynamic Properties - Fresnel Formulae - Brewster's Law and Polarization of EM waves - total internal reflection and Critical angle - Reflection from a metallic surface - Propagation of Electromagnetic waves between parallel and perfectly conducting planes and ***Rectangular waveguide.**	**20**	Skill Development
							Total	**20%**
6	Modern Optics		II	I	Phase velocity – Group velocity – Doppler effect – Energy flow – Liner polarization – Matrix representation of polarization (Jones calculus) – Reflection and refraction at a plane boundary – Amplitudes of reflected and refracted waves – Brewster angle – Phase changes in total internal reflection.	Maxwell equations and light probagation – speed of light in medium - plane Harmonic waves - Phase velocity - Group velocity - Doppler effect – Doppler broadening of spectral lines – relation ship between	**12**	Employability and

						electric and magnetic fields - Energy flow - Liner polarization – circular and elliptic polarization- Matrix representation of polarization (Jones calculus) - Reflection and refraction at a plane boundary – Fresnel equations – external and internal reflection - Amplitudes of reflected and refracted waves - Brewster angle – Evanescent wave in total reflection -Phase changes in total internal reflection – reflection matrix.		Skill development
				II	Theory of partial coherent light - Visibility of fringes - Coherent time and Coherent length - Spatial coherence - Fourier Transform spectroscopy - Interference with Multiple beam - Theory of multilayer films.	Theory of partial coherent light - Visibility of fringes - Coherent time and Coherent length – Coherence of a quasi monochromatic source - Spectral resolution of a finite wave train-coherence and line width – Airy Function- Fourier Transform spectroscopy –Fourier transform of intensity function-advantages- Interference with Multiple beam – Theory of multilayer films – transfer matrix- Anti-reflecting films- high reflectance films.	**10**	
				III	Laser rate equations – Three level system – Four level system – Population inversion – Optical resonators – Ruby laser – Helium-Neon Laser – Carbon dioxide laser – Four Level Solid Laser – Semiconductor laser –Holography- Theory of holography – Applications in Communication and Medicine.	Laser rate equations - Three level system - Four level system - Population inversion - Optical resonators - Ruby laser - Helium-Neon Laser - Carbon dioxide laser –High power Nd:YAG Laser working and its applications- Four Level Solid Laser - Semiconductor laser – Holography - Theory of holography - Applications in Communication and Medicine.	**4**	
				IV	Nonlinear response – Nonlinear phenomenon and harmonic generation – Phase matching – Susceptibility Tensors – Parametric amplifications –Monley –Row relations – Self focusing – Theory of	Nonlinear response - Nonlinear phenomenon and harmonic generation - Phase matching - Susceptibility Tensors –various nonlinear effects and susceptibility tensors - Parametric amplifications – Monley-Row relations	**6**	

					self focusing – Theory of laser Raman spectroscopy.	– Raman effect -stimulated Raman scattering - Self focusing - Theory of self focusing.		
				V	Basic optical laws and definitions – Optical fiber modes and configuration – Step index and Graded index fiber structure – Fiber materials – Fiber fabrication – Mechanical properties of Fibers – Fiber optic communication – Wavelength Division Multiplexing (WDM) – Local Area Network (LAN) – Optical fiber Bus – Nonlinear optical Effects.	Basic optical laws and definitions - Optical fiber modes and configuration – monomode and multimode fibers - Step index and Graded index fiber structure - Fiber materials - Fiber fabrication - Mechanical properties of Fibers - Fiber optic communication - Fiber and internet- Wavelength Division Multiplexing (WDM) - Local Area Network (LAN) - Optical fiber Bus.	**4**	
						Total	**36%**	
7	Quantum Mechanics		II	I	Wave packet- Time dependent and Time independent Schrödinger equation –Interpretation of wave function-Probability interpretation-Probability current density-Expectation value-Ehrenfest's theorem-Linear Vector Space – Linear Operator- Eigen function and Eigen values –Hermitian Operator – Postulates of Quantum Mechanics – Simultaneous Measurability of Observables – General Uncertainty Relation – Dirac's Notation.	Wave packet - Time dependent and Time independent Schrödinger equation – Stationary States - Interpretation of wave function - Ehrenfest's theorem - Linear Vector Space – Hilbert Space - Linear Operator - Eigen function and Eigen values - Hermitian Operator - Postulates of Quantum Mechanics - Simultaneous Measurability of Observables - General Uncertainty Relation – Problem: Calculation of potential and energy relation for an one dimensional wave function using Time independent Schrödinger equation.	**8**	Skill development
				II	Equation of motion – Schrödinger, Heisenberg and Interaction representation – Heisenberg method – Matrix representation of Wave Function and operator –Properties of Matrix elements –Schrödinger equation in Matrix form – Eigen value problem –Unitary transformations – Linear harmonic oscillator - Matrix method.	Dirac's Notation - Equation of motion - Schrödinger, Heisenberg and Interaction representation – Momentum representation - Heisenberg method - Matrix representation of Wave Function and operator - Properties of Matrix elements - Schrödinger equation in Matrix form - Eigen value problem - Unitary transformations – Change of basis - Linear harmonic oscillator: Matrix method.	**4**	
				III	Square well potential with rigid walls and finite walls – Square potential barrier – Alpha emission – Bloch waves in a periodic potential – Kronig – Penney square well periodic potential – Linear harmonic oscillator - Schrödinger method - Operator method – Delta function- Particle moving in a spherically symmetric potential - System of two interacting particles – Rigid rotator – Hydrogen atom - Hydrogenic orbitals.	**One-dimensional problems:** Square well potential with rigid walls - Square potential barrier - Alpha emission - Bloch waves in a periodic potential - Kronig-Penney square well periodic potential - Linear harmonic oscillator: Schrödinger method and Operator method - Delta function. **Three-dimensional problems:** Particle moving in a spherically symmetric potential - Rigid rotator - Hydrogen atom - Hydrogenic orbitals –	**4**	

						Free particle: Plane wave solution and spherical wave solution.		
				IV	Angular momentum operators – Angular momentum commutation relations – Eigen values and Eigen functions of $L^2$and L_z - General angular momentum - Eigen values of J^2 and J_z – Angular momentum matrices – Spin angular momentum – Spin vectors for spin 1/2 system – Addition of angular momenta.	Angular momentum operators - Angular momentum commutation relations - Eigen values and Eigen functions of $L^2$and L_z - General angular momentum - Eigen values of J^2 and J_z - Spin angular momentum - Spin vectors for spin 1/2 system - Addition of angular momenta – Clebsh-Gordan coefficients – Computation of Clebsh-Gordan coefficients – Components of arbitrary vectors A and B commute with those of σ.	**6**	
				V	Time independent perturbation theory - Basic concepts – Non degenerate energy levels – Anharmonic oscillator - First order correction – Ground state of helium – Effect of electric field on the ground state of hydrogen – Degenerate energy levels - Ground state theory of deuteron.	Time independent perturbation theory - Basic concepts - Non degenerate energy levels – First order correction to energy and wave function - Anharmonic oscillator - First order correction - Ground state of helium - Effect of electric field on the ground state of hydrogen - Degenerate energy levels - Ground state theory of deuteron – Calculation of first order correction to the ground state energy of Anharmonic oscillator subjected to various potentials.	**6**	
							Total	**28%**
8	Microprocessor and Microcontroller		II	I	555 Timer internal Structure - 555 Timer as schmitt Trigger - Flip-Flops - NAND Latch - SR, JK, JK Master Slave - Counters - Scale of two to ten counter - Shift Registers - Serial and Parallel - Shift left and Shift right operations - Up Down counters - Multiplexers and Demultiplexers - Decoders and Encoders.	Introduction to microprocessor - 8085 Architecture - Pin configuration - Addressing modes - Instruction classifications (Data transfer, Arithmetic, Logical, Branching and Control) - Design of an input and output port - Programmable Peripheral interface (8155 & 8255) - Programmable interrupt controller (8279) - Seven segment LED display interface.	**4**	Employability and Entrepreneurship
				II	D/A Conversion - Binary weighted resistor D/A converter - R- 2R resistive adder D/A converter- Counter type D/A converter successive approximation A/D converter- Dual slope A/D converter- Parallel comparator A/D converter, Sample and hold circuits, Multiplexing displays - Digital frequency counter - Digital	Introduction to microprocessor 8086 - Pin functions - 8086 Architecture - Flag and Segment registers - Hardware organization of the memory address space - Interfacing ROM to 8086 - Memory read and write bus cycle - Types of interrupts - Interrupt related instructions - External hardware interrupt interface - Input/output port interface minimum mode - Input and	**6**	

					Multimeter.	output maximum mode signals - Programmable Interrupt controller (PIC)8259A		
				III	Introduction to microprocessor - 8085 Architecture - Pin configuration - Addressing modes - - Instruction classification - Instruction set - Data transfer instructions - Arithmetic instructions - Logical and branch instructions- Programmable Peripheral interface (8255A) - Programmable interrupt controller (8259) - Seven segment LED display	Introduction to microprocessor 80286 - Pins and signals of 80286 - 80286 Architecture - Real and protected virtual addressing mode of 80286 - Introduction to microprocessor 80386 - Pins and signals of 80386 - 80386 Architecture - Registers of 80386 - Operating modes of 80386 - Introduction to microprocessor 80486 - Pins and signals of 80486 - 80486 Architecture - Pins, Signals and Architecture of Pentium microprocessor	**20**	
				IV	Introduction to microprocessor 8086 - Pin functions of 8086 - 8086 Architecture - Address space and data organization - Hardware organization of the memory address space - Memory read and write bus cycle - Input and output instructions - Input/output port interface minimum mode - Input and output maximum mode signals - Interrupt and 8086 response.	General program structure - Addition of two 16 bit numbers - multiplication of two 16 bit numbers - Division of a 32 bit number by a 16 bit number - Multibyte addition - Ascending order (bubble sort) - Factorial of a number using recursion - Temperature control system - Stepper motor interface - Traffic light interface.	**4**	
				V	General program structure – Addition of two 16 bit numbers – multiplication of two 16 bit numbers – Division of a 32 bit number by a 16 bit number - Multibyte addition - Ascending order-bubble start – Display character string - Programmable Interrupt controller(PIC)8259A – Interrupt applications – Stepper motor interface.	Comparison of Microprocessors and Microcontrollers - Architecture - Memory organization - I/O ports - Timers - Serial Communication - Interrupts - Programming tools and techniques -Addressing modes - Data transfer operations - Arithmetic operations - Logical operations - Rotate and sweep operations - Interfacing I/O Devices. **Applications:** Timer Counter Programming - Displays - D/A and A/D conversions - Multiple interrupts.	**20**	
						Total	**54%**	
9	Advanced Quantum Mechani		III	I	Variational principle-Rayleigh-Ritz method – Variation method for exited states – Ground state of helium – Hydrogen molecule ion- Ground state of deuteron – WKB Method – Connection formulas –Validity – Barrier penetration – Alpha Emission – Bound states in a potential well.	Variational principle - Rayleigh-Ritz method - Application of Variation methods: Ground state of helium, Zero point energy of one dimensional Harmonic oscillator - Hydrogen molecule ion - Ground state of deuteron - WKB Method - Connection formulas -Validity - Barrier penetration - Alpha Emission - Bound states in a potential well.	**6**	Skill Development

	cs							
				II	Introduction – First order perturbation – Harmonic perturbation – Transitions to continuum states – Absorption and emission of radiation – Einstein's A and B coefficients - Selection rules.	Introduction - First order perturbation - Harmonic perturbation - Transitions to continuum states - Absorption and emission of radiation – Electric dipole approximation - Transition probability -Einstein's A and B coefficients - Selection rules - Raman scattering.	**6**	
				III	Indistinguishable particles – Pauli principle – Inclusion of spin – Spin functions for two-electrons – Spin functions for three-electrons – Helium atom – Central field approximation – Thomas-Fermi model of the atom – Hartree equation – Hartree-Fock equation.	Indistinguishable particles - Symmetric and Anti symmetric wave functions – Particle exchange operators – Pauli's exclusion principle – Slater determinant - Inclusion of spin - Spin functions for two-electrons - Spin functions for three-electrons - Helium atom - Central field approximation - Thomas-Fermi model of the atom - Hartree equation - Hartree-Fock equation.	**6**	
				IV	Scattering cross- section - Scattering amplitude partial waves - Scattering by a central potential - Partial wave analysis - Significant number of partial waves - Scattering by an attractive square well potential - Breit- Wiger formula - Scattering length - Expression for phase shifts - Integral equation - Born approximation - Scattering by screened coulomb potential - Validity of born approximation - Laboratory and centre of mass coordinate system.	Scattering cross-section - Scattering amplitude - partial waves - Scattering by a central potential - Partial wave analysis - Significant number of partial waves - Scattering by an attractive square well potential - Breit- Wiger formula - Scattering length - Expression for phase shifts - Integral equation - Born approximations - Condition for validity of born approximation - Rutherford's scattering formula from Born approximation – Scattering of identical particles.	**8**	
				V	Klein-Gordon equation – Interpretation of the Klein-Gordon equation - Dirac's equation for a free particle – Dirac matrices – Covariant form of Dirac equation - Probability density – Plane wave solution – Negative energy states – Spin of the Dirac particle – Radial equation for an electron in a central potential – Hydrogen atom – Lamb shift – Coordinates of the field – Quantum equation for the field – Creation, destriction and number operators – Quantized field energy.	Klein-Gordon equation - Interpretation of the Klein-Gordon equation - Dirac's equation for a free particle - Dirac matrices - Covariant form of Dirac equation - Probability density - Plane wave solution - Negative energy states - Radial equation for an electron in a central potential - Lamb shift - Quantum field theory - Quantization of the field- Second quantization – Quantization of the Schrödinger equation - N-representation - Creation, destruction and number operators – Quantization of electromagnetic field.	**8**	
						Total	**34%**	

10	Solid State Physics		III	I	Miller Indices - Point groups - Space group - Reciprocal lattice - Bragg's law interpretation - Structure factor - fcc and bcc structures - Electron density distribution experimental techniques for crystal structure studies (Powder, Laue and Rotation crystal method) - Electron and neutron diffraction methods - Point defects - Colour centres - Line defects - Edge dislocation - Screw dislocation - Dislocation motion.	Miller Indices - Point groups - Space group - Reciprocal lattice - vector development of reciprocal lattice - properties of reciprocal lattice - reciprocal lattice to BCC - reciprocal lattice FCC - Bragg's law interpretation - Atomic scattering factor- Geometrical structure factor- **fcc and bcc*** - Electron density distribution experimental techniques for crystal structure studies (Powder, Laue and Rotation crystal method) - Electron and neutron diffraction methods - Point defects - Colour centres - Line defects - Edge dislocation - Screw dislocation - Dislocation motion.	**7**	Skill development
				II	Phonons in solids - One dimensional atomic chain - (Mono atomic and diatomic) - Momentum of phonons- Optical properties in the infrared - Inelastic scattering of neutrons by phonons - Local phonon model- Umklapp and normal process - Theory of specific heat (Classical, Einstein and Debye Model) - Thermal expansion and thermal conductivity - Boltzmann transport equation.	Phonons in solids - One dimensional atomic chain - (Mono atomic and diatomic) - Momentum of phonons - Inelastic scattering of Photons by long wavelength Phonons - Inelastic scattering of neutrons by phonons - Local phonon model- Umklapp and normal process - Theory of specific heat (Classical, Einstein and Debye Model) - Thermal expansion - **thermal conductivity*** - Boltzmann transport equation.	**2**	
				III	Elastic stress components - Analysis of elastic strains - Elastic energy density - Elastic stiffness constants of cubic crystals - Elastic waves in cubic crystals - Experimental determination of elastic constants for cubic crystals - Photo conductivity - Excitation across a gap - Simple model of photo conductor trapping capture - Recombination - Excitons - Luminescence - Activators - Absorption spectra - Emission spectra.	Elastic stress components - Analysis of elastic strains - Elastic compliance and stiffness constants - Elastic energy density - Elastic stiffness constants of cubic crystals - Elastic waves in cubic crystals - waves in the (100) direction - waves in (110) direction - Experimental determination of elastic constants for cubic crystals - Photo conductivity - Excitation across a gap - Simple model of photo conductor trapping capture - Recombination - Excitons - **Luminescence*** - Activators - Absorption spectra - Emission spectra.	**4**	
				IV	Magnetic permeability - Theory of diamagnetism - Langevin's theory of para magnetism - Weiss theory - Paramagnetic susceptibility of a solid - Calculation of susceptibility - Quantum theory of para magnetism - Determination of susceptibility- Para	Magnetic permeability - Theory of diamagnetism - Langevin's theory of para magnetism - Weiss theory - Paramagnetic susceptibility of a solid - Calculation of susceptibility - Quantum theory of para magnetism - Determination of susceptibility- Para	**4**	

					and diamagnetic materials - Ferromagnetism - Spontaneous magnetism in ferromagnetism - Curie-Weiss law - Ferromagnetic domains - Domain theory- Antiferromagnetism - Structure of ferrites.	and diamagnetic materials - Ferromagnetism - Spontaneous magnetism in ferromagnetism - Curie-Weiss law - Ferromagnetic domains - Domain theory - Molecular field theory of Antiferromagnetism - **Structure of ferrites***.		
				V	Microscopic concepts of polarization - Langevin's theory of polarization in polar dielectrics - Local field in liquids and solids - Evaluation of local fields for cubic structure- Computation of E_n- Clausius-Mossotti Relation - Lorentz formula - Ferroelectricity - Dipole theory of ferroelectricity - Classification of ferroelectric materials - Anti ferro electricity - Piezoelectricity - Complex dielectric constant and dielectric loss - Effects of dielectrics.	Microscopic concepts of polarization - Langevin's theory of polarization in polar dielectrics - Local field in liquids and solids - Evaluation of local fields for cubic structure - Computation of E_n- Clausius-Mossotti Relation - Lorentz formula - Ferroelectricity - Dipole theory of ferroelectricity - Classification of ferroelectric materials - Anti ferro electricity - Piezoelectricity **- Complex dielectric* constant and dielectric loss** - Dielectric breakdown - different types - characteristics.	**4**	
						Total	**21%**	
11	Advanced Materials and Characterization		III	I	Thin Film and growth process - Distribution of deposits - Deposition Techniques: Thermal evaporation - Cathodic sputtering - Glow discharge sputtering - RF sputtering - Chemical and Physical vapor deposition - Spray pyrolysis – Spin coating. **THICKNESS MEASUREMENTS:** Mass methods - Optical method - photometry, ellipsometry, interferometry - Microbalance technique.	Thin Film and growth process - Distribution of deposits - Deposition Techniques: Thermal evaporation - Cathodic sputtering - Glow discharge sputtering - RF sputtering –Reactive sputtering- magnetron sputtering - Chemical and Physical vapor deposition- plasma enhanced CVD- atomic layer deposition – Spray pyrolysis – Spin coating.-Properties of thin films (structural, optical, electrical and thermal) **THICKNESS MEASUREMENTS:** Mass methods – Optical method - photometry, ellipsometry, interferometry - Microbalance technique.	**7**	Employability
				II	Introduction and types - Photoconductive polymers - Composition and structure of polymers – Polymerization techniques – Chemical oxidative and Electrochemical polymerization - Applications. **SOLAR CELLS:** Introduction - History and types of solar cell - Thin film and Dye sensitized solar cell - Minority carrier diffusion - IV characteristics - Solar cell output parameters.	**POLYMERIC MATERIALS**: Introduction and types - Photoconductive polymers – discovery of polyacetylene-polarons and bipolarons- conduction mechanism- electro active polymers (redox type polymers-Composition and structure of polymers – Polymerization techniques – Chemical oxidative and electrochemical polymerization - Applications. **SOLAR CELLS:** Introduction - History and types of solar cell - Thin film and Dye sensitized solar cell - Minority carrier diffusion - IV characteristics - Solar cell output parameters- Solar cell modules and	**8**	

						arrays		
				III	Powder X-ray diffraction - Debye-Scherrer technique - Indexing the powder pattern - Calculation of particle size using Scherer method - Lattice constant calculations. **MICROSCOPY ANALYSIS:** Scanning Electron Microscope (SEM) - EDAX analysis - Principle and working of Atomic Force Microscopy (AFM) and - Principle of Transmission Electron Microscopy (TEM)	Powder X-ray diffraction - Debye-Scherrer technique - Indexing the powder pattern - Calculation of particle size using Scherer method - Lattice constant calculations- single crystal X-ray diffraction- shape-defects-microstrain-density map **MICROSCOPIC ANALYSIS:** Scanning Electron Microscope (SEM) - EDAX analysis - Principle and working of Atomic Force Microscopy (AFM) and - Principle of Transmission Electron Microscopy (TEM) - High ResolutionTransmission Electron Microscopy (HRTEM)	**5**	
				IV	UV-Vis spectroscopy studies - Band gap calculation - Determination of refractive index and optical conductivity - Fluorescence and Photoluminescence studies - Determination of direct band gap energy - Electroluminescence - FTIR spectroscopy - determination of different vibrational modes.	UV-Vis spectroscopy studies- Instrumentation - Band gap calculation - Determination of refractive index and optical conductivity - Fluorescence and Photoluminescence spectral studies - Determination of direct band gap energy - Electroluminescence - FTIR spectroscopy – FTIR spectral lines characterization-Instrumentation- determination of different vibrational modes- Raman Spectral Lines Characterization - Photocatalytic analysis.	**6**	
				V	Two probe and four probe methods - Hall effect setup measurement - Thermal Analysis: Introduction - Thermogravimetric analysis (TGA) - instrumentation - Determination of weight loss and decomposition products - Differential thermal analysis (DTA) - Cooling curves - Differential scanning calorimetry (DSC) - Instrumentation - Specific heat capacity measurements	Two probe and four probe methods - Hall effect setup measurement - Thermal Analysis: Introduction - Thermogravimetric analysis (TGA) - instrumentation - Determination of weight loss and decomposition products - Differential thermal analysis (DTA) - Cooling curves - Differential scanning calorimetry (DSC) - Instrumentation - Specific heat capacity measurements-Vibrational sample magnetometer (VSM)-. Non-destructive testing - Cyclic Voltametry	**6**	
						Total	**32%**	
12	Condensed Matter Phys		IV	I	Free electron model - Wave equation in a periodic table and bloch theorem - Kronig-Penney theory - Acceleration of electron in the periodic lattice and effective mass of the electron - Free electron approximation - Tight binding approximation - Brillouin zones - Construction of Fermi surfaces - Experimental methods in Fermi surface studies.	Free electron model - Wave equation in a periodic table and bloch theorem - Kronig-Penney theory -different zone schemes - Acceleration of electron in the periodic lattice and effective mass of the electron - Free electron approximation - **Tight binding approximation*** - Brillouin zones - Construction of fermi surfaces - Experimental methods in fermi surface studies - Cyclotron Resonance - De Hass-Vanalphen effect.	**4**	Skill development

	ics and Nanotechnology			II	Intrinsic Semiconductor - Carrier Concentration in Intrinsic Semiconductor – Calculation of density of holes and electrons – Fermi level and its variation with temperatures – Mobility and conductivity – Determination of band gap - Extrinsic Semiconductor – Expression for carrier concentration in n-type and p-type semiconductors – Variation of Fermi level with temperature and impurity concentration – Hall effect - Determination of Hall coefficient.	Intrinsic Semiconductor - Carrier Concentration in Intrinsic Semiconductor - Calculation of density of holes and electrons - Fermi level and its variation with temperatures - Mobility and conductivity - Determination of band gap - Extrinsic Semiconductor - Expression for carrier concentration in n-type and p-type semiconductors - Variation of Fermi level with temperature and impurity concentration - Hall effect - Determination of Hall coefficient. Quantitative **treatment of the P-N Junction rectifier- P-N junction in equilibrium - P-N junction with forward bias- P-N junction reverse bias*-** Rectifier equation.	**2**	
				III	Superconductivity phenomena - Thermodynamics of superconductivity transition - London equations - Type I and Type II superconductors - BCS theory - Josephson's tunneling - DC and AC Josephson's Effect - New superconductors - Applications - High temperature superconductors - SQUIDS.	Superconductivity phenomena - Experimental survey-Effect of magnetic field : The Critical Field - Magnetic properties of Superconductors - Isotope effect - Theoretical survey - Thermodynamics of superconductivity transition - London equations - Type I and Type II superconductors - BCS theory - Josephson's tunneling - DC and AC Josephson's Effect - **New superconductors - Applications - High temperature superconductors*** - SQUIDS.	**8**	
				IV	Classification of Nanostructured materials - Quantum well, quantum wires and quantum dots - Lithography - (Photoresist spinner, positive and negative photoresists) - Fabrication methods - Top down process - Bottom up approach - Plasma assisted deposition process - Deposition by epitaxy - Liquid phase methods - Techniques for synthesis of nanophase materials - Mechanical alloying - Inert gas condensation - Sol-gel techniques - Properties of nanomaterials - Methods for templating the growth of nanomaterials - Ordering of nanosystems.	Classification of Nanostructured materials - Quantum well, quantum wires and quantum dots - Lithography - (Photoresist spinner, positive and negative photoresists) - Fabrication methods – Photofragmentation - Coulombic explosion - Top down process - Bottom up approach - Plasma assisted deposition process - Deposition by epitaxy - Liquid phase methods - Techniques for synthesis of nanophase materials - **Mechanical alloying* - Inert gas condensation*** - Sol-gel techniques - Properties of nanomaterials - Methods for templating the growth of nanomaterials - Ordering of nanosystems - Process of Self Assembly.	**6**	
				V	Energies associated with ferromagnetic material - Effect of physical dimensions on magnetic properties of materials - Nanomagnetic materials - Geometric Nanomagnets - Layered Nanomagnets - Carbon nanotubes - Organic field effect transistor	Energies associated with ferromagnetic material - Nanomagnetic materials - Geometric Nanomagnets - Layered Nanomagnets - Carbon nanotubes- Graphene - Organic field effect transistor (OFET) - Organic light emitting diode (OLED) - Bilayer organic solar cell using CuPc and PTC	**4**	

					(OFET) - Organic light emitting diode (OLED) - Organic photovoltaic - Bilayer organic solar cell using CuPc and PTC - Injection laser - Quantum well lasers - Quantum cascade laser - Single electron tunneling and coulomb blockade behavior - Optical memories - Quantum dot laser.	- Injection laser - Quantum well lasers - Quantum cascade laser - **Single electron tunneling and coulomb blockade behavior*** - Optical memories - Quantum dot laser - Nanoelectromechanical systems (NEMS's) - fabrication- Nanomachines.		
Total							**24%**	
13	Nuclear and Particle Physics		IV	I	Theories of nuclear composition (Proton- electron theory, proton neutron theory) – Mass spectroscopy – Bainbridge and Jordan mass spectrograph – Nier's mass spectrometer– Deuteron - Magnetic and quadra pole moment of deuteron – Ground state of deuteron – Excited state of deuteron –Meson theory of nuclear forces - Yukawa potential.	Theories of nuclear composition (Proton- electron theory, proton neutron theory) - Mass spectroscopy - Double focusing Spectrometer - Bainbridge and Jordan mass spectrograph - Nier's mass spectrometer - Deuteron - Magnetic and quadra pole moment of deuteron - Ground state of deuteron - Excited state of deuteron - Meson theory of nuclear forces - Yukawa potential.	**4**	Skill Development
				II	**Alpha Decay:** Properties of alpha particles – Velocity and energy of alpha particles - Geiger-Nuttal law – Gamow's theory of alpha decay. **Beta Decay:** Properties and beta particles - Fermi's theory of beta decay – Kurie plot - Forms of interaction and selection rules – Electron capture. **Gamma Transitions:** Absorption of gamma rays by matter – Interaction of gamma rays with matter – Measurement of gamma rays energies – Dumond bent crystal spectrometer - Internal conversion.	**Alpha Decay:** Velocity and energy of alpha particles - Geiger-Nuttal law - Gamow's theory of alpha decay- Alpha particle disintegration energy - Alpha particle spectra. **Beta Decay:** General futures of beta ray Spectrum, Pauli's hypothesis - Neutrino theory of beta decay - Fermi's theory of beta decay - Kurie plot - Forms of interaction and selection rules - Electron capture. **Gamma Transitions:** Absorption of gamma rays by matter - Interaction of gamma rays with matter - Measurement of gamma rays energies - Dumond bent crystal spectrometer - Internal conversion.	**8**	
				IV	Types of Nuclear reaction - Conservation laws for nuclear reactions – Kinematics of Nuclear reactions – Exothermic and endothermic reactions – threshold energy- compound nucleus- Nuclear fission- Energy released in fission- Nuclear fusion- hydrogen burning and solar energy.	Types of Nuclear reaction - Conservation laws for nuclear reactions - Kinematics of Nuclear reactions - Exothermic and endothermic reactions - threshold energy - Nuclear reaction cross section - Measurement - Different types of cross section - compound nucleus - Nuclear fission - Energy released in fission - Nuclear fusion- hydrogen burning and solar energy - Helium burning in stars.	**6**	
				V	Classification of elementary particles – Fundamental interactions – Electromagnetic, strong, weak and gravitational interactions – Quantum numbers - – Conservation laws –	Classification of elementary particles - Fundamental interactions - Parameters of elementary particles - Quantum numbers - Conservation laws - The CPT Theorem - Particle symmetries -	**4**	

					The CPT Theorem - Particle symmetries – SU (2) Symmetry - SU (3) symmetry – Quarks theory.	SU (2) Symmetry - Gell-mann Okubu mass formula for SU (3) symmetry - Quarks theory.		
						Total	**22%**	
14	Spectroscopy		IV	I	Introduction to atomic spectroscopy – spectra of the alkali metal vapours – Normal Zeeman effect - Lande's 'g' formula - Paschen back effect - Stark effect – Linear molecules- Spherical top molecules- Symmetric top molecules- Study of hindered internal rotation and inversions (elementary ideas only).	Introduction to atomic spectroscopy - spectra of the alkali metal vapours - Normal Zeeman effect -The anomalous Zeeman effect - Lande's 'g' formula - Paschen back effect - Stark effect - observed stark effect in Hydrogen - weak field stark effect, strong field effect in Hydrogen - calculation of magnetic moment Bohr magneton of an atom - Linear molecules - Spherical top molecules - Symmetric top molecules - ***Study of hindered internal rotation and inversions (elementary ideas only).**	**10**	Skill development
				II	Radiation sources - Pure rotational spectra of gaseous diatomic molecules - Molecular vibration - IR rotation vibration spectra of gaseous diatomic molecules – Classical theory of Raman effect and the selection rule for Raman scattering – Quantum theory of the Raman effect - Pure rotational Raman spectra of diatomic and polyatomic molecules - Raman vibration studies of diatomic molecules.	Radiation sources - Pure rotational spectra of gaseous diatomic molecules - Molecular vibration - salient features of vibrational rotational spectra - IR rotation vibration spectra of gaseous diatomic molecules - molecule as a harmonic oscillator - isotopic effect on vibrational levels - Classical theory of Raman effect and the selection rule for Raman scattering - Quantum theory of the Raman effect - ***Pure rotational Raman spectra of diatomic and polyatomic molecules** - Raman vibration studies of diatomic molecules - calculation of Raman shift.	**6**	
				III	Born-oppenheimer approximation – vibrational coarse structure:progressions – Deslanders table formation – Intensity of vibrational electronic spectra: The Franck-Condon principle – Molecular orbital theory – chemical analysis by electronic spectroscopy – Effect of solvents of electronic spectra Electronic spectra of transition metal complexes: Selection rules only – Jablonski diagram – Resonance fluorescence – normal florescence – Ultraviolet photo electron spectroscopy.	Electronic excitation of Diatomic species - Vibrational analysis of band systems of diatomic molecules and radicals - Deslanders table - Application of Vibratoinal analysis data - Intensity distribution in a band system - The Franck-Condon principle - Jablonski diagram - Resonance fluorescence - Normal florescence - Intensities of transition (selection rules & symmetry forbidden transition) - Phosphorescence and the nature of the triplet state - Population of the triplet state - Intersystem crossing - Phosphoresence Intesity - Excitation spectra.	**16**	
				IV	NMR Quantum mechanical description - Classical description - Bloch equations - Relaxation process - Mechanisms of spin lattice relaxation – chemical shift - Mechanisms of spin-spin relaxation - Experimental technique: The	NMR Quantum mechanical description - Classical description - Bloch equations - Relaxation process - Mechanisms of spin lattice relaxation - Mechanisms of spin-spin relaxation - Experimental technique: The spectrometer: Basic requirements only	**4**	

					spectrometer: Basic requirements only – Fourier transform spectrometer. NQR: Fundamental requirements - General principles - Integral spins – Experimental detection of NQR frequencies – the Super regenerative oscillator - Continuous wave oscillator – Chemical application (main uses only).	- chemical shift - Fourier transform spectrometer - The Analysis of high resolution NMR spectra. NQR: Fundamental requirements - General principles - ***Half integral spins and Integral spins** - Experimental detection of NQR frequencies - the Super regenerative oscillator - Continuous wave oscillator - pulsed r.f. detection - Chemical application (main uses only).		
				V	The ESR experiment - Thermal equilibrium and relaxation - ESR spectrometer - Reflection cavity and microwave bridge - Magnetic field modulation - Characteristics of the g-factor - Hyper fine structure - Energy levels for a radical with S=1/2 and I=1/2 - Mossbauer effect – Recoilness emission and absorption - Mossbauer spectrum - Experimental methods – Chemical isomer shift.	ESR experiment - Thermal equilibrium and relaxation - ESR spectrometer - Reflection cavity and microwave bridge - Magnetic field modulation - ***Characteristics of the g-factor** - Hyper fine structure - Energy levels for a radical with S=1/2 and I=1/2 - Mossbauer effect - Recoilness emission and absorption - Mossbauer spectrum - Experimental methods - Chemical isomer shift - Biological applications.	**4**	
Total							**40%**	
15	Special Electronics		IV		1. Gray code converter. 2. A/D Converter using 741 IC. 3. Flip flops- RS, JK and MS. 4. Wave form generator – 8038. 5. D/A Converter using 741 IC. 6. Study of Multiplexers and Demultiplexers. 7. Decade counter. 8. Digital timers and Frequency Dividers. 9. Counters-MOD-2 to MOD-10. 10. Microprocessor - Musical Tone generator. 11. Microprocessor - Seven segment Running display. 12. Microprocessor - Stepper motor controller 13. Microprocessor - Traffic light interface. 14. Microprocessor - A/D and D/A converters. 15. C++ Program - Evaluating polynomial by Lagrange's interpolation method. 16. C++ Program - Computing area under a curve. 17. C++ Program - Evaluating Sine, Cosine and Exponential series.	1. Gray code converter. 2. A/D Converter using 741 IC. 3. Flip flops- RS, JK and MS. 4. Wave form generator – 8038. 5. D/A Converter using 741 IC. 6. Study of Multiplexers and Demultiplexers. 7. Decade counter. 8. Digital timers and Frequency Dividers. 9. Counters-MOD-2 to MOD-10. 10. Microprocessor - Musical Tone generator. 11. Microprocessor - Seven segment Running display. 12. Microprocessor - Stepper motor controller 13. Microprocessor - Traffic light interface. 14. Microprocessor - A/D and D/A converters. 15. Ring Counter 16. Simultaneous Addition and Subtraction using OP-AMP 17. Clipping and Clamping circuits using OP-AMP 18. OP-AMP - Integrator, Differentiator and Time marker 19. OP-AMP - Sign and Scale changer, CMRR 20. OP-AMP: Analog Computation - First order differential equations	**30**	Skill Development

					18. C++ Program - Solving differential equation by Runge - Kutta method. 19. C++ Program - Evaluating integral by Simpson's 1/3 rule . 20. C++ Program-. Roots of the equation by Newton- Raphson method.			
						Total	**30%**	
16	Relativity and Wave Mechanics		III	I	Einstein's mass-energy relation - Relation between momentum and energy - Four vectors - Four velocity - Energy - Momentum four vectors - Four force - Relativistic classification of particles - Relativistic Lagrangian, Hamiltonian function - Relativistic Lagrangian and Hamiltonian of a charged particle in an EM field.	Variation of mass with velocity and its Experimental verification - Einstein's mass-energy relation - Relation between momentum and energy - Four vectors - Four velocity - Energy - Momentum four vectors - Four force - Relativistic classification of particles - Relativistic Lagrangian, Hamiltonian function - Relativistic Lagrangian and Hamiltonian of a charged particle in an EM field.	**4**	Skill development
				II	Failure of classical mechanics - De Broglie's Theory - Davisson and Germer experiment - G.P Thomson experiment - Uncertainity principle - Illustration of Heisenberg's uncertainity principle - Electron microscope - Advantages over ordinary optical microscope - Applications.	Failure of classical mechanics - De Broglie's Theory - Davisson and Germer experiment - G.P Thomson experiment - Phase velocity and Group velocity - Velocity of De Broglie waves - Uncertainty principle - Illustration of Heisenberg's uncertainty principle - Applications - Electron microscope - Advantages over ordinary optical microscope.	**4**	
				III	Postulates of Quantum Mechanics - Equation of motion of matter waves - Time Independent Schrödinger equation - Schrödinger equation for a free particle - Time Dependent Schrödinger's Equation - Physical Interpretation of the Wave Function - Normalized and orthogonal wave functions - Solution of the Schrödinger Equation - Values of dynamical quantities - Probability current density - Particle flux - Ehrenfest theorem - Eigen value and Eigen function.	Postulates of Quantum Mechanics - Equation of motion of matter waves: Time Dependent Schrödinger's Equation - Physical Interpretation of the Wave Function - Normalized and orthogonal wave functions - Expansion theorem - Solution of the Schrödinger Equation - Values of dynamical quantities - Probability current density - Ehrenfest theorem - Eigen value and Eigen function.	**4**	
				IV	Solution of Schrödinger's equation for a particle in a box - Linear harmonic oscillator - One dimensional square well potential - Step potential - Rigid rotator. Operators - Operator formalism in Quantum Mechanics - Dynamical variables as operators - Hamiltonian operator - Commutation relation between position and momentum -	Time Independent Schrödinger equation - Application of Schrödinger's equation: Particle in a box, linear harmonic oscillator, one-dimensional square well potential and rigid rotator. Operators - Types of operators - Dynamical variables as operators - Momentum operator -Hamiltonian operator - Commutator algebra -	**6**	

					Commutation rules for the components of orbital angular momentum - Ladder operators.	Commutation relation between position and momentum, momentum and Hamiltonian - Commutation rules for the components of orbital angular momentum - Ladder operators.		
				V	First order Time independent perturbation theory - Perturbed harmonic oscillator - Zeeman effect (without electron spin) - First order Stark effect in hydrogen atom - Helium atom.	Time independent perturbation theory - First order and second order perturbation - Perturbed harmonic oscillator - Ground state energy of Helium atom - Zeeman effect (without electron spin) - First order Stark effect in hydrogen atom -.The Variational principle - Rayleigh-Ritz method - Variation method for excited states.	10	
						Total	**28%**	

Chandrasekaran. 22.07.21

Chairman-BoS

Dr. I. CHANDRASEKARAN Ph.D
Associate Professor & Head of Physics
SRMV College of Arts and Science
Coimbatore - 641 020

Principal, Chairman-IQAC

DR. R. THANGAVEL,
M.Sc.,M.Tech.,MBA.,M.Phil.,Ph.D.
PRINCIPAL
SRI RAMAKRISHNA MISSION VIDYALAYA
COLLEGE OF ARTS & SCIENCE
COIMBATORE - 641 020.

SRI RAMAKRISHNA MISSION VIDYALAYA COLLEGE OF ARTS AND SCIENCE, COIMBATORE - 641 020

Department of Physics

Action Taken Report (ATR) of Feedback on Curriculum (2019-20)

The Department of Physics participating in a well-organized descriptive feedback system accompanying all the stakeholders including faculty members, students, Alumni and employers to help the individuals and Department as a whole to enrich the curriculum. The percentage of refinement has been incorporated in the revised curriculum (BoS on 27.11.2020) is depicted as follows.

S.No.	Course Title	Course Code	% of revision
1.	Core -1 Properties of Matter and Sound	20UPH1C01	23
2.	Core - 2 Kinematics, Waves and Oscillations	20UPH1C02	New Course
3.	Core - 3 Electricity and Magnetism	20UPH2C03	20
4.	Core - 4 Dynamics of Fluids and Rigid bodies	20UPH2C04	New Course
5.	Core - 5 Analog and Digital Circuits	20UPH3C05	31
6.	Core - 6 Heat, Thermodynamics and Statistical Mechanics	20UPH4C06	23
7.	Core - 7 Mathematical Physics and Classical Mechanics	20UPH5C07	21
8.	Core - 8 Optics	20UPH5C08	45
9.	Core - 9 Atomic Physics and Spectroscopy	20UPH5C09	21
10.	Core - 10 Microprocessor and its Physics Applications	20UPH5C10	32
11.	Core - 11 Relativity, Wave Mechanics and Space Physics	20UPH6C11	28
12.	Core - 12 Solid State Physics	20UPH6C12	20
13.	Core - 13 Nuclear Physics	20UPH6C13	22
14.	Core - 14 Programming in C and its Physics Applications	20UPH6C14	22
15.	Elective - I Alternate Energy Resources/ Data science using "R"	20UPH6EA1/6EB1	86
16.	Allied Physics – I	20UMA1AL1/20UCH3AL1	47
17.	Allied Physics – II	20UMA2AL2/20UCH4AL2	82

Date: 27.11.2020

27.11.20

HoD of Physics
Dr. J. CHANDRASEKARAN Ph.D
Associate Professor & Head of Physics
SRMV College of Arts and Science
Coimbatore - 641 020

Principal
PRINCIPAL
SRI RAMAKRISHNA MISSION VIDYALAYA
COLLEGE OF ARTS AND SCIENCE
COIMBATORE-641020.

SRI RAMAKRISHNA MISSION VIDYALAYA COLLEGE OF ARTS AND SCIENCE, COIMBATORE-20

DEPARTMENT OF PHYSICS

MINUTES OF BOARD OF STUDIES MEETING

27.11.2020

The Board of Studies meeting in Physics was held on 27.11.2020 between 10.30 am and 1.30 pm through **online platform**. The chairman of BoS, welcome the BoS members, University representative, Subject Experts from various institutions appreciated the tireless efforts made by the Faculty members for redefining the structure and syllabi enrichment of UG programme.

The following are the minutes of the meeting.

The committee

1. passed the change of evaluation pattern comprising of 50 internal and 50 external marks for the students admitted in UG and PG programme from 2020-21 onwards.
2. approves maximum credit of 144 and the maximum marks of 3650 for UG programme for the students admitted from 2020-21 onwards.
3. approves the revised Programme outcomes, Programme Specific outcomes and Course outcomes for all courses in UG programme.
4. encouraged self study/online topics for all the courses in UG programme.
5. approves the two new courses namely “Kinematics, Waves and Oscillations” and “Dynamics of Fluids and Rigid bodies” with 2 credits to interface between School and College.
6. approves the ‘Data Science’ as an optional Elective course for interested students, offered by RKM VERI, Coimbatore campus, instead of ‘Programming in C and its Physics Applications’.
7. endorses the students assignments carried out in Summer training programmes/Internships/Field Projects as a Project Course work at UG and PG level.
8. approves the Value added courses namely, ‘Physics Instrumentation Skills’, ‘CCTV installation and services’ and ‘Mobile phone servicing’ for UG programmes.
9. pronounced to change the title of Unit - III & IV as “Magnetic principles and laws” and “Magnetic potential” respectively, in the Electricity & Magnetism (18UPH2C02) course.
10. proposed to add the content ‘cyclotron’ in the “Unit -II Detectors and Accelerators” in the Nuclear Physics (14UPH6C11) course.

11 suggested to update the syllabi of 'Allied Physics - I & II' and 'Alternate Energy Resources' courses.

In addition, the Stakeholders Feedback analysis and suggestions were incorporated to the continuous success, scaling the sustainability, daunting challenges and textural factors influence met by the learners, responding to needs for curricular change and abreast skills demanded by prospective employers.

Layout of Syllabus revision 2020-21

S.No.	Course Title	Course Code	Semester	Unit	Existing Content	Modified Content	% of revision	Course Focus on
1	Properties of Matter and Sound	**20UPH1C01**	**I**	**I**	Newton's law of gravitation from Kepler's laws – Determination of 'G' by Boy's method – Poynting's method - Variation of 'g' with altitude, depth and latitude – Gravitational potential and field – solid, hollow spheres and Spherical shell.	Newton's law of gravitation- Kepler's laws – Deduction of Newton's law of gravitation from Kepler's law. Determination of 'G' by Boy's method - Poynting's method - Gravitational field and Gravitational potential – ***Determination of gravitational potential and field due to a solid sphere-** Determination of 'g' by compound pendulum and Kater's pendulum.	**2**	Skill Development
				II	Relation between module of elasticity and Poisson's ratio – Work done in stretching and twisting – Twisting couple of a cylinder – Rigidity modulus – Static torsion and Torsional oscillations –uniform and non-uniform bending - Bending moment - 'q' by Koenig's method – Cantilever oscillations.	Relation between the elastic moduli - Poisson's ratio – Determination of Poisson's ratio for rubber – Torsion of a cylinder- Expression for torque per unit twist – Determination of Rigidity modulus – Static torsion method- Dynamic torsion method- Work done in twisting a couple – Torsional oscillations of a body - Bending of Beam-Expression for the bending moment -***Measurement of Young's modulus- Non-uniform and Uniform bending**.	**2**	

				III	Molecular theory – Relation between curvature, pressure and surface tension – Applications to cylindrical, spherical drops and bubbles – Surface tension by Quincke's method, Jacgor's method and Ripple method – Variation of surface tension with temperature. Poiseuille's formula – Viscosity by capillary flow method – Motion through highly viscous liquids-Stoke's formula - Viscosity of gases – Rankine's method.	***Surface tension and surface energy**- Pressure difference across a liquid surface-Excess pressure inside a Liquid drop- Soap bubble – Curved liquid surface – Application s to cylindrical, spherical drops and bubbles - Determination of surface tension by drop weight method- Coefficient of Viscosoty – Poiseuille's formula for rate of flow of liquid in a capillary tube-Poiseuille method for determination of coefficient of viscosity of a liquid- ***Terminal Viscosity and Stoke's formula**- Stoke's formula for the coefficient of viscosity of viscous liquid.	**5**	
				IV	Laws of transverse vibration of strings -Velocity of transverse waves along a stretched string –Melde's experiment –Closed end organ pipe – Open end organ pipe. Classification of sound – Intensity of sound – Measurement of intensity of sound - Doppler effect –Microphones and loud speakers –Wave front at super sonic speed.	Classification of Sound- Intensity of sound - Measurement of intensity of sound - ***Doppler effect -** wave front at supersonic speed -SHM and harmonic oscillator- Energy of a harmonic oscillator –Free, Damped and Forced vibrations – free vibrations of a body- equations of damped harmonic oscillations – Equations of Forced oscillations – Resonance.	**14**	
				V	Reverberation –Sabine's formula –Determination of absorption coefficient –Factors affecting the acoustics of building and their remedies –Ultrasonic waves – protection and applications – Acoustic grating –Wave velocity and group velocity – Frequency	Reverberation –Sabine's formula – Determination of absorption coefficient – Factors affecting the acoustics of building and their remedies –Ultrasonic waves – protection and applications – Acoustic grating –Wave velocity and group velocity – Frequency measurements – Study of waves using		

					measurements – Study of waves using CRO - CRO Applications – Lissajou's figures.	CRO **- *CRO Applications**.		
						Total	**23%**	
2	Electricity and Magnetism	**20UP H2C03**		**I**	Electrical measurements: Potential difference – Electric current – Ohm's law – Resistance – Resistances in series and parallel – Kirchhoff's laws - Ammeters and voltmeters. R, C, L, RC, RL and RLC Circuits in AC and DC	DC Circuits containing L and R, C and R, L,C and R & AC circuit containing C, L, R and R, C and R, L, C - R L C in series and parallel - Phenomenon of Resonance - Series and parallel resonance circuit and Q factor. NETWORK THEOREMS: Thevenin theorem - Norton theorem - Superposition theorem - Maximum Power Transfer theorem - *FILTER CIRCUITS: Low pass, High pass, Band pass circuits.	**20**	Skill Development
				II	Gauss's theorem and its applications- Coulomb's law – Mechanical force experienced by unit area of a charged sphere – Electrified soap bubble – Electrical images (Basics Only). Capacitors: Capacity of a conductor- Energy of a charged conductor- Sharing of energy between two capacitors - Principle of a capacitor- capacity of a spherical and cylindrical capacitors- Capacitors in series and in parallel.	Gauss's theorem and its applications- Coulomb's law – Mechanical force experienced by unit area of a charged sphere – Electrified soap bubble – ***Electrical images (Basics Only).** Capacitors: Capacity of a conductor- Energy of a charged conductor- Sharing of energy between two capacitors - Principle of a capacitor- capacity of a spherical and cylindrical capacitors - ***Capacitors in series and in parallel.**		
				III	Biot-Savart law – Ampere's circuital law – Lorentz force - Electromagnetic Induction: Faraday's laws – Lenz's law - Fleming's right hand thumb rule – Self	Biot-Savart law – Ampere's circuital law – Lorentz force - Electromagnetic Induction: Faraday's laws – Lenz's law - Fleming's right hand thumb rule – Self inductance –		

					inductance – Self inductance of a long solenoid – Determination of self inductance by Rayleigh's method – Mutual inductance – mutual inductance between two solenoids – Determination of mutual inductance.	Self inductance of a long solenoid – Determination of self inductance by Rayleigh's method – Mutual inductance – mutual inductance between two solenoids – ***Determination of mutual inductance.**		
				IV	Magnetic potential – potential and intensity at a point due to a bar magnet-magnetic intensity at any point due to bar magnet - magnetic potential at a point due to a magnetized sphere – magnetic shell – potential at a point due to a magnetic shell – permeability – susceptibility – Relation between μ and χ - Gauss theorem in magnetism - applications.	Permeability - susceptibility - Relation between μ and χ - Magnetic potential - potential and intensity at a point due to a bar magnet - magnetic intensity at any point due to bar magnet - magnetic potential at a point due to a magnetized sphere - magnetic shell - potential at a point due to a magnetic shell - ***Gauss theorem in magnetism - applications**.		
				V	Magnetic induction – Magnetization M – Properties of dia, para and ferro magnetic materials –Anti ferro magnetism and ferri magnetism - Electron theory of magnetism – Langevin's theory of para magnetism - Weiss's theory of ferro magnetism – determination of draw M-H curve (horizontal model) – Energy loss due to hysteresis.	Magnetic induction - Magnetization M - Properties of dia, para and ferro magnetic materials - Antiferro magnetism and ferri magnetism - Electron theory of magnetism - Langevin's theory of para magnetism - Weiss theory of ferromagnetism - ***determination of draw M-H curve (horizontal model) - Energy loss due to hysteresis.**		
						Total	**20%**	

3	Analog and Digital Circuits	**20UP H3C05**	**III**	**I**	Energy band in solids – types of semiconductor – majority and minority carriers – Mobile charge carriers and immobile ions – drift current in intrinsic semiconductor – PN junction – Depletion layer – barrier voltage – Effect of temperature – forward biased and reverse biased pn junction – Zener breakdown – Avalanche breakdown – H parameters in CE and CB configuration.	Energy band in solids - types of semiconductor - majority and minority carriers - Mobile charge carriers and immobile ions - drift current in intrinsic semiconductor - PN junction - Depletion layer - barrier voltage - Effect of temperature - forward biased and reverse biased pn junction - Zener breakdown - Avalanche breakdown - Tunnel diode - Varactor diode - PIN diode – *LED - Diode characteristics*	**2**	Skill Development
				II	Single stage Transistor amplifiers – CB,CE and CC – comparison of amplifier configuration – Amplifier classification based on the biasing condition – Class B push-pull amplifier – Complementary Symmetry push-pull class B amplifier – Distortion in amplifiers – RC and Transformer coupled two stage amplifiers – Direct-couple amplifier using complementary and symmetry of two transistors – Darlington pair	**Amplifiers:** Transformer coupled Class A amplifier - Class B push-pull amplifier – RC and Impedance coupled two stage amplifiers - Distortion in amplifiers – H parameters in CE and CB configuration **Oscillators:** Comparison between an amplifier and oscillator – Damped and undamped Oscillations – Tuned base oscillator – ***Tuned collector oscillator** - Hartley and ***Wien bridge oscillator** - Crystal controlled Oscillator - Phase shift oscillator - Astable, ***Monostable** and Bistable multivibrator.	**2**	
				IV	Rectifiers – Half wave - full wave rectifiers – voltage regulation using Zener diode and transistor-Characteristics of ideal and practical operational amplifiers –Inverting and Non-inverting amplifier – Adder – Subtractor - Integrator – Differentiator -	Rectifiers – Half wave - full wave rectifiers – Ripple factor - *Voltage regulation using Zener diode* – Limiters, Clippers, Clampers - Characteristics of ideal and practical operational amplifiers – Unity gain follower – Parameters of OP-AMP - Adder – Subtractor - Integrator – Differentiator –	**5**	

					Comparator.	Comparator - Low pass, High pass and Band pass filter Circuits		
				IV	Comparison between an amplifier and oscillator – Damped and undamped Oscillations – Tuned base oscillator – Tuned collector oscillator - Hartley and Colpitt's oscillator Phase shift oscillator and Crystal controlled oscillator – Astable and Bistablemultivibrator	Difference between Analog and Digital circuits - Decimal, Binary, Octal and Hexadecimal number system - Conversions between them – Advantages of Octal and Hexadecimal number system - Binary addition, subtraction and multiplication – 1s and 2s complements – BCD – Signed and Unsigned numbers - Weighted and non-weighted codes – ASCII code – *Gray to Binary and Binary to Gray conversion*	**20**	
				V	Basic logic gates – Demorgan's theorem – NAND and NOR as a universal gates – Half adder – Full adder - Half subtractor – Full subtractor – 4 Bit binary adder – RS flip flop- J-K flip flop – Digital to Analog Converter (R-2R ladder D/A converter) – Analog to Digital converter (Counter type A/D converter).	Boolean laws – Associative and distributive properties - Basic and Derived logic gates (AND, OR, NOT, XOR, NAND, NOR and XNOR) - *Demorgan's theorem* - NAND and NOR as a universal gates – Half adder - Full adder - Half subtractor - Full subtractor – Four Bit binary adder - RS and J-K flip flops - R-2R ladder Digital to Analog Converter - Counter type Analog to Digital converter	**2**	
						Total	**31%**	
4	Heat, Thermodynamics and Statistical Mechanics			**I**	Concept of heat and temperature-Centigrade and Fahrenheit Scales-Types of thermometer- Platinum resistance thermometer-Expansion of solids-Coefficient of liner expansion - Coefficient of superficial expansion-	Postulates of kinetic theory of gases - Expression for the pressure exerted by gas - rms speed - kinetic energy per unit volume of a gas - Derivation of gas equation and gas laws - Graham's law of diffusion of gases. ***Molecular Collision - Sphere of influence**	**20**	Skill Development

					relation between α and β-Expansion of liquids -Relation between Co-efficient of apparent and real expansion.	- Clausius' expression for mean free path - Transport phenomena - Viscosity: transport of momentum - Thermal conductivity: transport of thermal energy - Diffusion: transport of mass.		
		20UP H4C06		**II**	Coefficient of thermal conductivity- Forbe's method -Lee's method for bad conductors - Radial flow of heat - Widemann Franz's law -Stefan's law and verification -Newton's law of cooling - Wein's law Rayleigh jeans law and Planck's law -Solar constant -Surface temperature of sun -Angstrom's Pyroheliometer.	Coefficient of thermal conductivity- Forbe's method -Lee's method for bad conductors – Thermal conductivity of Rubber- Radialflow of heat – Cylindrical flow of heat- Widemann Franz's law -Stefan's law and verification - -Wein's law Rayleigh jeans law and Planck's law - ***Solar constant - Surface temperature of sun** -Angstrom's Pyroheliometer.	**2**	
				III	Porous plug experiment and its results - Joule Kelvin effect -Temperature of inversion -Liquefaction of air, Liquefaction of hydrogen, Liquefaction of helium -Adiabatic demagnetization – Electrolux Refrigerator.	Porous plug experiment - Theory of Porous plug experiment and its results - Joule Kelvin effect -Temperature of inversion – Relation between Boyle temperature, temperature of inversion and critical temperature - Liquefaction of air- Linde's process - ***Liquefaction of hydrogen**, Liquefaction of helium- K.Onnes method - Helium I and II- ***Adiabatic demagnetization**	**1**	
				IV	First law of Thermodynamics - Determination of γ -Clement and Desormer's method -Second law of thermodynamics – Carnot engine-Otto Cycle -Clausiusclapcyron's latent heat equation and its applications -Entropy - Third law of thermodynamics -Entropy of a perfect gas -Entropy diagram -Zero	First law of Thermodynamics - Determination of γ-Clement and Desormer's method -Second law of thermodynamics – Carnot engine Otto Cycle –Clausius clapcyron's latent heat equation and its applications -Entropy -Third law of thermodynamics -Entropy of a perfect gas -		

					point energy -Maxwell's Thermo dynamical relations	Entropy diagram - Zero point energy -Maxwell's Thermo dynamical relations.		
				V	Statistical equilibrium -Probability theorems in statistical thermodynamics- Maxwell Boltzmann distribution in terms of temperature -Ideal gas- Quantum statistics -Phase space - Bose Einstein statistics -Distribution law -Photon gas - Fermi Dirac statistics -Distribution law - Electron gas -Comparison of three statistics.	***Statistical equilibrium** - Maxwell Boltzmanndistribution Law - Maxwell Boltzmanndistribution in terms of temperature -Ideal gas- Quantum statistics - Phase space - Bose Einsteinstatistics - Distribution law -Photon gas - Fermi Dirac statistics -Distribution law -Electron gas - ***Comparison of three statistics.**		
Total							**23%**	
5	Mathematical Physics and Classical Mechanics	20UPH5C07	V	I	Gradient of a scalar field - line, surface and volume integral - Divergence of a vector function - examples - Curl of a vector function - ***Important vector identities** - Gauss divergence theorem - Stoke's theorem - Green's theorem - examples.	Gradient of a scalar field - line, surface and volume integral - Divergence of a vector function - examples - Curl of a vector function - ***Important vector identities** - Gauss divergence theorem - Stoke's theorem - Green's theorem - examples.		Skill Development
				II	Curvilinear coordinates – transformation of coordinates – orthogonal curvilinear coordinates – unit vectors in curvilinear systems – cylindrical coordinates – spherical polar coordinates – curl, divergence and gradient in curvilinear, cylindrical and spherical polar coordinates.	Orthogonal curvilinear coordinates - Cylindrical coordinates - Spherical polar coordinates - Curl, Divergence and Gradient in terms of curvilinear, cylindrical and spherical polar coordinates. **Laplace transforms:** Definition - important formulae - properties of Laplace transforms - Laplace transform of the derivative of a function f(t)	**10**	

				III	Special types of matrices -Properties of unitary and orthogonal matrices -Eigen values and Eigen functions- Cayley - Hamilton theorem- Diagonalisation of matrix -Solution of quadratic equations by matrix method.	Special types of matrices -Properties of unitary and orthogonal matrices -Eigen values and Eigen functions- Cayley - Hamilton theorem- Diagonalisation of matrix – Hermitian matrix – Skew Hermitian matrix - Non-symmetric matrix with Non-repeated Eigen values – Repeated Eigen values - Symmetric matrices with Non-repeated Eigen Values – Repeated values.	**10**	
				IV	Complex analysis - Analytic functions - Cauchy - Riemann equations - Cauchy's Integral theorem - Integral formula - Residues - *Residue theorem (Evaluation of Definite integrals of trigonometry functions of cos θ and sin θ only). Special Functions: Definition - Beta function - Gamma function - Evaluation of Beta function - Evaluation of Gamma function - Relation between Beta and Gamma functions.	Complex analysis - Analytic functions - Cauchy - Riemann equations - Cauchy's Integral theorem - Integral formula - Residues - *Residue theorem (Evaluation of Definite integrals of trigonometry functions of cos θ and sin θ only). Special Functions: Definition - Beta function - Gamma function - Evaluation of Beta function - Evaluation of Gamma function - Relation between Beta and Gamma functions.		
				V	Conservation theorem – linear and angular momentum - energy – Degress of freedom – constraints – Generalized co-ordinates – transformation equations – Generalized displacement, velocity, acceleration, momentum and force – Principle of virtual work – D' Alembert's principle – Lagrange's equation of motion – linear Harmonic Oscillator, Simple Pendulum and Compound Pendulum.	Conservation theorem for linear and angular momentum and energy - *Degrees of freedom* - *Constraints* - Generalized displacement, velocity, acceleration, momentum - Principle of virtual work - D' Alembert's principle - Lagrange's equation of motion - Application of Lagrange's equation of motion to linear Harmonic Oscillator, Simple Pendulum Compound Pendulum, The Atwood's machine, LCR circuit.	**1**	

						Total	**21%**	
6	Optics	20UPH 5C08	III	I	**OPTICAL INSTRUMENTS** Aberrations: – Lens aberrations – pherical aberrations – reducing spherical aberrations –comma – astigmatism – distortion – chromatic aberration – chromatic lens- telephotolens- microscope – simple microscope- compound microscope- Telescope: angular magnification of telescope- Refracting Astronomical - Reflecting Astronomical - Reflecting telescopes - Eye pieces: Huygens and Ramsden – comparison – Velocity of light: Michelson's rotating mirror method - Houston's method.	**Newton's corpuscular theory - reflection of light on corpuscular theory - refraction of light on corpuscular theory - origin of wave theory - reflection of a spherical wavefront at a plane surface - reflection of a spherical wavefront at a spherical surface - Refraction of a spherical wavefront at a plane surface - refraction of a spherical wavefront at a spherical surface.** **Velocity of light: Foucault's rotating mirror method - Michelson's modification of Foucault's method - Rotating mirror null method - Kerr cell method - Houston's method - *Refraction through a convex and concave lenses.**	**20**	Employability and Skill development
				II	**INTERFERENCE** Young's experiment-Coherent sources – phase difference and path difference- theory of interference fringes- Fresnel's Biprism – Lloyd's single mirror- Billet's split lens- Interference in thin films- interference due to reflected light- Colours of Thin Film - Newton's rings - Determination of the wavelength of the sodium light - Refractive index of a liquid - Newton's rings with white Light – Haidinger's fringes- Michelson Interferometer– visibility of fringes- applications- determination of the	Coherent sources – phase difference and path difference- theory ofinterference fringes- Fresnel's Biprism – Lloyd's single mirror- Billet's split lens-Newton's rings - Determination of the wavelength of the sodium light - Refractive index of a liquid - Newton's rings with white Light – Haidinger's fringes – Michelson Interferometer– visibility of fringes- applications- Determination of the difference in wavelength between two neighbouring spectral lines - Determination of the refractive index of thin transparent plates - Determination of the refractive index of	**8**	

					refractive index of gases – Jamin'sRefractometer – Mach-Zehnderrefractometer - Rayleigh's Refractometer - FabryPerot Interferometer.	gases –Jamin'sRefractometer – Mach-Zehnderrefractometer - Rayleigh's Refractometer - FabryPerot - Interferometer.- Holography- Temporal coherence - Spatial coherence		
	Optics			III	**DIFFRACTION** Fresnel assumptions - Rectilinear propagation of light - Zone plate -action of zone plate for an incident spherical wave front –difference between a zone plate and a convex lens-Fresnel and Fraunhofer Diffraction –diffraction at a circular aperature- diffraction at an opaque circular disc Fresnel Diffraction at a Straight edge- intensity at a point inside thegeometrical shadow (straight edge) - Fresnel Diffraction at a narrow slit and Narrow wire-Fraunhofer Diffraction at a Single slit and Double slit - Plane Transmission grating - Dispersive power of grating.	Fresnel assumptions - Rectilinear propagation of light - Zone plate -action of zone plate for an incident spherical wave front –difference between a zone plate and a convex lens-Fresnel and Fraunhofer Diffraction –diffraction at a circular aperature- diffraction at an opaque circular disc Fresnel Diffraction at a Straight edge- intensity at a point inside the geometrical shadow (straight edge) - Fresnel Diffraction at a narrow slit and Narrow wire- Fraunhofer Diffraction at a Double slit – Dispersive power of grating- concave reflecting grating- Echelon grating	**5**	
				IV	**POLARISATION** Polarization of transverse waves –plane of polarization- Brewster's law-polarization by refraction -Double refraction - Nicol prism –Nicol prism as an analyser- Huygen's theory for uniaxial crystals - Quarter wave plate and half wave plate - Production and	Polarization of transverse waves –plane of polarization- Brewster's law- Huygen's theory for uniaxial crystals-Optic axis in the plane of incidence and inclined to the crystal surface - Optic axis in the plane of incidence and parallel to the crystal surface - Optic axis in the plane of incidence and perpendicular to the crystal surface- Quarter	**6**	

					Detection of Plane, Circularly and Elliptically Polarized light - Babinet's compensator – Dichroism- Optical activity - Fresnel's Explanation of optical rotation – Experimental verification - Specific rotation: Laurent's half shade polarimeter.	wave plate and half wave plate - Production and Detection of Plane, Circularly and Elliptically Polarized light - Babinet's compensator – Dichroism- Fresnel's Rhomb- Optical activity - Fresnel's Explanation of optical rotation – Experimental verification - Specific rotation: Laurent's half shade polarimeter- LippichPolarimeter-***Huygen's theory for uniaxial crystals**		
	Optics			V	**LASERS AND FIBRE OPTICS** Lasers: Induced absorption - spontaneous emission and stimulated emission – The ruby laser – semiconductor laser. Fibre Optics : Introduction – optical fibre – optical fibre system – optical fibre cable –total internal reflection – propagation of light through and optical fibre- critical angle of propagation – acceptance angle – numerical aperture – skip distance and number of total internal reflections – classification of optical fibres – The three types of fibres – single mode step index fibre – multimode step index fibre – graded index fibre –fibre optic communication system – merits of optical fibres.	Telephoto lens- microscope – simple microscope- electron microscope Telescope: angular magnification of telescope- Terrestrialtelescope–Galileo's telescope -Eye pieces: Huygens – Cardinal points of Huyges eyepiece -Ramsden eyepiece- cardinal points of Ramsden eyepiece-Gauss eyepiece – comparison of Huyges and Ramsden eyepiece-Abbe's Homogeneous oil immersion objective –Types of reflecting telescope- Lasers- spontaneous and stimulated emission and Einstein's A and B coefficients-Ruby laser- Population inversion and Helium- neon laser- optical fibre system- optical fibre cable -The three types of fibres.	**6**	
						Total	**45%**	
7	Atomic Physics and	20UPH 5C09	V	I	Rutherford's experiments on α particle scattering - Experimental verification - Bohr's atom model - Critical potentials -	Rutherford's experiments on α particle scattering - Experimental verification - Bohr's atom model - Critical potentials -		Skill developme nt

	Spectroscopy				Atomic excitation - Experimental determination of critical potentials - Franck and Hertz method - Davis and Goucher's method - ***Mass spectrograph: Dempster's mass spectrograph** - Aston's mass spectrograph.	Atomic excitation - Experimental determination of critical potentials - Franck and Hertz method - Davis and Goucher's method - ***Mass spectrograph: Dempster's mass spectrograph** - Aston's mass spectrograph.		
				II	Sommerfeld's relativistic atom model – The Vector atom model – Quantum numbers associated with the vector atom model – Coupling schemes – L-S coupling –J J coupling – The Pauli's exclusion principle – magnetic dipole moment – The stern and Gerlach Experiment – Spin orbit coupling.	Sommerfeld's relativistic atom model – The Vector atom model – Quantum numbers associated with the vector atom model – Coupling schemes – Electronic configuration of elements - The Pauli's exclusion principle – magnetic dipole moment due to orbital and spin – The stern and Gerlach Experiment – Spectral terms and notations – selection rules - intensity rule and interval rule – Fine structure of sodium D lines	**8**	
				III	Zeeman effect – Larmor's theorem – Paschen back effect – Stark effect – Production of X-rays – Bragg's law – Bragg's X-ray spectrometer – X- ray spectra – Characteristics of X-ray spectra – Mosley's law – Compton effect – Photo electric effect – Experimental investigation – Einstein's Photo electric equation – Photo voltaic cell.	Zeeman effect – Experimental arrangements – Expression for Zeeman shift – Quantum mechanical explanation of normal Zeeman effect - Larmor's theorem – Paschen back effect – Stark effect – Mosley's law and its importance – X-ray spectra – Continuous spectrum – Characteristic spectrum - Compton effect – Expression for Compton shift (dλ) - Photo electric effect – Richardson and Compton experiment – Einstein's Photo electric equation – Millikan's experiment - *Photo voltaic cell*.	**10**	
				IV	**Molecular spectra:** Introduction –	Molecular spectra: Introduction – Origin of	**1**	

					Origin of molecular spectra – Nature of molecular spectra – Rotation of linear system – Non rigid rotator -Theory of the origin of pure rotational spectrum of a molecule – Electronic spectra of molecule. **Raman effect:** Experimental study of Raman effect – Quantum theory of Raman effect – applications- Laser Raman spectroscopy - Classical theory of Raman effect - vibrational Raman spectra of diatomic molecules.	molecular spectra – Nature of molecular spectra – Rotation of linear system – Non rigid rotator -Theory of the origin of pure rotational spectrum of a molecule – Electronic spectra of molecule. Raman effect: *Experimental study of Raman effect* – Quantum theory of Raman effect – *Laser Raman spectroscopy* - Classical theory of Raman effect - vibrational Raman spectra of diatomic molecules – Pure rotational Raman spectra		
				V	The energy of a diatomic molecule – vibrating diatomic molecule as a harmonic oscillator - spectroscopic techniques – constant deviation spectrograph – recording the spectrum – UV spectroscopy – Quartz spectrograph for near UV region - Infra red spectroscopy – absorption spectroscopy – Double beam IR spectrometer –Raman spectroscopy – Raman spectrometer.	The energy of a diatomic molecule - vibrating diatomic molecule as a harmonic oscillator- spectroscopic techniques – constant deviation spectrograph – recording the spectrum – UV spectroscopy – Quartz spectrograph for near UV region - Littrow spectrograph - Infra red spectroscopy – Wadsworth Prism-Mirror spectrograph - *absorption spectroscopy – Double beam IR spectrometer.*	**2**	
						Total	**21%**	
8	Microprocessor and its Physics Applications	20UPH5C10		I	Evolution of Microprocessor-First, second, third and fourth generation microprocessors- Microprocessor based systems - Micro, Mini and Large computers - Advantages and disadvantages of microprocessor based system - General description of Intel	Evolution of Microprocessor-First, second, third and fourth generation microprocessors- Microprocessor based systems - Micro, Mini and Large computers - Advantages and disadvantages of microprocessor based system - General description of Intel 8085 - Pin configuration - 8085 Signal description	**4**	Employability and Skill development

					8085 - Pin configuration - 8085 Signal description summary - Block diagram of Intel 8085 - Intel 8085 architecture - Introduction to memory – Semiconductor memory - ROM, PROM, EPROM, static RAM, DRAM and NOVRAM	summary - Intel 8085 architecture - Machin cycles of 8085-T-states-Opcode fetch machine cycleof 8085- **Memory read/write Machine cycle of 8085*(self study).** Introduction to memory – Semiconductor memory - ROM, PROM, EPROM, static RAM, DRAM and NOVRAM.		
				II	Instruction format of 8085 – Basics of Addressing modes-Instruction set –Data transfer Instructions - Arithmetic instructions – ADD reg; ADI d8; ADD M; ACI d8; ADC reg; ADC M; SUB reg; SUI d8; SUB M; SBB reg; SBI d8; SBB M; DAA; DAD rp; INR reg; INR M; DCR reg; DCR M; INX rp and DCX rp with examples.Logical instructions – ANA reg; ANI d8; ANA M; ORA reg; ORA M; ORI d8; XRA reg; XRI d8; XRA M; CMP reg; CPI d8; CMP M; CMA; STC; CMC; RLC; RRC;RAR and RAL with examples. Branching and Machine control instructions- JMP addr16; J<condition>addr 16; CALL addr 16; C <condition>addr 16; RET; R <condition> ; RSt n; PCHL; DI; EI; SIM; RIM HLT and NOP with detailed descriptions - Assembler – Assembler Directive - Flow Charts – Assembly language program development tools – Program development algorithms	Instruction format of 8085 –Hexcode- Basics of Addressing modes-Instruction set –Data transfer Instructions - Arithmetic instructions – ADD reg; ADI d8; ADD M; ACI d8; ADC reg; ADC M; SUB reg; SUI d8; SUB M; SBB reg; SBI d8; SBB M; DAA; DAD rp; INR reg; INR M; DCR reg; DCR M; INX rp and DCX rp with examples.Logical instructions – ANA reg; ANI d8; ANA M; ORA reg; ORA M; ORI d8; XRA reg; XRI d8; XRA M; CMP reg; CPI d8; CMP M; CMA; STC; CMC; RLC; RRC;RAR and RAL with examples. Branching instructions- JMP addr16; J<condition>addr 16; CALL addr 16; C <condition>addr 16; RET; R <condition> ; RSt n; **Machine control instructions PCHL; DI; EI; SIM; RIM HLT and NOP with detailed descriptions.(self study)**	-	

				III	Programme to transfer data between memory and accumulator – 1's and 2's complement of 8 bit data - Programme to add two 8 bit data –Subtract two 8 bit data – Subtract two BCD data – Binary to Gray – Gray to Binary conversion. Programme to add two 16 bit data – Subtract two 16 bit data – Add two BCD data – add an array of datas - Programme to sort an array of data in Ascending and Descending order- Programme to multiply two numbers of 8 bit data - Programme to find the square root of a given binary number – Programme to search a smallest in the given array of data.	Assembler – need for assembler -advantages of assembler -symbols and representation in Flow Charts. Instruction execution and data flow in 8085-Programme to transfer data between memory and accumulator – 1's and 2's complement of 8 bit data - Programme to add two 8 bit data –Subtract two 8 bit data – Subtract two BCD data. Programme to add two 16 bit data – Add two BCD data – add an array of datas - Programme to sort an array of data in Ascending and Descending order- Programme to multiply two numbers of 8 bit data– Programme to search a smallest in the given array of data. **Assembly level programming for Binary to Gray – Gray to Binary conversion- Programme to find the square root of a given binary number. (Algorithm, flowchart and programming. Self study through online)**	**8**	
				IV	Interfacing SRAM and EPROM – Memory capacity – Choice of memory IC's and address allocation – Interfacing I/O devices and peripheral IC's — I/O device mapping (simple descriptions) - Needs for interrupts – Types of interrupts —Polling of interrupts – Data transfer schemes – Synchronous data transfer scheme – Asynchronous data transfer scheme – Interrupt driven data transfer scheme - 8259 Programmable interrupt	Interfacing SRAM and EPROM – Memory capacity – Choice of memory IC's and address allocation I/O structure of typical microcomputer– Interfacing I/O devices and peripheral IC's — I/O device mapping (simple descriptions) -comparision of memory mapping and I/O mapping-DMA datatransfer scheme. Needs for interrupts – Types of interrupts —Polling of interrupts – – Interrupt driven data transfer scheme - 8259 Programmable interrupt controller –	**4**	

					controller – 8255 peripheral interface- 8257 DMA controller.	8255 peripheral interface-**Data transfer schemes – Synchronous data transfer scheme – Asynchronous data transfer scheme(self study)**		
				V	Temperature control system– Motor speed control system – Stepper motor control system – Traffic control system – Keyboard control system.	Temperature control system– motor speed control system – Traffic control system – Keyboard interfacing using ports. **Subroutine- Delay routine-writing practice for different delay routine to produce a time delay in 8085 processor based system whose clock frequency is 3 MHz.and 6 MHz.(self study)**	**16**	
						Total	**32%**	
9	Alternate Energy Resources	20UPH 6EA1		I	**INTRODUCTION** Introduction – Consumption pattern – Oil shock – Types based on usage – Usage pattern of primary energy sources – Necessity of harnessing alternate energy resources – Energy chain – Energy and its major classifications.	**ENERGY AND RADIATION MEASUREMENT** World Energy Futures - Energy Sources and their availability - Renewable Energy Sources - Prospects of Renewable energy sources - Solar Constant - Solar Radiation at the Earth's surface -solar radiation Geometry - *Solar radiation measurements - Estimation of average solar radiation - Solar radiation on tilted surface.	**20**	Employability, Entrepreneurship and Skill development
				II	**ENERGY CRISIS** Salient features and drawbacks of energy sources in practice- Alternate energy sources and their significances- Energy and its influence on environment - Heating values of various fuels – Energy status – Global context –Indian context	**HEAT TRANSFER PRINCIPLE AND SOLAR COLLECTORS** Conduction - Convection-Radiation – Reflectivity – Transmissivity - Transmittance Absorptance product - Physical Principles of the Conversion of Solar radiation into Heat - Flat Plate Liquid	**20**	

						Collectors - Transmissivity of cover system - Energy Balance Equation and Collector Efficiency - Thermal performance of FPC - Solar Air Heater and their applications - Concentrating Collector - *Performance analysis of a Cylindrical Parabolic Concentrating Collectors.		
				III	**THERMAL CONVERSION** Principles of Solar thermal conversion - Solar collectors - Solar water heater- Solar passive space heating and cooling systems - Solar industrial heating systems - Solar cookers – Solar furnaces- Solar green house - Solar desalination - Solar pumping – Satellite solar power stations	**APPLICATIONS OF SOLAR ENERGY** Solar Water Heating - Solar Thermal Electric Conversion - Solar Photovoltaics - Types of solar cells - Solar Distillation - Solar Pumping - Solar Furnace - Solar Cooking - Solar Energy Storage Systems - Solar Ponds - *Types of Solar Ponds.	**8**	
				IV	**BIOMASS ENERGY** Introduction - Photosynthesis - Bio-gas generation - Digesters and their design - Some materials for biogas and biomass - Advantages and disadvantages of biological conversion of solar energy applications of biogas.	**BIOMASS AND WIND ENERGY** Bio Mass conversion Technologies - Bio Gas generation - Factors Affecting Bio – Digestion - Classification of Biogas Plants - Types of Biogas Plants - Materials used for Biogas Generation -Basic principles of wind energy conversion - Basic components of wind energy conversion system - Classification of WEC System - *Wind energy collectors - Performance of wind Machines.	**18**	
				V	**FUEL CELL** Introduction to fuel cell – Potential	**ENERGY STORAGE AND INDIRECT SOURCES OF SOLAR ENERGY**	**20**	

					applications – Classifications – Phosphoric acid fuel cell (PAFC) – Alkane fuel cell (AFC) – Fuel cell power plot- Magneto hydro dynamic (MHD) power conversion – Principle MZHD generator – Advantages – Limitations.	**CONVERSION** Solar Energy Storage Systems - Chemical Storage - Thermal Storage - Electrical Storage - Geothermal energy - Nature of Geothermal Fields - Geothermal Sources - Hydrothermal Resources - Material Selection for Geothermal Power Plants - Geothermal explanation - *Ocean Thermal Electric Conversion.		
						Total	**86%**	
10	Relativity, Wave Mechanics and Space Physics	20UPH 6C11	VI	I	Michelson-Morley Experiment - Gallilean Transformationand Newtonian Relativity - Inadequacy of Gallilean Transformation - Fundamental Postulates of Special Theory of Relativity - Lorentz Transformation Equations - Length Contraction and Time Dilation –Law of Addition of Velocity- Variation of Mass with Velocity -Equivalence of Mass and Energy.	Frame of Reference - inertial and non-inertial frames - Michelson-Morley Experiment - Galilean Transformationand Newtonian Relativity - *General theory of relativity – Predictions on general theory of relativity* - Fundamental Postulates of Special Theory of Relativity - Lorentz Transformation Equations - Length Contraction and Time Dilation – Law of Addition of Velocity - Variation of Mass with Velocity - Equivalence of Mass and Energy.	**4**	Skill development

				II	De Broglie hypothesis - Concept of Phase Velocity and Group Velocity - Relation between group velocity and wave velocity - Experiments of Davisson and Germer and G.P. Thomson - Wave packet - Heisenberg uncertainity principle and its proof - Illustrations - Diffraction of electrons by a slit - Gamma ray microscope - Applications of uncertainity principle - Non-existence of electrons in the nucleus - ***Radius of Bohr's first orbit of hydrogen atom and energy of ground state.**	De Broglie hypothesis - Concept of Phase Velocity and Group Velocity - Relation between group velocity and wave velocity - Experiments of Davisson and Germer and G.P. Thomson - Wave packet - Heisenberg uncertainity principle and its proof - Illustrations - Diffraction of electrons by a slit - Gamma ray microscope - Applications of uncertainity principle - Non-existence of electrons in the nucleus - ***Radius of Bohr's first orbit of hydrogen atom and energy of ground state.**	-	
				III	Wave function for a free particle – Schrodinger's one dimensional wave equation – Time dependent and independent parts- Physical interpretation of wave function – Operators in quantum mechanics – Eigen functions – Eigen value – Eigen value equations – Postulates of quantum mechanics – Orthogonality of Eigen functions – Probability current density – Ehrenfest's theorem.	Wave function for a free particle - Physical interpretation of wave function Schrodinger's one dimensional wave equation - Time dependent and independent parts - Solution of Schrodinger equation for Particle in a box, Rigid rotator and ***Linear harmonic oscillator** - Postulates of quantum mechanics - Probability current density - Ehrenfest's theorem.	-	
				IV	Significance of various quantum numbers – n, l, m_l – Electron probability density – Commutation relations – Position and momentum, H and P, between the components of L, L^2 with	Significance of various quantum numbers – n, l, m_l – Operators for momentum, kinetic energy and total energy - Orbital angular momentum operator - Commutation relation between position and momentum, H and P,	**4**	

					L_x, L_y and L_z – Ladder operators L_+ and L_- - Particle in a box – Potential step – The barrier penetration problem – Linear harmonic oscillator.	the components of L, L^2 with L_x, L_y and L_z – *Ladder operators L_+ and L_-* Solution of Schrodinger equation for Particle in a box, Rigid rotator, The barrier penetration problem and Linear harmonic oscillator.		
				V	Solar system-Astronomical Instruments-Refracting telescope-Reflecting telescope-Radio telescope measurement of distance-Size-Rotation – Mass of the sun-Surface temperature – Atmosphere - Planets- Asteroids – Comets -Meteorites-Sun - Star- Physical Properties of Stars-Masses of stars-Stellar Evolution-Milky Way Galaxy – Expanding Universe- Big-bang theory.	Sun synchronous orbit – Geo synchronous orbit – Rocket technology in India – Rohini-75 – Launching of Satellites SLV, ASLV and PSLV programmes – *Other Satellite launch vehicles* – India's achievements in space science INSAT-1A, 1B, 1C and 1D – INSAT – 2 second generation – INSAT 2A, 2B, 2C, 2D and 2E – INTELSAT-I - INTELSAT-VII – Mars Orbiter Mission (Mangalyaan) - *Chandrayaan*	**20**	
						Total	**28%**	
11	Solid State Physics	20UPH 6C12		I	Elements of Crystal Structure - X ray Diffraction - Bragg's Law - Miller Indices - Simple Crystal Structures - Calculation of number of atoms per unit cell – Atomic radius – co-ordination number – Packing factor for SC,BCC,FCC and HCP structures – Rotating crystal method - Powder Photograph method – determination of unit cell dimensions. Crystal imperfections**:** Point defects – line defects –Surface defects – Volume defects.	Lattice – Unit cell – Bravais lattice – Lattice planes - Miller indices - d spacing in cubic lattice - calculation of no of atoms per unit cell - Atomic radius – co-ordination number - packing factor for SC, BCC, FCC and HCP structures – ***Diamond and Graphite structures**.* X-Ray diffraction – Bragg's law – Rotating crystal method – Powder photograph method – crystal imperfection : Point defects – line defects – surface defects – volume defects **–** ***Effects of crystal imperfection.**	**7**	Skill development

				II	Electrical conduction classification of conducting materials – Drude Lorentz theory – Expression for electrical conductivity – Thermal conductivity – Expression for thermal conductivity – Wiedemann – Franz law – electrical resistivity versus temperature- schottky effect- photoelectric effect – photoelectric emission-free electron gas in three dimensions- periodic boundary conditions- The Fermi Energy failure of the free electron model.	Electrical conduction classification of conducting materials – Drude Lorentz theory – Expression for electrical conductivity – Thermal conductivity – Expression for thermal conductivity – Wiedemann – Franz law – electrical resistivity versus temperature- Fermi surface- Fermi distribution function-.* High resistive materials- High resistive alloys – photoelectric emission-free electron gas in three dimensions- periodic boundary conditions- The Fermi Energy failure of the free electron model.	**8**	
				III	Dielectric polarization -Dielectric constant and displacement vector - Different types of dielectric polarization – Frequency and temperature effects on polarization – Dielectric loss – Dielectric break down – local fields – ClausiusMossotti relation.- Piezoelectric effect- properties of ferroelectrics.	Dielectric polarization -Dielectric constant and displacement vector - Different types of dielectric polarization – Frequency and temperature effects on polarization – Dielectric loss – local fields – Clausius Mossotti relation.- Solid insulating materials- liquid insulating materials- gaseous insulating materials- properties of ferroelectrics.	**5**	

				IV	Super conductivity phenomena – Effect of magnetic field - Properties of Superconductors – Type I and Type II Superconductors -Meissner effect – High Tc Superconductors -SQUIDS. Isotope effect -Thermodynamic effects (Entrophy, Specific heat, Thermal conductivity) – Application of superconductors (Electric generators, Electric power transmission line, Magnetic levitation	Super conductivity phenomena – Effect of magnetic field - Properties of Superconductors – Type I and Type II Superconductors -Meissner effect – High Tc Superconductors -SQUIDS. Isotope effect - Thermodynamic effects (Entrophy, Specific heat, Thermal conductivity) – Application of superconductors (Electric generators, Electric power transmission line, Magnetic levitation		
				V	Types of bonding- Ionic bond- characteristics of ionic bond- Covalent bond – characteristics of covalent bond – Metallic bond – characteristics of metallic bond- Vander waals bonding - New materials: Metallic glasses - Fiber Reinforced Plastics (FRP) and Fiber Reinforced Metals (FRM) – Surface Acoustic Wave materials- applications (Delay lines and memories, frequency filter, surface acoustic wave resonator) - Metal matrix composites – Biomaterials – Ceramics – Shape memory alloys – SMART materials – conducting polymers.	Types of bonding- Ionic bond- characteristics of ionic bond- Covalent bond – characteristics of covalent bond – Metallic bond – characteristics of metallic bond- Vander waals bonding - New materials: Metallic glasses - Fiber Reinforced Plastics (FRP) and Fiber Reinforced Metals (FRM) – Surface Acoustic Wave materials- applications (Delay lines and memories, frequency filter, surface acoustic wave resonator) - Metal matrix composites – Biomaterials – Ceramics – Shape memory alloys – SMART materials – conducting polymers.		
						Total	**20%**	
12	Nuclear Physics	20UPH 6C13		I	Radio activity - Fundamental laws of Radio activity - Laws of Radioactive disintegration - Half life - Mean life -	Radio activity - Fundamental laws of Radio activity - Laws of Radioactive disintegration - Half life - Mean life - Laws of Successive	**4**	Skill developme nt

					Laws of Successive disintegration – Radioactive dating – The age of earth – radioactive series – Alpha emission – properties of alpha particles – alpha spectrum – Geiger Nuttal law – Beta decay – Properties of Beta decay – Gamma ray spectrum – Determination of the wavelength of gamma rays.	disintegration – Radioactive dating – The age of earth – biological effects of nuclear radiation- radioactive growth and decay- radioactive series – Alpha emission – properties of alpha particles – alpha spectrum – Geiger Nuttal law – Beta decay – Properties of Beta decay – Gamma ray spectrum – *Determination of the wavelength of gamma rays. v		
				II	Linear accelerator (LINAC) – Betatron – Synchroton – Proton Synchroton – Ionization chamber – GM counter – Wilson's cloud chamber – Bubble chamber – Spark chamber - Scintillation counter – Cerenkov counter	Wave Observatory detector - Proportional counter - GM counter - Wilson's cloud chamber - Bubble chamber - Spark chamber - Ionization chamber - Solid state detector - Laser Interferometer - ***Scintillation counter - Cerenkov counter -** Linear accelerator (LINAC) - Cyclotron - Betatron - Synchroton - Proton Synchroton.	**4**	
				III	Classification of nuclei - General properties of nucleus – Binding energy – Nuclear stability - Theories of nuclear composition – Nuclear forces - Proton-electron hypothesis – Proton-neutron hypothesis – Models of nuclear structure – The Liquid drop model – The Shell model – The Collective model.	Classification of nuclei - General properties of nucleus – Binding energy – Nuclear stability - Theories of nuclear composition – Nuclear forces -Meson theory of nuclear forces- Proton-electron hypothesis – Proton-neutron hypothesis – Models of nuclear structure – The Liquid drop model – Semi-empirical mass formula-The Shell model – *The Collective model.	**4**	
				IV	The Discovery of artificial transmutation – The Q-value equation for a Nuclear reaction – Types of nuclear reactions – Energy balance in nuclear reactions and the Q-value – Threshold energy of an	The Discovery of artificial transmutation – The Q-value equation for a Nuclear reaction – Types of nuclear reactions – Energy balance in nuclear reactions and the Q-value – Threshold energy of an endoergic reaction	**8**	

					endoergic reaction – Nuclear fission – critical mass – chain reaction – Nuclear fusion – source of stellar energy - Transuranic elements.	– Nuclear fission – critical mass – chain reaction – Nuclear fusion – source of stellar energy - Transuranic elements. Nuclear Reactor safety Approach: Defense in depth approach in design- operating license, Regulatory inspection – Radiation dose limits.		
				V	Discovery of cosmic rays – latitude effect – Azimuth effect – Altitude effect – Primary and Secondary cosmic rays – cosmic ray showers – Discovery of positron – the mesons – Van allen belts. Elementary Particles: Classification – Particles and anti particles – the fundamental interactions.	Discovery of cosmic rays – latitude effect – Azimuth effect – Altitude effect – Primary and Secondary cosmic rays – cosmic ray showers – Discovery of positron – the mesons – *Van allen belts. Elementary Particles: Classification – Particles and anti particles – the fundamental interactions-the quark model-Conservation laws and symmetry.	**2**	
						Total	**22%**	
13	Programming in C and its Physics Applications	20UPH6C14		I	History of C language - Basic Structure of C Programming - Character set - Constants - Variables - Data Types - Operators and Expression - Escape Sequence Characters -Library Functions - Input and Output statements: scanf - printf - getchar - putchar - gets – puts.	History of C-language – Basic Structure of C Programming - Character set – Constants - Variables - Data Types - Operators and Expression - Escape Sequence Characters – Library Functions - Input and Output statements: scanf - printf - getchar - putchar - gets – puts. **Example Programmes:** Simple program by using scanf and printf.	**4**	Employability
				II	Arrays Variables – Assigning Data for Array - One, Two and Multi dimensional Array - Conditional control statement: if, else, nested if, switch case - Looping	Arrays Variables – Assigning Data for Array - One, Two and Multi dimensional Array - Conditional control statement: if, else, nested if, switch case - Looping statement: while,	**4**	

					statement: while, do while, for, nested for- break - continue and Unconditional control statement: go..to statement.	do while, for, nested for- break - continue and Unconditional control statement: goto statement. Function declaration – argument – Call the function – Return statement - Type of functions - Recursive functions.- Passing Array to functions - Automatic, Static, Register and External storage. **Example Programmes:** Simple interest calculation, Average of marks and grades, Sum of series.		
				III	Function declaration – argument – Call the function – Return statement - Type of functions - Recursive functions - Passing Array to functions - Automatic, Static, Register and External storage - Defining a structure – Declaring structure variables – Accessing structure members – Structure initialization – Structure within structures – Structures and functions – Unions – Size of structures.	Defining a structure – Declaring structure variables – Accessing structure members – Structure initialization – Copying and comparing structure variables – Operations on individual members – Array of structures – Structure within structures – Structures and functions – Unions – Size of structures. **Example Programmes:** Largest of 'n' numbers and its position, ascending order, Addition and Subtraction of 2 matrices, Factorial calculation	**7**	
				IV	Understanding pointers – Accessing the address of a variable – Declaring pointer variables – Initialization of pointer variables – Accessing a variable through its pointer – Pointer expressions Defining and opening a file – Closing a file - Input/output operation in files – Error handling during I/O operations – Command line arguments.	Understanding pointers – Accessing the address of a variable – Declaring pointer variables – Initialization of pointer variables – Accessing a variable through its pointer – Pointer expressions Defining and opening of a file – Closing a file - Input/output operation in files – Error handling during I/O operations – Random access to files – Command line arguments.	**7**	

						Example Programmes: Command line arguments, opening and closing of file, copying the contents of one file to another, merge of two files.		
				V	Quadratic equations - Matrix multiplication - Conversion of temperature from C to F and F to C - Determination of G by Boy's Method - Young's Modulus - Uniform bending - Spectrometer - Refractive index & Dispersive power of prism - Newton's Rings - Radius of curvature - Determination of Velocity of light - Foucault's Rotating Mirror Method - Estimation of Average Global Solar Radiation	Quadratic equations - Matrix multiplication - Conversion of temperature from C to F and F to C - Determination of G by Boy's Method - Young's Modulus - Uniform bending - Spectrometer - Refractive index & Dispersive power of prism - Newton's Rings : Radius of curvature - Determination of Velocity of light: Foucault's Rotating Mirror Method - Estimation of Average Global Solar Radiation		
						Total	**22%**	
	Allied Theory Physics - I	20UCH3AL1/20UMA1AL1	I/III	I	**GRAVITATION** Determination of 'G' by Boy's method – Potential and field due to a solid sphere – Variation of 'g' due to altitude and depth. **ELASTICITY** Bending moment – Determination of 'Y' by non uniform bending – Torsional oscillations – use of Torsional Pendulum to determine 'n' and 'I'	**GRAVITATION AND ELASTICITY** Kepler's law of planetary motion - Laws of gravitation - Determination of 'G' by Boy's method - Potential and field due to a solid sphere - Variation of 'g' due to altitude and depth - Determination of 'g' by compound pendulum - Poisson's ratio - Twisting couple on a cylinder - Bending moment - Determination of 'Young's modulus by non uniform bending - Torsional oscillations - use of Torsional Pendulum to determine 'rigidity modulus' and 'moment of inertia' - *Relation between elastic constants.	**8**	Skill development

				II	**OPTICS** Newton's rings – Determination of refractive index of a liquid – Plane diffraction grating – Determination of wavelength – Dispersive power of a grating – Polarization – Production and analysis of elliptically and circularly polarized light.	**THERMODYNAMICS** *Laws of thermodynamics I and II - Derivation of gas laws - Avagadro's hypothesis - Graham's law of diffusion of gases - degrees of freedom - *viscosity of gases - *thermal conductivity of gases - Joule Thomson effect - Adiabatic demagnetization - Liquefaction of Helium-Black body radiation - Planks radiation law-thermal conductivity- Meissner effect - Properties of Liquid Helium I and II - Super conductivity - Measurement of Radiation from SUN - Pyroheliometer.	**10**	
				III	**THERMODYNAMICS** Joule Thomson effect – Adiabatic demagnetization – Liquefaction of Helium – Meissner effect – Properties of Liquid Helium I and II – Super conductivity. Measurement of Radiation from SUN – Pyroheliometer.	**RELATIVITY** Theory of relativity: Frame of reference - inertial frames - Galilean transformation equations -Michelson Morley experiment - Postulates of Special Theory of Relativity - Lorentz transformation - Time dilation and length contraction - Addition of Velocities - Variation of mass with velocity - *Mass Energy relation.	**5**	
				IV	**MAGNETISM AND ELECTRICITY** Field along the axis of along solenoid – tangent Galvanometer – Moving coil galvanometer. Self induction – Mutual induction – Alternating current – LR and LCR series, circuits – Impedance and Resonance.	**OPTICS** Coherent sources - theory of interference fringes - Fresnel Biprism: Experimental arrangement - determination of wavelength of light - interference fringes with white light using a Biprism - Interference due to Reflected light - Lloyd's single-mirror - Determination of refractive index of a liquid - Fresnel and Fraunhofer diffraction - Plane	**16**	

						diffraction grating - Determination of wavelength - Dispersive power of a grating - *Plane of Polarization - Double refraction - Production and analysis of elliptically and circularly polarized light - *Optical activity - Half shade polarimeter.		
				V	**RELATIVITY** Michelson Morley experiment – Postulates of Special Theory of Relativity – Lorentz transformation – Time dilation and length contraction – Addition of Velocities – Mass Energy relation.	**MAGNETISM AND ELECTRICITY** Ampere's circuital law - Magnetic flux - Field along the axis of along solenoid - tangent Galvanometer - Moving coil galvanometer - Ballistic galvanometers - Current and charge sensitiveness - Vibration magnetometers - determination of M and H - Self induction - Mutual induction - Experimental determination - Alternating current - LR and LCR series, circuits - Impedance and Resonance - *Quality Factor - *Band Width.	**8**	
						Total	**47%**	
	Allied Theory Physics - II	20UCH4AL2 /20UMA2AL2		I	**QUANTUM OPTICS** Einstein's photo electric equation – Photo Voltaic Cell – Photomultiplier – Production and properties of X rays – X ray spectrum –Mosley's law – Compton effect – Derivation of formula for 'd'.	**ATOMIC STRUCTURE** Thomson's plum pudding model - Rutherford's experiment on α-particle scattering - Rutherford's nuclear atomic model: Distance of closest approach - major deficiencies in Rutherford's nuclear model - Bohr's atomic model: Calculations concerning Bohr's atomic model - spectral series of hydrogen atom - deficiencies in Bohr's theory - Sommerfeld's relativistic model - *Pauli's exclusion principle.	**20**	Skill development
				II	**LASER PHYSICS** Population Inversion – Methods of	**ATOMIC NUCLEUS** Theories of nuclear composition: Proton-	**20**	

					producing population inversion – Ruby Laser – Helium-Neon Laser – CO laser, Semiconductor laser - Uses of Lasers.	neutron theory of nuclear composition - general properties of a nucleus - *Packing fraction - mass defect and atomic binding - accurate expression for mass defect - variation of binding energy - significance of average binding energy - nuclear forces - meson theory of nuclear forces - Nuclear models: Liquid-drop model - nuclear shell model.		
				III	**QUANTUM MECHANICS** Principle Uncertainty – wave function - Probability Density – Schrodinger's one dimensional equation – Eigen function and Eigen values – Particle in a box – One dimensional Potential well	**QUANTUM PHYSICS** Waves and particle duality of matter: De Broglie's matter waves - De Broglie's electron waves - Properties of matter waves - Particle nature of X-rays - Experimental study of matter waves - The Davisson-Germer experiment - ***Electron microscope** - Heisenberg's principle of indeterminacy - Physical significance of wave function – Eigen values and Eigen functions - Time independent Schrödinger equation - Rigid rotator	**20**	
				IV	**SEMICONDUCTOR PHYSICS** PN Junction– Zener Diode – VI Characteristics – Action of a transistor – Transistor characteristics (Common Base and Common Emitter) – Transistor as an Amplifier – Switching action of a Transistor	**TRANSISTORS** Transistor action: Transistor connections: Common base connection - Characteristics of common base connection - Common emitter connection - Measurement of leakage current - Characteristics of common emitter connection - Common collector connection ***Comparison of transistor connections** - Transistor circuit as an amplifier (CE arrangement) - RC and Transformer Coupled two stage amplifier.	**10**	
				V		**LOGIC GATES**	**12**	

					INTEGRATED ELECTRONICS Operational Amplifier – Block diagram – Operation Amplifier as an Adder and Subtractor - Integrator and Differentiator. OR, AND & NOT gates – Demorgan's theorems – NAND gate as a universal gate.	Definitions for digital signals: Digital waveforms - digital logic - The basic gates: NOT, OR and AND gates - Universal logic gates: NOR and NAND gates - AND-OR-INVERT gates - Positive and negative logic - Boolean laws and theorems: Sum-of-products method - truth table to Karnaugh map - pairs, quads and octets - Karnaugh simplifications - *don't-care conditions – product-of-sums method - product-of-sums simplification.		
							Total	**82%**

27.11.20

Dr. J. CHANDRASEKARAN Ph.D
Associate Professor & Head of Physics
SRMV College of Arts and Science
Coimbatore - 641 020

Chairman, BoS

Sri Ramakrishna Mission Vidyalaya College of Arts and Science
Coimbatore – 641 020
Department of Physics
Action Taken Report for the year academic year 2018-19

Action Taken Report

Suggestions from the feedback	Action taken
▪ Self study topics in each course may be indexed in the existing curriculum. ▪ Value added course may be integrated. ▪ Bridge course may be introduced in first year. ▪ The courses "Allied Physics-I and II" may be enriched.	Will be implemented.

HoD of Physics
Dr. J. CHANDRASEKARAN Ph.D
Associate Professor & Head of Physics
SRMV College of Arts and Science
Coimbatore - 641 020

Principal
SRI RAMAKRISHNA MISSION VIDYALAYA
COLLEGE OF ARTS AND SCIENCE
COIMBATORE-641020.

Sri Ramakrishna Mission Vidyalaya College of Arts and Science
Coimbatore – 641 020
Department of Physics
Action Taken Report for the academic year 2017-18

Action Taken Report

Suggestions from the feedback	Action taken
▪ Problem solving practice is suggested to challenge competitive examination. ▪ The courses "Simulation in Physics - C++ Programming and MATLAB Programming" may be merged as a single course.	Implemented.
▪ The course "Advanced Materials and Characterization" may be introduced. ▪ The course "Energy Auditing" may be introduced as NME.	Implemented.
▪ OBE system may be introduced.	Implemented.

HoD of Physics

Dr. J. CHANDRASEKARAN Ph.D
Associate Professor & Head of Physics
SRMV College of Arts and Science
Coimbatore - 641 020

Principal

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COLLEGE OF ARTS AND SCIENCE
COIMBATORE-641020.

Sri Ramakrishna Mission Vidyalaya College of Arts and Science
Coimbatore - 641 020
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Action Taken Report for the academic year 2016-17

Action Taken Report

Suggestions from the feedback	Action taken
▪ The course "Electricity and magnetism" may be enriched. ▪ The course "Electronics" may be revised and also include latest text books. ▪ Construction of IC regulated power supply may be included in "Core practical - II".	Implemented.
Course rearrangement ▪ The course "Mathematical Physics" may be shifted from semester II to semester I. ▪ The course "Electromagnetic Theory and Electrodynamics" may be shifted from semester I to semester II.	Implemented.
▪ Value added course may be included in PG level. ▪ The course "Energy auditing" may be introduced as NME. ▪ The course "Advanced Physics" may be introduced. ▪ The courses "Solid State Physics" and "Condensed Matter Physics and Nanoscience" may be strengthened.	Will be implemented.

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DEPARTMENT OF PHYSICS
SRI RAMAKRISHNA MISSION VIDYALAYA
COLLEGE OF ARTS AND SCIENCE,
COIMBATORE - 641 020.

Principal

SRI RAMAKRISHNA MISSION VIDYALAYA
COLLEGE OF ARTS AND SCIENCE
COIMBATORE-641020.

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Coimbatore - 641 020
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Action Taken Report for the academic year 2015-16

Action Taken Report

Suggestions from the feedback	Action taken
▪ The course "Mathematical Physics and Classical Mechanics" may be revised with the inclusion of Coordinate Systems. ▪ The course "Core Practical-III" Advanced Experiments may be strengthened.	Implemented
▪ The course "Alternate Energy Recourses" may be enriched.	Will be implemented

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COLLEGE OF ARTS AND SCIENCE
COIMBATORE-641020.