Programme:- B.Sc Physics

(2017 Admission onwards)

Board of Studies Members:-

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8. **Ms. Tinu John**, Assistant Professor, Dept. of Physics, B.C.M College, Kottayam.

Graduate Programme Outcomes

GPO No.	Graduate Programme Outcomes
GPO No. 1	**Disciplinary Knowledge & Critical Thinking:** Articulate knowledge of one or more disciplines that form a part of UG programme. Critically think, analyse, apply and evaluate various information and follow scientific approach to the development of knowledge.
GPO No. 2	**Communication Skill:** Communicate thoughts and ideas clearly in writing and orally. Develop careful listening, logical thinking and proficiency in interpersonal communication.
GPO No. 3	**Environmental Awareness:** Sustainable approach to use of natural resources. Capable of addressing issues, promoting values and give up practices that harm the ecosystem and our planet.
GPO No. 4	**Ethical Awareness:** Uphold ethics/morals in all spheres of life. Identify and avoid unethical behaviour in all aspects of work.
GPO No. 5	**Social Commitment:** Be aware of individual roles in society as nation builders, contributing to the betterment of society. Foster social skills to value fellow beings and be aware of one's responsibilities as international citizens.
GPO No. 6	**Lifelong learners:** Equip students to be life long learners. Be flexible to take up the changing demands of work place as well as for personal spheres of activities.

Programme Specific Outcome (PSO)

PSO. No.	Programme Specific Outcome (PSO)	GPO
1.	Understand basic concepts of different branches of Physics like, thermodynamics, Classical and Quantum Mechanics, and electrodynamics.	1
2.	Apply the principles of Physics in day to day life.	1,3,6
3.	Develop the expertise in operating different electrical, electronic, optical, and mechanical instruments.	1,6

4.	Develop the skills in performing, analyzing and documenting laboratory experiments.	1,2,6
5.	Develop analytical thinking and problem solving skills.	1,2,5,6
6.	Equip students for their future careers by inculcating the qualities of accuracy, clarity of thought and expression, and systematic approach.	2,4,5,6
7.	Develop awareness regarding the need for eco-friendly and sustainable technological use.	3,4,5,6

Course Outcome

1. Semester I (Core)

PH1CRT01 -Methodology and Perspectives in Physics

Sl.No.	Course Outcome	Cognitive Level	PSO
1.	Recognize the contributions of scientists in Physics.	Remember	1
2.	Appreciate the inventions and discoveries in Physics.	Understand	1
3.	Compute the binary operations based on binary rules.	Apply	1,5
4.	Calculate different operations in vectors.	Apply	5,6
5.	Differentiate different Co-ordinate systems.	Analyze	1,5
6.	Apply the knowledge of error and precision to check the accuracy of measuring instruments.	Evaluate	4,5,6

Course Description

Sl. No.	Course description	Hrs.	CO
1.0	**Concepts and Development Physics**	8	1
1.1	Development of physics in the last century	1	1
1.2	scientific contributions of Galileo, Newton	1	1
1.3	Contributions of Einstein, J.J.Thomson	2	1
1.4	Curies, Rayleigh,Max Plank	1	1
1.5	Heisenberg and Schrodinger	1	1
1.6	Contributions of Indian Physicists C.V.Raman, H.J. Babha, J.C.Bose, S.N.Bose, M.Saha, S.Chandrasekhar, Vikram Sarabhai	2	1
2.0	**Number Systems**	**18**	1, 4, 5, 6
2.1	Decimal, hexadecimal and Binary Conversions	2	1, 5
2.2	Binary arithmetics – addition, subtraction and multiplication,	2	1, 5
2.3	Binary substraction using 1's and 2's complement method	2	1, 5, 6
2.4	Signed binary arithmetics, BCD code, ASCII code,	1	1, 5
2.5	Significance of binary number system in digital electronics, microprocessors and in computer	1	1, 4, 5
2.6	Introductory Vector Analysis - Applications of vectors in Physics, Differential and integral vector calculus	4	1, 5, 6
2.7	The operator ∇- physical significance of Gradient, Divergence and Curl	2	1, 5
2.8	Line integral, surface integral and volume integral of vectors	2	1, 5

2.9	Co-ordinate systems: Cartesian Co-ordinate system, plane polar and spherical polar coordinates, cylindrical coordinates	2	1, 5
3.0	**Experimental methods and error analysis**	**10**	1, 4, 5, 6
3.1	Experimental methods, least count of instruments, Instruments for measuring mass, length, time, angle , current, voltage.	3	1, 5
3.2	Fundamental units, precision and accuracy of measurements	2	1, 4, 5, 6
3.3	Source of error in measurements, necessity of estimating errors and types of errors	1	4, 5
3.4	Significant digits, order of magnitude and rounding of numbers, rounding error, absolute and relative errors	1	4,5,6
3.5	Errors of computation- addition, subtraction, multiplication, division, error in power and roots	2	1,4,5
3.6	Analysis of data, standard deviation, Calculation of Mean value	1	1,4,5,6

References:

1. Feynman lectures of Physics
2. Concepts of Modern Physics, Arther Beisser
3. Modern Physics, Kenneth Krane
4. Modern Physics, R Murugeshan
5. Introduction to Electrodynamics, David J. Griffiths
6. Advanced course in Practical Physics, D Chattopadhyay

2. Semester II (Core)

PH2CRT01 –Mechanics and Properties of Matter

Sl.No.	Course Outcome	Cognitive Level	PSO
1.	Identify different types of motion.	Understand	1, 2,5
2.	Develop knowledge and understanding of Mechanical properties of matter.	Understand	1,2,5
3.	Understand the dynamics of different types of pendulum.		1,5
4.	Determine moment of inertia of symmetrical rigid bodies based on parallel and perpendicular axes theorem	Apply	1,5
5.	Differentiate different types of fluid flow.		1,2,5
6.	Understand the phenomena of surface tension and relate it to daily life.		2,5

Course Description

Sl. No.	Course description	Hrs.	CO
1.0	**Wave motion and Oscillations**	**12**	**1, 2, 5, 6**
1.1	General equation of wave motion, plane progressive harmonic wave, energy density	2	1, 5
1.2	Intensity of a wave, superposition of waves, beats	1	1
1.3	Transverse waves in stretched strings, modes.	1	1, 2
1.4	Periodic motion, simple harmonic motion and harmonic oscillator, energy of a harmonic oscillator	2	1, 2, 5
1.5	Examples of harmonic oscillator – simple and compound pendulum	2	2, 5
1.6	Theory of Damped harmonic oscillator	2	1, 5
1.7	Theory of forced oscillator, resonance, applications	2	1, 2, 5
2.0	**Rotational mechanics**	**7**	1, 2, 5
2.1	Angular velocity- angular acceleration- angular	1	1, 2

	momentum- conservation		
2.2	torque-moment of inertia- Parallel and perpendicular axes theorems	1	1, 2, 5
2.3	Calculation of moment of inertia- (rod, ring, disc, cylinder, and sphere)	4	1, 2,5
2.4	Theory of flywheel	1	1,2,5
3.0	**Elasticity and Hydrodynamics**	**17**	1, 2, 5
3.1	Basic ideas on elasticity – Young's modulus, bulk modulus, rigidity modulus, Poisson's ratio, relations connecting various elastic constants.	3	1, 2,5
3.2	Work done per unit volume in a strain, Bending of beams, bending moment, flexural rigidity.	2	1, 5
3.3	Young's modulus – uniform and non-uniform bending, cantilever	2	1,5
3.4	I –section girders. Determination of rigidity modulus using Static and Dynamic methods.	3	1,5
3.5	Streamline and turbulent flows, coefficient of Viscosity – Determination of viscosity by Poiseuille's method.	2	1, 2, 5
3.6	Equation of continuity, energy possessed by a liquid, Bernoulli's theorem.	2	1, 2, 5
3.7	Surface tension, surface energy, excess pressure in a liquid drop and bubble, factors affecting surface tension, applications.	3	1, 2, 5

References:

1. Mechanics-D.S. Mathur

2. Mechanics-Hans and Puri, TMH

3. Classical Mechanics by J.C. Upadhyaya, Himalaya Pub

4. Classical Mechanics-Takwale and Puranik, TMH

5. Properties of Matter- Mathur, S. Chand

6. Classical mechanics-K.SankaraRao, PHI

3. Semester III (Core)

PH3CRT03: OPTICS, LASER & FIBER OPTICS

4.

Sl No.	Course Outcome	Cognitive Level	PSO No.
1	Understand the basic idea of optics-interference, diffraction, polarisation.	Understand	1
2	Illustrate the construction and working of basic optics and laser related equipments.	Understand	1,3
3	Apply the basic equations of optics in problem solving.	Apply	2,5
4	Apply the principles of optics in conducting experiments related to optics.	Apply	2,3,4,5
5	Focus on the applications of laser and fibre optics in day today life.	Analyse	6
6	Identify the cause and effects of the basic phenomena of nature based on the principles of optics.	Analyse	7

Course Description

Sl.No	Course Description	Hrs	CO
1.0	**Interference**	**13**	**1,3,4,6**
1.1	Review of basic ideas of interference, Coherent waves-Optical path and phase change	1	1
1.2	Superposition of waves-theory of interference-intensity distribution	2	1
1.3	Young's double slit experiment. Coherence-Conditions for interference	2	1,3
1.4	Thin films-plane parallel film- interference due to reflected light-conditions for brightness and darkness	2	1,3

1.5	Interference due to transmitted light-Haidinger fringes	1	1,3
1.6	Interference in wedge shaped film-colours in thin films-Newton's rings-applications	3	1,3,4,6
1.7	Michelson interferometer-construction, working and mention the applications.	2	1,3
2.0	**Diffraction, Polarisation**	**22**	**1,3**
2.1	Fresnel Diffraction – Huygens- Fresnel theory	1	1
2.2	Zone plate –Difference between zone plate and convex lens	2	1,3
2.3	Comparison between interference and diffraction diffraction pattern due to a straight edge, single silt	2	1
2.4	Fraunhoffer diffraction at a single slit, double slit,N slits	3	1
2.5	Theory of plane transmission grating. Dispersive power and resolving power of grating.	2	1,3
2.6	Concept of polarization – plane of polarization- Types of polarized light	1	1
2.7	Production of plane polarized light by reflection-refraction	2	1
2.8	Malu's law-Polarization by double refraction.	1	1
2.9	Calcite crystal, Anisotropic crystals-optic axis-Double refraction-Huygens explanation of double refraction	2	1
2.10	Retarders - Quarter wave plate and Half wave plate.	2	1,3
2.11	Production and Detection of plane, elliptically and circularly polarized light	2	1
2.12	Optical Activity- specific rotation.	2	1,3
3.0	**Laser, Fiber Optics**	**19**	**2,3,4,5,6**
3.1	Absorption and emission of light-Absorption-spontaneous	1	2

	emission and stimulated emission		
3.2	Einstein relations	1	2,3
3.3	Population inversion- Active medium-Pumping, different pumping methods	2	2
3.4	Resonators – plane mirror and confocal resonators	1	2
3.5	Metastable state, Three level and Four level Laser systems.	1	2
3.6	Ruby Laser, He-Ne laser, Semiconductor Laser	2	2,4
3.8	Laser beam Characteristics, coherence. Applications of Laser	1	2
3.9	Holography (qualitative study only)	1	2
3.10	Propagation of light in a fiber -acceptance angle, numerical aperture, V-number	3	2,3,5
3.11	Singlemode and multimode step index fiber	2	2,3
3.12	Graded index fiber- attenuation	2	2
3.13	Application of fiber-optical fiber communication – advantages.	2	2,3,6

References:

1. Optics N.Subramanayam, Brijlal, M.N Avadhanulu S Chand.
2. Optics, 3 rd edition, AjoyGhatak
3. Laser Fundamentals, William T Silfvast
4. Fiber Optics and Optoelectronics, R P Khare, Oxford 2012..
5. Introduction to Optics, Frank L Pedrotti, Leno M Pedrotti& Leno S Pefrotti
6. Semiconductor physics and optoelectronics- V.Rajendran, J.Hemaletha and M.S.M.Gibson

4. Semester IV (Core)

PH4CRT04: Semiconductor Physics

Sl. No.	Course Outcome	Cognitive Level	PSO
1	Understand the concepts of semiconducting diodes and its applications	Understand	1
2	Execute the principles of diodes in rectifiers, filters, clippers and clampers.	Apply	1, 2, 3 ,5
3	Understand the concepts of transistor configurations and its application	Understand	1
4	Execute the principle of transistor configuration for the study of oscillators and amplifiers.	Understand, Apply	1, 2, 3 ,5
5	Understand FET, Op-Amp, and modulation	Understand	1
6	Calculate different parameters related to transistors, oscillators and amplifiers.	Apply	5

Course Description

Module	Course Description	Hrs	CO
1.0	**Semiconducting diodes and applications**	**14**	**1,2,6**
1.1	PN Junction, Depletion layer, Barrier potential, Biasing- forward and reverse	1	1
1.2	PN Junction, Depletion layer, Barrier potential, Biasing- forward and reverse	1	1
1.3	PN Junction diode – V-I characteristics	1	1
1.4	Diode parameters, Diode current Equation, Diode testing, Ideal diode. Problems	2	1,6

1.5	Zener diode and its reverse characteristics. Thermistors.	1	1,6
1.6	Rectification - Half wave, Full wave, Centre tapped, Bridge rectifier circuits	2	2
1.7	Nature ofrectified output, Efficiency & Ripple factor	1	2
1.8	Filter circuits – Inductor Filter, Capacitor Filter, LC Filter, π Filter	2	2,6
1.9	Regulated Power supplies - Zener diode voltage regulator	1	2
1.10	Voltage multipliers – Doubler & Tripler- Wave shaping circuits -Clipper- Positive,negative and biased	1	2
1.11	Clampers- Positive, negative and biased.	1	2
2.0	**Transistors Configurations and Feed back, Amplifiers and Oscillators**	**24**	**3,4,6**
2.1	Bipolar junction transistors, Transistor biasing, CB, CC, CE configurations and their characteristics- Active, saturation and cut-off regions.	4	3
2.2	Current gain α, β, γ and their relationships. Problems	2	3,6
2.3	Leakage currents- Thermal runaway. DC operating point and AC and DC Load line, Q-Point.	2	3
2.4	Basic principles of feedback, positive & negative feedback, Advantages of negative feedback	2	3
2.5	negative feedback circuits – voltage series & shunt, current series & shunt.	2	3,6
2.6	Need for biasing-Stabilization- Voltage divider bias. Single stage transistor Amplifiers-CE amplifier - amplification factors	4	4
2.7	Decibel system, Variations in Amplifier gain with frequency.	1	4,6
2.8	Oscillatory Circuits, LC oscillators – Hartley Oscillator, Colpit's Oscillator	4	4

2.9	RC oscillators -Phase shift Oscillator. Astable and monostable multivibrator (basic idea only)	3	4
3.0	**FET, Operational Amplifier & Modulation**	**16**	**5,6**
3.1	FET -characteristics, FET- Parameters. Comparison between FET and BJT.	3	5
3.2	MOSFET	1	5
3.3	OP-amp- Symbol and terminals. Characteristics of ideal OP-amp, CMRR	2	5,6
3.4	Applications -inverting, Non-inverting, Unity follower and Summing amplifiers.	4	5
3.5	Types of modulation – AM, FM, Pulse modulation and Phase modulation	3	5
3.6	Amplitude modulation- modulation index - Analysis of AM wave – Sidebands–bandwidth- AM Demodulation.	3	5,6

References:

1. Basic Electronics-B.L.Theraja
2. A Text Book of Applied Electronics-R.S.Sedha
3. Principles of electronics, VK Mehta
4. Basic Electronics(7 th Edition)-Malvino and Bates
5. Electronics Fundamentals and Applications-D. Chattopadhyay and P.G.Rakshit,
6. Electronics: Fundamentals of Analog circuits-Thomas L. Floyd, David Buchla,
7. Electronic Devices and Circuit Theory-Robert Boylestad, Louis Nashelsky
8. Basic Electronics-Debashis De
9. Basic Electronics-Santiram Kal

5. Semester V

PH5CRT05- Electricity and Electrodynamics

Sl.No.	Course Outcome	Cognitive Level	PSO
1.	Understand the difference between resistance and impedance in an a.c circuit.	Understand	1, 2
2.	Understand the concepts of flux, electric field, and magnetic field.	Understand	1, 2
3.	Compute the current and voltage in electrical circuit containing L,C,R.	Apply	2, 5, 6
4.	Simplify complex circuits using network theorems.	Apply	2, 5, 6
5.	Apply the fundamental theorems of curl and divergence in specific situations.	Apply	2, 5, 6
6.	Evaluate the electric field due to symmetric charge distribution by applying Gauss's law.	Apply	5
7.	Understand that Maxwell's equations are the base of electromagnetic theory.	Understand	5, 6
8.	Apply the Biot-Savart law and Ampere's law to compute magnetic field due to a charge distribution.	Apply	4,5

Course Description

Module	Course Description	Hrs	CO
1.0	**Alternating Current and Network Theorems**	**15**	**1, 3, 4**
1.1	EMF induced in a coil rotating in a magnetic field - AC applied to resistive	2	3, 1

1.2	AC applied to inductive and capacitance circuits - AC applied to LR circuit	2	3, 1
1.3	AC applied to RC circuit - Analysis of LCR series circuits	3	3, 1
1.4	LCR parallel resonant circuit – comparison - Power in ac circuits - Wattless current	2	3, 1
1.5	Choke coil - transformer on no load- skin effect.	1	1, 3
1.6	Ideal voltage source and current source - Superposition theorem - Reciprocity theorem	2	4
1.7	Thevenin's theorem - Norton's theorem - Maximum power transfer theorem.	3	4
2.0	**Transient Current and Thermo electricity**	**8**	**3**
2.1	Growth and decay of current in an LR circuit	2	3
2.2	Charging and discharging of a capacitor through a resistor - Growth and decay of charge in an LCR circuit	2	3
2.3	Seebeck effect - Laws of thermo emf - Peltier effect	1	3
2.4	Thomson effect- Thermoelectric diagrams -Thermocouple	1	3
2.5	Explanation of thermoelectric effects based on electron theory.	2	1, 3
3.0	**Electrostatics and Magnetostatics**	**20**	**2, 5, 6, 7, 8**
3.1	Fundamental theorems of divergence and curl (physical concepts) - Electric field - Continuous charge distribution-	2	2, 5
3.2	Divergence and curl of electrostatic field- Gauss's law and applications: solid sphere, infinite wire, infinite plane sheet	5	2, 6
3.3	Electric potential - Poisson's and Laplace's equations - Potential of a localized charge distribution	2	2, 5

3.4	Electrostatic boundary conditions- work and energy in electrostatics	2	5
3.5	The work done to move a charge – Energy of a point charge distribution and continuous charge distribution	2	5
3.6	Basic properties a conductor. Lorentz Force law- Biot- Savart law-	2	8
3.7	Divergence and curl of B- Applications of Amperes' law: long straight wire, infinite plane, solenoid	3	8
3.8	Comparison of electrostatics and magnetostatics- Magnetic vector potential	2	2, 6
3.9	Magnetostatics boundary conditions Electromagnetic induction- Faraday's law.	2	2, 7
4.0	**Maxwell's Equations and Electromagnetic wave propagation**	**11**	7
4.1	Maxwell's equations - Boundary conditions for free space - Continuity equations	4	7
4.2	Poynting's theorem, Wave equations, reflection at boundary and polarization	3	7
4.3	Electromagnetic wave in vacuum - Wave equation for E and B - Monochromatic plane waves- Energy of electromagnetic waves	4	7

References:

1. Introduction to Electrodynamics, David J Griffiths
2. Electricity and Magnetism, R. Murugeshan
3. Fundamentals of Magnetism and Electricity, D.N Vasudeva
4. Electricity and Magnetism, KK Tewari-
5. Principles of Electromagnetics, Mathew N.O Sadiku
6. Classical Electromagnetism, Jerrold Franklin
7. Electromagnetic Fields and Waves, KD Prasad

6. Semester V

PH5CRT06: Classical and Quantum Mechanics

Sl No.	Course Outcome	Cognitive Level	PSO No.
1	Understand the advantages of analytical mechanics over Newtonian mechanics and basic formulation of Lagrangian and Hamiltonian methods.	Understand	1
2	Understand the importance of Qunatum Mechanics by the successful explanation of blackbody radiation, photoelectric effect and Compton effect where classical thoery failed.	Understand	1
3	Solve simple systems using Lagrangian and Hamiltonian formulations.	Apply	2,5
4	Understand wave particle duality by illustrating Davisson Germer experiment and de Broglie hypothesis and solve problems	Understand Apply	1,5
5	Understand the basic tools for the formulation of quantum mechanics and the basic equations of quantum mechanics.	Understand	1
6	Summarize that Classical Mechanics and Quantum Mechanics are two different interpretations of same aspects.	Understand	1
7	Apply the quantum mechanical principle for normalising the wave functions and to estimate the values of eigen values and eigen functions.	Apply	5

Course description

Module	Course description	Hrs	CO
1.0	**Lagrangian and Hamiltonian Formulations of Classical Mechanics**	**15**	**1,3**
1.1	Constraints, degrees of freedom, generalized co-ordinates	2	1
1.2	Principle of virtual work, D'Alembert's principle	1	1
1.3	Lagrange's equations(no derivation required), Application of Lagrangian (Linear Harmonic oscillator, Planetary motion and Simple Pendulum only)	5	1,3
1.4	Hamilton's Canonical equations of motion, Advantages of Hamilton's method	2	1,3
1.5	Applications of Hamilton's method (Linear Harmonic oscillator and Simple pendulum only)	2	1,3
1.6	Hamilton's Principle of Least Action.	1	1
1.7	Derivation of Lagrange's equation from Hamilton's Principle.	2	1
2.0	**Historical development and origin of quantum theory, General Formalism of Quantum Mechanics**	**24**	**2,4,5,6,7**
2.1	Failure of classical physics- Black Body radiation-Planck's radiation law	2	2
2.2	Photoelectric effect-Einstein's explanation	2	2,4
2.3	Compton effect	2	2,4
2.4	Bohr's correspondence principle-Wave particle Dualism	1	2,6
2.5	Dual nature of matter- De Broglie hypothesis	1	2,4
2.6	Davisson-Germer Experiment	1	2
2.8	De Broglie waves, Wave packet, Group and phase velocities	3	2,4

2.9	Eigen functions and eigen values	3	5,7
2.10	Hermitian operator	3	5,7
2.11	Postulates of Quantum Mechanics	1	5
2.12	wave function, Operators, Expectation value	3	5,7
2.13	Uncertainty relation(position-momentum)	2	5,7
3.0	**Schrödinger equation and its applications**	**15**	**5,6,7**
3.1	Time dependent Schrödinger equation	2	5
3.2	Interpretation of wave function, Probability density, Probability current density	3	5
3.3	Ehrenfest theorem- Extension to three dimensions	3	6
3.4	Time independent Schrödinger equation- Stationary states	2	5
3.5	Admissibility conditions ofwave function	1	5
3.6	General properties of one dimensional Schrödinger equation	1	5
3.7	Particle in a box	2	7
3.8	Orthogonality of wave functions	1	7

References:

1. Textbook of Quantum Mechanics- G Aruldhas.
2. Classical Mechanics by J.C. Upadhyaya. Himalaya Pub.
3. Concepts of Modern Physics- Arthur Beiser, TMH
4. Classical Mechanics by G. Aruldhas
5. Concepts of Modern Physics- Arthur Beiser, TMH
6. A Textbook of Quantum Mechanics- G Aruldhas- (2 nd Edition)- PHI

7. Semester V

PH5CRT07: Digital Electronics and Programming

SL.NO	COURSE OUTCOME	CONGNITIVE LEVEL	PSO
1	Understand the basics of Boolean algebra and logic gates and study the methods to simplify Boolean expressions	Understand	1
2	Apply K map method to simplify Boolean expressions	Apply	5
3	Differentiate combinational logic circuits and sequential logic circuits. Apply these logics in simple circuits.	Understand Apply	1,5
4	Understand basics of C++ programming like control structures, loops , functions	Understand	1
5	Create simple programs in C++ using loops	Create	6

Course Description

Module	Course Description	Hrs	CO
1.0	**Boolean algebra and logic gates**	**9**	**1,2**
1.1	Basic gates NOT, OR, AND. Universal Logic Gates- NOR, NAND. XOR and XNOR Gates.	2	1
1.2	Rules and Laws of Boolean algebra. Duality theorem -De Morgan's Theorems.	1	1
1.3	analysis and simplification of logic circuits. Boolean equation and truth table - SOP and POS. Minterms and Maxterms.	2	1
1.4	Standard SOP and Standard POS- Conversion between Standard SOP & Standard POS.	2	1
1.5	Karnaugh Map (up to four variables). K map SOP minimization.	2	2

2.0	**Combinational logic, Sequential logic**	**19**	**3**
2.1	Half Adder and Full Adder.	2	3
2.2	Half and Full subtractor, 4-bit parallel Adder/Subtractor.	2	3
2.3	Multiplexer, De-multiplexer, Encoder & Decoder.	2	3
2.4	Flip-flops, RS, Clocked RS.	3	3
2.5	Master Slave JK FF, DFF, T Flip-flop,	3	3
2.6	Buffer registers- Shift register-SISO and SIPO	2	3
2.7	Counters- Binary ripple counter. D/A converters (Ladder type).	3	3
2.8	A/D Converter (Counter type).	2	3
3.0	**Programming in C++**	**26**	**4,5**
3.1	Basic C++ program structure –comments-data types-variable types constants	3	4
3.2	Operators(arithmetic, relational, logical and assignment operators)	1	4
3.3	if, if-else and else if, do while - case – loops(while, do-while, and for)-nested loops	3	4
3.4	Arrays(Defining Arrays,Accessing Array Elements, Initializing Arrays)	4	4
3.5	Basic ideas of functions(qualitative idea), object and classes.	4	4
3.6	Programs using loops.	11	5

References:

1. Digital fundamentals, Thomas L. Floyed
2. Digital principles and applications, Malvino, Leach and Saha
3. Digital electronics, S Salivahanan & S Arivazhagan
4. Digital design, M Morris Mano
5. Object oriented programming in Turbo C++ - Robert Lafore
6. Digital logic and computer design - M Morris Mano, PHI

8. Semester V

PH5CRT08: Environmental Physics and Human rights

Sl No.	Course Outcome	Cognitive Level	PSO
1	Understand the scope and importance of environmental studies, differentiate different types of natural resources and ecosystems .	Understand	1,2,7
2	Understand the negative impacts on nature by human beings and to create awareness.	Understand	1,2,7
3	Understand the capacity of solar power technology in replacing the non renewable sources of energy.	Understand	1,2,7
4	Understand the importance of human rights and the national and international perspectives on human rights.	Understand	1,2,7
5	Differentiate the causes of environmental pollution and to encourage the students to develop positive attitudes and values.	Analyse	6,7

Course Description

Module	Course Description	Hrs	CO
1.0	**Water Resources and Its Management, Remote sensing, Environmental Pollution**	**15**	**1,2,5**
1.1	Water resources: Use and over-utilization of surface and ground water, floods, drought, dams-benefits and problems.	2	1,2
1.2	Water harvesting-Importance of rain water harvesting in Kerala.	1	1
1.3	Remote sensing-principles, spectral reflectance of earth's surface features.	1	2

1.4	Remote sensing satellites and sensors, aerial photography, Applications of Remote Sensing in environmental monitoring and assessment.	2	2
1.5	Environment and human health; Environmental pollution- Primary and secondary pollutants	1	5
1.6	Air pollution- Sources, Effects and Control/Treatment methods; Acid Rain; Ozone layer depletion; Green house gases; Global warming - Climatic effects	2	5
1.7	Water pollution- Sources, Effects and Control/Treatment methods; Groundwater pollution; Marine pollution, Soil pollution	2	5
1.8	Noise pollution- Sources and measurement indices of noise pollution, Noise exposure level and standards, Noise control measures, Impact of noise on human health.	2	5
1.9	Environmental pollution due to environmental disasters; Consumerism and waste products	1	5
1.10	E-waste-an emerging environmental threat. Disaster management: floods, earthquake,cyclone and landslides.	1	5
2.0	**Waste Management, Environment Impact Assessment and Control**	**12**	**2,5**
2.1	Waste minimization and resource conservation:- Source reduction, Recycling, Value-added products	2	2,5
2.2	Waste minimization promotional methods- awareness generation, control methods and economic benefits, Benefits of waste minimization	2	2,5
2.3	Management of solid wastes- Municipal solid wastes, Hazardous solid waste-characteristics and management of HSW	2	2,5
2.4	Waste treatment and disposal methods- physical, biological and chemical process.	2	2,5
2.5	Basic ideas of environment impact assessment; Environment ethics	1	2
2.5	Environmental laws and constitutional provisions to control pollutions in India-The general acts.	1	2
2.6	Air (prevention and control of pollution) act; Water (prevention and control of pollution) act	1	2
2.7	Wild life protection act; Forest conservation act; Environment protection acts.	1	2
3.0	**Non-renewable and Renewable Energy Sources**	**13**	**1**

3.1	Non-renewable energy sources:-Coal, Oil, Natural gas; Nuclear fission energy; Merits and demerits of non-renewable energy.	2	1
3.2	Renewable energy sources: Biomass energy- Biofuels, Biogas plant - Fixed dome type and moving drum type	3	1
3.3	Wind energy; Wave energy; Tidal energy; Hydroelectricity; Geothermal energy conversion	3	1
3.4	Ocean thermal energy conversion; Fusion energy; Hydrogen energy- Production and storage	3	1
3.5	Merits and demerits of each renewable energy sources; Storage of intermittently generated renewable energy	2	1
4.0	**Solar energy**	**14**	**3**
4.1	Sun as a source of energy- Solar radiation, Solar Constant, Spectral distribution.	1	3
4.2	Solar pond -Convective and salt gradient types; Flat plate collector.	2	3
4.3	Solar water heater - Direct and indirect systems, Passive and active systems.	2	3
4.4	Optical concentrator - Parabolic trough reflector - Mirror strip reflector - Fresnel lens collector.	2	3
4.6	Solar desalination; Solar dryer -Direct and indirect type; Solar cooker; Solar heating of buildings; Solar green houses.	3	3
4.7	Need and characteristics of photovoltaic (PV) systems; Solar cells - Principle, Equivalent circuits, V-I characteristics, fill factor, conversion efficiency	3	3
4.8	PV Sun tracking systems; Merits and demerits of solar energy.	1	3
5.0	**Human Rights,Human Rights and United Nations, Human Rights National Perspective**	**18**	**4**
5.1	An Introduction to Human Rights, Meaning, concept and development –History of Human Rights-Different Generations of Human Rights.	3	4
5.2	Universality of Human Rights- Basic International Human Rights Documents - UDHR, ICCPR, ICESCR.-Value dimensions of Human Rights	3	4
5.3	Human Rights co-ordination within UN system- Role of UN secretariat, The Economic and Social Council.	2	4
5.4	The Commission Human Rights-The Security Council and Human rights- The Committee on the Elimination of Racial Discrimination- The Committee on the Elimination of	2	4

	Discrimination Against Women		
5.5	The Committee on Economic, Social and Cultural Rights- The Human Rights Committee- Critical Appraisal of UN Human Rights Regime.	2	4
5.6	Human Rights in Indian Constitution – Fundamental Rights- The Constitutional Context of Human Rights-directive Principles of State Policy and Human Rights.	2	4
5.7	Human Rights of Women-children –minorities- Prisoners- Science Technology and Human Rights	2	4
5.8	National Human Rights Commission- State Human Rights Commission- Human Rights Awareness in Education.	2	4

References:

1. Non-conventional energy sources - G.D Rai
2. A textbook of Environmental Studies- E Bharucha
3. Environmental Science: Principles and Practice- R.C. Das and D.K. Behera
4. Renewable Energy Sources and Emerging Technologies-D.P. Kothari K. C. Singal, Rakesh Ranjan

9. Semester V (Open Course)

PH5OPT02 : Physics In Daily Life

Sl. No.	Course Outcome	Cognitive Level	PSO
1	Understand the fundamentals of units and dimensions and dimensional analysis	Understand	1
2	Understand the basic properties of light including basic ideas of diffraction, interference and scattering	Understand	1
3	Differentiate linear and rotational motion. Understand the forces acting in different types of motion.	Understand	1
4	Undersatnd the working principles of electrical appliances, transformer and generator and how they are used in power generation	Understand	1
5	Understand the different phases of matter and their properties.	Understand	1
6	Understand how energy is transported in forms of light, waves heat etc and different phenomena related to it and the universe	Understand	1

Course Description

Module	Course Description	Hrs	CO
1.0	**Units and Dimensions, Light**	**20**	**1,2**
1.1	Fundamental and derived quantities.	1	1
1.2	Units and dimensions,dimensional analysis.	2	1

1.3	Order of magnitude, significant figures	3	1
1.4	Errors.	2	1
1.5	Reflection, refraction, diffraction,interference, scattering(elementary ideas only) – examples from daily life apparent depth, blue color of sky, twinkling of stars.	3	2
1.6	Total internal reflection, mirage, sparkling of diamond, primary and secondary rainbow – optical fibers.	2	2
1.7	Concave and convex mirrors, lenses – focal length, power of a lens.	2	2
1.8	Refractive index, prism, dispersion.	2	2
1.9	Human eye, defects of the eye – myopia, hypermetropia, presbyopia and astigmatism and their correction by lens.	3	2
2.0	**Motion, Electricity**	**22**	**3,4**
2.1	Velocity, acceleration, momentum, Idea of inertia, force - laws of motion.	3	3
2.2	Newton's law of gravitation, acceleration due to gravity, mass and weight, apparent weight, weightlessness.	3	3
2.3	Rotational motion, Moment of inertia, torque, centripetal and centrifugal acceleration	3	3
2.4	Banking of curves, centrifugal pump, roller coasters.	3	3
2.5	Voltage and current, ohms law.	2	4
2.6	Electric energy, electric power, calculation of energy requirement of electric appliances.	3	4
2.7	Transformer, generator, hydroelectric power generation.	2	4
2.8	Wind power – solar power – nuclear power.	3	4
3.0	**Matter and energy, Universe**	**30**	**5,6**

3.1	Different phases of matter, fluids - surface tension.	2	5
3.2	Viscosity- capillary rise, Bernoulli's theorem and applications.	3	6
3.3	Heat energy, temperature, different temperature scales – degree Celsius, Fahrenheit and Kelvin.	4	6
3.4	Waves – transverse and longitudinal waves, sound waves, Doppler Effect.	4	6
3.5	Lasers, fluorescence, phosphorescence	2	6
3.6	Electromagnetic waves – applications – microwave oven, radar, super conductivity.	3	6
3.7	Planets, – solar system.	2	6
3.8	Moon- faces of moon, lunar and solar eclipses, constellations,	3	6
3.9	Different types of stars, Galaxies, black hole.	3	6
3.10	Satellites, Artificial satellites, Global positioning system. Geo stationary satellite.	4	6

References:

1. Fundamentals of Physics with Applications by Arthur Beiser

2. Conceptual Physics by Paul G Hewitt

10. Semester VI

PH6CRT09 : Thermal and Statistical Physics

Sl. No.	Course Outcome	Cognitive Level	PSO
1	Recall the basic ideas of thermodynamics and to understand the laws of thermodynamics.	Remember, Understand	1
2	Understand the working of heat engine .	Understand	1
3	Explain the concepts of entropy and to derive thermodynamic relations.	Understand	1
4	Understand heat transfer mechanisms and related laws.	Understand	1
5	Apply thermodynamic laws to estimate thermodynamic variables.	Apply	5
6	Understand the basics of statistical mechanics.	Understand	1
7	Distinguish statistical distributions.	Understand	1

Course Description

Module	Course Description	Hrs	CO
1.0	**Basics of Thermodynamics**	**21**	**1,2,5**
1.1	Equation of an ideal gas, behavior of real gases, Andrew's experiment on carbon dioxide,	2	1
1.2	Critical state, two phase region, intermolecular forces, van der Waals equation of state	2	1
1.3	Van der Waals isotherms, critical constants, limitation of van der Waals equation	1	1
1.4	Thermodynamic system, surroundings, variables, thermal equilibrium: zeroth law	1	1
1.5	Thermodynamic equilibrium, thermodynamic processes, reversible and irreversible processes, equation of state, expansivity and	3	1

	compressibility.		
1.6	Internal energy, heat, work, cyclic processes, first law, heat capacity	2	1
1.7	Energy equation and difference of specific heat capacities, indicator diagram	2	1
1.8	Work done in reversible isothermal expansion of ideal gas, work done in reversible adiabatic expansion of ideal gas.	3	1
1.9	Second law statements, heat engine, efficiency, Carnot's ideal heat engine, work done by the engine per cycle, reversibility	2	2
1.10	Carnot refrigerator, heat pump, Carnot theorem, absolute scale of temperature, Clausius- Clapeyron latent heat equation.	3	2,5
2.0	**Entropy, Thermodynamic relations, Conduction and radiation**	**17**	**3,4,5**
2.1	Definition of entropy, principle of increase of entropy, entropy and unavailable energy	1	3
2.2	Change in entropy in heat conduction, change in entropy in reversible and irreversible process	2	3
2.3	Efficiency of Carnot cycle from TS diagram, entropy of an ideal gas, entropy and disorder.	2	3
2.4	Maxwell's thermodynamic relations	3	3
2.5	TdS equations, energy equation, heat capacity equations	3	3
2.6	Thermodynamic functions, third law of thermodynamics	2	3,5
2.7	Conduction, thermal conductivity, thermal conductivity of bad conductor Lee's disc experiment	2	4
2.8	Thermal resistance, thermal radiation and its properties, fundamental definitions of energy flux	1	4
2.9	Intensity and radiant emittance, Stefan's law, Stefan-Boltzmann law.	1	4,5

3.0	Statistical mechanics Statistical distributions	16	5,6,7
3.1	Microstates and macrostates, Phase space, density of states, mu space and Gamma space	2	6
3.2	Principle of equal a priori probability, ergodic hypothesis, statistical equilibrium	2	6
3.3	Ensemble, ensemble formulation of statistical mechanics,	2	6
3.4	Average energy of particle, equipartition theorem.	2	5,6
3.5	Maxwell Boltzmann, Fermi-Dirac and Bose-Einstein statistics, distribution laws	4	6
3.6	Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distribution.	4	7

References:

1. Thermal and Statistical Physics, R.B. Singh Part 1
2. Thermal and Statistical Physics, R.B. Singh Part 1
3. An introduction to thermodynamics by Y.V.C. Rao
4. An introduction to Thermal Physics by D.V. Schroeder
5. Heat and thermodynamics by Mark W Zemansky, Richard H Dittman & Amit K
6. Chattopadhyay.
7. Thermodynamics and Statistical physics Brij Lal, N.Subrahmanyam and P S Hemne
8. Berkeley Physics Course Volume 5; Statistical Physics; Frederick Reif.
9. Statistical Mechanics, R.K. Pathria

11. Semester VI

PH6CRT10 : Relativity and Spectroscopy

Sl.No	Course Outcome	Cognitive Level	PSO
1	Understand the concepts of special theory of relativity and to solve problems using it	Understand , Apply	1, 5
2	Explain different atom models	Uderstand	1
3	Illustrate Sodium D lines, Zeeman effect and Paschen-back effect on the basis of atomic spectroscopy	Understand	1
4	Understand electronic, vibrational and rotational energy levels of molecules.	Understand	1
5	Explain Raman effect based on classical and quantum theory	Understand	1
6	Basic principles and instrumentation of NMR and ESR spectroscopy	Understand	1

Course Description

Module	Course Description	Hrs	CO
1.0	**Special Theory of Relativity**	**18**	**1**
1.1	Inertial and non inertial frames of reference- Galilean transformation	2	1
1.2	Significance of Michelson-Morley experiment	2	1
1.3	Postulates of Special Theory of Relativity, Lorentz transformation	4	1
1.4	Spatial contraction, Time dilation, composition of velocities, mass of moving particle	5	1
1.5	Equivalence of mass and energy.	1	1
1.6	Introductory concept of general theory of relativity.	2	1
2.0	**Atomic Spectroscopy**	**21**	**2,3,7**

2.1	Historical introduction. Electrostatic spectrum	2	2
2.2	Types of spectra. Absorption and emission of light by atoms, quantum theory	2	2
2.3	Early atom models – Bohr model, electron spin and magnetic moment, Exclusion principle	3	2
2.4	Stern-Gerlach experiment	2	2
2.5	Vector atom model, quantum numbers associated with vector atom models	3	2
2.6	Total angular momentum and LS coupling	2	2
2.7	Fine structure of Sodium D lines	2	3
2.8	Zeeman effect, quantum mechanical explanation for anomalous Zeeman effect	4	3,7
2.9	Paschen-Back effect.	1	3
3.0	**Molecular Spectroscopy, NMR and ESR Spectroscopy**	**33**	**4,5,6,7**
3.1	Molecular energy levels. Electronic, rotational and vibrational energies	2	4
3.2	Rotationalspectra, explanation in terms of rigid rotator model	3	4
3.3	Vibrational energy levels, explanation in terms of harmonic oscillator.	4	4
3.4	Electronic energy levels of atoms, Fluorescence and phosphorescence	4	4
3.5	Raman effect –experimental arrangement and result, classical theory and its failure, quantum theory ofRaman effect	5	5,7
3.6	IR and Microwave spectroscopes.	3	4
3.7	NMR Spectroscopy- Basic principles and instrumentation	4	
3.8	Medical applications of NMR.	3	
3.9	ESR Spectroscopy- Basic principles and instrumentation	5	

References:

1. Molecular structure and spectroscopy, Aruldas
2. Modern Physics, Kenneth S Krane
3. Concepts of modern Physics, Arthur Beiser
4. Spectroscopy: Straughan and Walker –(Vol.1) John Wiley
5. Fundamentals of Molecular Spectroscopy: CN Banwell
6. Introduction to Atomic Spectra, HE White
7. Elements of spectroscopy, Guptha, Kumar and Sharma
8. Special Relativity- Resnick
9. Mechanics – D.S.Mathur
10. Mechanics - J.C. Upadhayaya (Ramprasad)
11. Semiconductor physics and optoelectronics- V Rajendran, J Hemaletha and M S M Gibson

12. Semester VI

PH6CRT11 : Nuclear Physics, Astrophysics

Sl. No	Course Outcome	Cognitive Level	PSO
1	Understand the structure and properties of nucleus.	Understand	1, 5
2	Understand different nuclear models.	Understand	1
3	Understand different particle accelerators and counters.	Understand	1
4.	Estimate the energy of nuclear reactions	Apply	1, 5
5	Differentiate between different nuclear radiations.	Understand	1
6	Classify different types of Nuclear reactors	Understand	1
7	Categorize different elementary particles and Understand particle quantum numbers	Understand	1
8	Understand the effects of cosmic rays.	Understand	1
9	Understand the theory of birth and evolution of stars	Understand	1

Course Description

Module	Course Description	Hrs	CO
1.0	**Nuclear structure, Nuclear Radiation Detectors, and Particle Accelerators**	**18**	**1, 2, 3**
1.1	Nuclear composition – Discovery of neutron – Nuclear electrons	1	1
1.2	Nuclear properties: Nuclear radii – Spin and magnetic moment - Stable nuclei - Binding energy	1	1
1.3	Binding energy curve, Liquid drop model - Semi empirical binding energy formula with correction factors	2	1
1.4	Shell model - Nuclear forces- Meson theory of nuclear forces	3	2
1.5	Discovery of pion – Virtual Photons	1	1

1.6	Interactions between energetic particles and matter – Ionization chamber	2	3
1.7	Solid state detectors - Proportional counter, Geiger-Muller counter	3	3
1.8	The Wilson cloud chamber - Bubble chamber	1	3
1.9	Scintillation counters - Van de Graaff generator	2	3
1.10	Linear accelerator - Cyclotron - Betatron	2	3
2.0	**Nuclear Transformations and Cosmic rays**	**19**	**4, 5, 6, 8**
2.1	Radioactive decay – Radiation hazards – Half life -	2	4
2.2	Radiometric dating – Radioactive series - Alpha decay, tunnel theory of alpha decay, derivation for alpha decay constant	3	4
2.3	Beta decay, positron emission, electron capture	2	5
2.4	Inverse beta decay – Gamma decay	2	4
2.5	The concept of interaction cross section, reaction rate	1	5
2.6	Nuclear reactions, Resonance-	1	4
2.7	Center of mass coordinate system, Q value of nuclear reaction, Nuclear fission	2	4
2.8	Nuclear reactors – Breeder reactors	1	6
2.9	Nuclear fusion in stars – Formation of heavier elements	1	4
2.10	Fusion reactors – Confinement methods	1	6
2.11	Cosmic rays- Latitude effect – Azimuth effect – Altitude effect	1	8
2.12	Primary cosmic rays – Secondary cosmic rays	1	8
2.13	Cosmic ray showers – Discovery of Positron – Mesons Van Allen belts – Origin of cosmic rays	1	8
3.0	**Particle Physics and Astrophysics**	**17**	7
4.1	Interactions and Particles – Leptons – Neutrinos and Antineutrinos, other leptons	2	7

4.2	Hadrons – Resonance particles – Elementary particle quantum numbers –	4	7
4.3	Basic concepts of symmetries and conservation principles	3	7
4.4	Basic concepts of Quarks – color, flavor, Quark confinement –Higgs boson	3	7
4.5	Classification of stars – Hertzsprung - Russel diagram – Luminosity of a star	2	9
4.6	Stellar evolution - White Dwarfs - Chandrasekhar limit - Neutron stars - Black holes	2	9
4.7	Supernova explosion – Photon diffusion time.	1	9

References:

1. Concepts of Modern Physics- Arthur Beiser
2. Modern Physics- R Murugeshan and K. Sivaprasath
3. Atomic and Nuclear Physics- S N Ghoshal
4. Nuclear and Particle Physics- S L Kakani and Subhra Kakani

13. Semester VI

PH6CRT12: Solid State Physics

Sl.No.	Course Outcome	Cognitive Level	PSO
1	Recall the basic solid state structures already studied	Remember	1
2	Understand the basics of Solid State Physics.	Understand	1
3	Illustrate the different crystal types and bonding in solids found in nature.	Understand	1
4	Determine the free electron theory and elementary band theory	Apply	2
5	Relevance of superconductivity, LED and photodiodes	Analyze	3
6	Problem solving in the field of solid state physics	Analyze	5
7	Organize the crystals type based on their conducting, dielectric and magnetic properties	Analyze	5

Course Description

Module	Course Description	Hrs	CO
1.0	**Crystal Structure**	**18**	**1,2,3,6**
1.1	Solid state, crystalline, polycrystalline and amorphous materials	2	1
1.2	Crystal lattice, periodicity, translation vectors,	2	2
1.3	Unit cell, basis, symmetry operations	2	2
1.4	Bravais lattice in two and three dimensions	2	3
1.5	Miller indices, Interplanar spacing	2	3
1.6	Simple crystal structures-hcp, fcc, bcc and simple cubic	2	2
1.7	Structures of NaCl, Diamond and ZnS	1	2
1.8	X-ray diffraction from crystals- Bragg's law, powder method	2	2
1.9	Reciprocal lattice-properties, reciprocal lattice to sc, bcc and fcc, Bragg's law in reciprocal lattice.	2	3
1.10	Problems	1	6
2.0	**Bonding in solids-**	**7**	**1,2**

2.1	Inter-atomic forces	1	1
2.2	Ionic bonding, bond dissociation and cohesive energy, madelung energy	3	2
2.3	Covalent bonding, metallic bonding, hydrogen bonding, van derwaals bonding	3	2
3.0	**Free electron theory and elementary band theory**	**12**	**4,6,7**
3.1	Free electron gas in one dimension, three dimensionElectronic specific heat, band theory, Bloch theorem, Kronig-Penney model (derivation not expected), energy-wave vector relations, different zone schemes, velocity and effective mass of electron	9	4
3.2	Distinction between metals, insulators and semiconductors.	2	7
3.3	Problems	1	6
4.0	**Semiconducting properties of materials**	**12**	**2,5,6**
4.1	Intrinsic and extrinsic semiconductors, drift velocity, mobility and conductivity of intrinsic semiconductors, carrier concentration and Fermi level for intrinsic semiconductor	4	2
4.2	Carrier concentration, conductivity and Fermi level for extrinsic semiconductor.	3	2
4.3	Hall Effect, Direct and Indirect band gap	2	2
4.4	LED and Photodiodes	2	5
4.5	Problems	1	6
5.0	**Dielectric Properties of Materials**	**5**	**2,7**
5.1	Dielectric Properties- Introduction	1	2
5.2	Polarization and susceptibility, local filed, dielectric constant and polarizability,	2	7
5.3	sources of polarizability, Clausius-Mossoti relation, piezoelectricity.	2	7
6.0	**Magnetic properties of materials**	**7**	**2,6,7**
6.1	Magnetic properties- Introduction	1	2
6.2	Response of materials to magnetic field, classification of	1	7

	magnetic materials		
6.3	Langevin's classical theory of diamagnetism and paramagnetism, ferromagnetism	2	7
6.4	Weiss theory, domain theory, antiferromagnetism and ferrimagnetism.	2	7
6.5	Problems	1	6
7.0	**Superconductivity**	**10**	**2,5**
7.1	Superconductivity- Introduction	1	2
7.2	Origin of superconductivity, response of magnetic field, Meissner effect	2	5
7.3	Super current and penetration depth, critical field and critical temperature	2	5
7.4	Type-I and type –II superconductors, thermodynamic and optical properties	2	5
7.5	Isotope effect, Josephson effect and tunneling- SQUID BCS theory-Cooper pairs-Existence of bandgap	3	5

References:

1. Solid State Physics- Puri and Babbar
2. Solid State Physics,-M.A. Wahab
3. Introduction to Solid State Physics- Charles Kittel
4. Crystallography applied to solid state Physics-AR Verma, ON Srivastava
5. Solid State Physics- AJ Dekker.

14. Semester VI

PH6CBT02 : Material Science

SL.NO	CO	Cognitive Level	PSO
1	Explain the basic structure of materials at microscopic scales	Understand	1
2	Classifications of defects in crystalline solids	Understand	1
3	Determine the diffusion coefficient, *D*. Using Fick's first law and Second law	Apply	5
4	Explain the property of a substance in which there is no definite relation between stress and strain.	Understand	1
5	Explain the properties ,applications and preparation of nanoparticles.	Understand	
6	Distinguish differentmaterial characterization Technique	Understand	1
7	Understand the thermal, electrical, magnetical, chemical, optical propeties of materials.	Understand	1

Course description

Module	Course description	Hrs	CO
1.0	**Structure and properties of materials**	**18**	**1**
1.1	Classification of materials – Advance materials- level of structures	2	2
1.2	Physical properties of materials – imperfections in solids	2	2
1.3	Mechanical properties of materials	4	4
1.4	Thermal properties of materials	3	3
1.5	Electrical and magnetic properties	3	7
1.6	Dielectric strength and dielectric constant	2	7
1.7	Basic ideas of chemical properties	1	7
2.0	**Optical properties of materials**	**18**	
2.1	Absorption process – fundamental absorption -exciton absorption	3	4
2.2	Free – carrier absorption, Photoconductivity ,photoelectric effect	3	4
2.3	Photovoltaic effect, photoluminescence	2	4
2.4	Colour centres – Generation of colour centres	2	4

2.5	Display devices – active and passive – liquid crystals	2	6
2.6	Types of liquid crystals – Nematic , cholesteric liquid crystals	3	6
2.8	General features of liquid crystals – numeric display using LCD	3	6
3.0	**Nanoscience**	**18**	
3.1	Metal nanoclusters -magic numbers ,theoretical modelling,geometric and electronic structure	2	4
3.2	Magnetic clusters -Semiconducting nanoparticles	2	4
3.3	Molecular clusters – carbon nano structures- carbon clusters	2	4
3.4	CNT preparation	1	
3.5	Quantum wells,wires and dots – preparation,size and dimensionality effects ,applications	2	5
3.6	Qualitative study of powder – XRD ,SEM, SPM	3	6
3.7	TEM, STM, AFM	3	6
3.8	PES ,Raman spectroscopy	2	6

References:

1. Solid State Physics -M.A Wahab
2. Modern Physics- Murugeshan
3. Semiconductor physics and optoelectronics-V Rajendran
4. Nanotechnology – The science of Small ,M A Shah and K A Shah
5. Crystallography applied to solid state Physics -A.R Verma ,O N Srivastava
6. Nanotechnology-L E Foster ,Pearson
7. Introduction to nanotechnology -C P Poole, F.J Owenns
8. Nanotechnology : Principles and practices-Sulabha k Kulkarni

15. Semester I & II (Core Practical)

PH2CRP01 –Mechanics and Properties of Matter

Sl.No.	Course Outcome	Cognitive Level	PSO
1.	Apply the knowledge of different types of pendulum to determine 'g'.	Understand, Apply	2,3,4,6
2.	Determine surface tension of liquid using capillary rise method.	Understand, Apply	2,3,4,6
3.	Determine moment of inertia of fly wheel.	Understand, Apply	2,3,4,6
4.	Determine the rigidity modulus of a material using static and dynamic method.	Understand, Apply	2,3,4,6
5.	Determine Young's modulus of a material by different bending methods.	Understand, Apply	2,3,4,6

Course Description

Sl.No	Course Description	Hrs	CO
1	Symmetric, asymmetric compound pendulum and Kater's pendulum-determination of 'g'.	4	1
2	Determination of Young's modulus of a material by uniform and non-uniform bending methods using pin and microscope method	4	5
3	Torsion pendulum-Determination of rigidity modulus	2	4
4	Determine surface tension by capillary rise method	1	2
6	Fly wheel-Determination of moment of inertia	1	3
7	Cantilever- Determination of Young's modulus	2	5
8	Static torsion- Determination of rigidity modulus	1	4

16. Semester III & IV (Core Practical)

PH4CRP02: Optics and Semiconductor Physics

Sl.No	Course Outcome	Cognitive Level	PSO
1	Determine optical constants of different materials using spectrometer and liquid lens	Apply	1, 2,3,4,5,6
2	Execute and analyse the characteristics of semiconductor devices.	Apply, Analyze	1,2,3,4,5
3	Execute and analyze the characteristics of semiconducting circuits	Apply, Analyze	1,2,3,4,5

Course Description

Sl.No	Course Description	Hrs	CO
1	Liquid Lens – optical constant of convex lens and liquid	4	2,3
2	Spectrometer – refractive index of material of prism and water using prism,hollow prism and small angled prism	8	1,2,3,
3	Determination of wavelength of sodium light using Newtons rings	2	1,2,3
4	Determination of diameter of thin wire- Air wedge	2	1
5	Caracteristics – Zener diode, transistor, FET, OPAMP	8	2
6	Study of ripple factor and load regulation with and without filter circuit – half wave rectifier, full wave rectifier (center tap, bridge)	6	3
7	Zener diode – voltage regulation – line and load regulation	2	3
8	Study of output waveforms – Clippers, Clampers	4	3
9	Study of gain – inverter, non-invertor, buffer - OPAMP	2	3
10	LC and Phase shift oscillator using transistor	4	3

17. Semester V & VI Practical

PH6CRP03: Electricity, Magnetism and LASER

Sl.No.	Course Outcome	Cognitive level	PSOs
1	Estimation and calibration of basic electrical equipments.	Apply	1,3,4,5
2	Determine the magnetic field and related parameters	Apply	1,3,4,5
3	Determine basic parameters related to current	Apply	1,3,4,5
4	Verify current theorems	Analyze	1,3,4,5
5	Determine optical constants using varying experimental methods	Apply	1,3,4,5
6	Determination of Dielectric constant of a thin sheet/ a liquid	Apply	1,3,4,5

Course Description

Expt	Course Description	Hrs	CO
1	Potentiometer – Measurement of resistance of wire	2	3
2	Potentiometer – Calibration of low range voltmeter	2	1
3	Potentiometer – Calibration of high range voltmeter	2	1
4	Potentiometer – Calibration of ammeter	2	1
5	Tangent galvanometer – Calibration of ammeter	2	1
6	Moving coil galvanometer – figure of merit	2	1
7	Conversion of galvanometer into voltmeter	2	1
8	Conversion of galvanometer into ammeter	2	1
9	Field along the axis of a circular coil – magnetic flux variation	2	2
10	Field along the axis of a circular coil – m and Bh	2	2
11	Searle's vibration magnetometer – magnetic moment	2	2
12	Deflection and vibration magnetometer – m and Bh	2	2
13	Carey Foster's bridge – Measurement of resistivity of wire	2	3
14	LCR series and parallel resonant circuit analysis	2	3
15	Verification of Thevenin's and Norton's theorems	2	4
16	Verification of Superposition and Maximum power transfer theorems	2	4
17	Laser – Grating – Determination of wavelength	2	5
18	Laser – Determination of spot size and divergence	2	5
19	Optical fiber – Determination of numerical aperture	2	5
20	Single slit diffraction using laser – Determination of slit width	2	5
21	e/m – Thomson's apparatus – Bar magnet/magnetic focusing	2	2
22	Determination of Dielectric constant of a thin sheet/ a liquid	2	6

18. PH6CRP04: Digital Electronics

Sl.No.	Course Outcome	Cognitive level	PSOs
1	Verify the truth table of basic and universal gates	Analyze	1,3,4,5
2	Verification of electronic theorems and circuits	Analyze	1,3,4,5
3	Characteristic study of electronic circuits	Analyze	1,3,4,5

Course Description

Expt	Course Description	Hrs	CO
1	Realization of logic gates – AND, OR and NOT – Using diodes, transistors etc.	2	1
2	Realization of logic gates – AND, OR and NOT – Using universal gates	2	1
3	Verification of truth table of NAND, NOR, XOR and XNOR gates	2	1
4	Verification of De Morgan's theorems – Using IC 7400	2	2
5	BCD to 7 segment decoder	2	3
6	Realization of Half adder / Full adder using gates – Verification of truth table	2	3
7	Astable Multivibrator using Transistor	2	3
8	Astable Multivibrator using IC 555	2	3
9	Monostable Multivibrator using Transistor	2	3
10	Monostable Multivibrator using IC 555	2	3
11	D/A converter using IC 741 – Using binary weighed resistor / R – 2R ladder type	2	3
12	A/D converter using IC 741	2	3
13	SR Flip Flops using IC 7400 – Verification of truth table	2	2
14	JK Flip Flops using IC 7400 & 7410 – Verification of truth table	2	2
15	Digital counter using IC 7490 / 7495 / 74194 / 74151 – Verification of truth table	2	2
16	Schmitt trigger using IC 741	2	3
17	Bistable multivibrator using IC 555	2	3
18	Multiplexer using gates	2	3
19	Demultiplexer using gates	2	3
20	Shift register – SISO	2	3
21	Shift register – SIPO	2	3
22	4-Bit Binary to Gray conversion	2	3
23	4-Bit Gray to Binary conversion	2	3

19. PH6CRP05: Thermal Physics, Spectroscopy and C++

Sl. No.	Course Outcome	Cognitive level	PSOs
1	Characteristic study related to thermal physics	Analyze	1,3,4,5
2	Determination of spectroscopic parameters	Apply	1,3,4,5
3	Carry out C++ programs	Apply	1,3,4,5

Course Description

Expt	Course Description	Hrs	CO
1	Thermistor – Resistance - Temperature characteristics and temperature coefficient of resistance	2	1
2	Newton's law of cooling – Specific heat capacity of a liquid	2	1
3	Thermal conductivity of bad conductor – Lee's disc	2	1
4	Carey Foster's bridge – Temperature co-efficient of resistance	2	1
5	Study of Seeback effect/Peltier effect	2	1
6	Electrochemical equivalent of Copper	2	1
7	To determine e/k using transistor	2	1
8	Spectrometer – Cauchy's constants	2	2
9	Spectrometer – Resolving power of a prism	2	2
10	Spectrometer – Resolving power of grating	2	2
11	Spectrometer – Dispersive power of grating	2	2
12	Spectrometer – Dispersive power of prism	2	2
13	Computer programming in C++ – Conversion of temperature scale	2	3
14	Computer programming in C++ – Solving a quadratic equation 15.	2	3
15	Computer programming in C++ – Generation of Fibonacci series 16.	2	3
16	Computer programming in C++ – Conversion of a decimal number into binary number	2	3
17	Computer programming in C++ – Simple Pendulum – Calculation of 'g' from experimental data	2	3
18	Computer programming in C++ – Resistance colour code to numerical value conversion	2	3
19	Computer programming in C++ – For different initial velocity and angle of projection, find out time of flight, horizontal range, Maximum height of a Projectile	2	3
20	Computer programming in C^{++} – sorting the numbers in ascending and descending order	2	3
21	Computer programming in C^{++} – multiplication of two matrices	2	3

20. PH6CRP06: Acoustics, Photonics and Advanced Semiconductor Physics

Sl. No.	Course Outcome	Cognitive level	PSOs
1	Characteristic study of wave motion	Analyze	1,3,4,5
2	Determination of optical constants	Apply	1,3,4,5
3	Characteristic study in advanced semiconductor Physics	Analyze	1,3,4,5
4	Verification of electronic circuits	Analyze	1,3,4,5

Course Description

Expt	Course Description	Hrs	CO
1	Melde's string – Determination of frequency of given tuning fork	2	1
2	Sonometer – Determination of frequency of AC	2	1
3	Sonometer – Determination of frequency of given tuning fork, unknown mass and verification of laws of strings	2	1
4	Kundt's tube – Determination of velocity of sound	2	1
5	Spectrometer – Quartz prism – Refractive indices of quartz for the ordinary and extra –ordinary rays	2	2
6	Characteristics of LED – V- I characteristic for different colors	2	3
7	Characteristics of solar cell / photodiode – V- I characteristics	2	3
8	Characteristics of Light Depend Resistors	2	3
9	Planck's constant using LED's of at least 3 different colours	2	3
10	Weinbridge Oscillator using IC 741	2	4
11	Realization of XOR and Ex NOR using transistor	2	4
12	Sweep wave generator using transistor	2	4
13	Regulated power supply using zener diode and IC 741 – Study of line and load regulations	2	4
14	Regulated power supply using IC 78XX/79XX etc – Study of line and load regulations	2	4
15	Voltage regulator using zener diode and transistor – Study of line and load regulations	2	4
16	RC coupled common emitter amplifier – Study of frequency response and bandwidth	2	4
17	Voltage multipliers – doubler & tripler	2	4
18	Wave shaping R C circuits – Integrator and differentiator	2	4
19	OPAMP – adder and subtractor	2	4
20	Amplitude modulation using transistor	2	4
21	Pulse Width Modulation using IC 555	2	4

Course Outcome for Complementary Physics

21. Semester I (complementary physics for Mathematics)

PH1CMT01: Properties of Matter and Error Analysis

Sl.No	Course Outcome	Cognitive Level	PSO
1	Understand the elastic behavior of materials	Understand	1
2	Calculate the elevation and depression of beams &rigidity modulus using different methods	Apply	5
3	Understand the basic theories of surface tension and it's applications in daily life	Understand Apply	1,5
4	Solve problems to find viscosity using different methods.	Analyse	5
5	Understand the basics of error analysis and rounding off in calculations	Understand	1
6	Understand the origin of errors and how errors propagate in calculations	Understand	1

Course Description

Sl. No.	Course description	Hrs.	CO
1.0	**Elasticity**	**13**	**1, 2, 5**
1.1	Stress- strain- Hooke's law- Elastic moduli- Poisson's ratio- twisting couple	2	1, 5
1.2	Determination of rigidity modulus- static and dynamic methods-	1	1
	static torsion- torsion pendulum		

1.3	Bending of beams- Cantilever, uniform and non-uniform bending	4	1, 2
1.4	I - section girder	1	2, 5
2.0	**Surface tension and Hydrodynamics**	**10**	**1, 2, 5**
2.1	Molecular theory of surface tension - surface energy - excess pressure in a liquid drop	2	1, 2
2.2	Factors affecting surface tension - applications	1	1, 2, 5
2.3	Streamline and turbulent flow - critical velocity - Coefficient of viscosity	2	1, 2,5
2.4	Derivation of Poiseuille's equation,	2	
2.5	Stokes equation-Determination of viscosity by Poiseuille's method.	2	1,2,5
2.6	Brownian motion – Viscosity of gases – Bernoulli's theorem.	1	1, 2, 5
3.0	**Error Analysis**	**13**	**1, 2, 5**
3.1	Basic ideas – uncertainties of measurement – importance of estimating errors	1	1, 2,5
3.2	Dominant errors – random errors – systematic errors - rejection of spurious measurements.	2	1, 5
3.3	Estimating and reporting errors – errors with reading scales, errors of digital instruments.	3	1,5
3.4	Number of significant digits –absolute and relative errors – standard deviation.	3	1,5
3.5	Propagation of errors – sum and differences – products and quotients – multiplying by constants – powers.	4	1, 2, 5

References:

1. Elements of properties of matter-D S Mathur
2. Advanced course in Practical Physics-D Chattopadhyay
3. Properties of Matter- Brijlal and N. Subrahmanyam
4. Concepts of Modern Physics- A. Beiser
5. Modern Physics- G. Aruldas and P. Rajagopal
6. Physics- Resnick and Halliday

22. Semester II (complementary physics for Mathematics)

PH2CMT01: Mechanics and Astrophysics

Sl.No	Course Outcome	Cognitive Level	PSO
1	Understand different types of pendulum and compute the acceleration due to gravity.	Understand	1
2	Identify different types of motion.	Apply	1, 2
3	Determine moment inertia of symmetric rigid bodies applying parallel and perpendicular axes theorem.	Remember, Understand Apply	1,5
4	Classify different types of waves.	Understand	1
5	Understand different phenomena related to progressive waves.	Understand	1, 5
6	Understand the basics of stellar evolution.	Understand	1

Course Description

Sl. No.	Course description	Hrs.	CO
1.0	**Motion under gravity and rotational dynamics**	**15**	**1, 2, 5, 6**
1.1	Velocity- acceleration- force – acceleration due to gravity	2	1, 5
1.2	Compound pendulum (symmetric and asymmetric), radius of gyration	1	1, 2
1.3	Kater's Pendulum		1
1.4	Centripetal acceleration and force - centrifugal force	4	1, 2
1.5	Angular velocity- angular momentum- torque- conservation of angular momentum	1	2, 5
1.6	Angular acceleration- moment of inertia- parallel and perpendicular axes theorems		1, 5, 6
1.7	Moment of inertia of rod, ring, disc, cylinder and sphere		1, 5,
1.8	Theory of Flywheel		1, 5
2.0	**Oscillations and Waves**	**13**	**1, 2, 5**
2.1	Periodic and oscillatory motion- simple harmonic motion- differential equation,	2	1, 2

2.2	Expression for displacement, velocity and acceleration- graphical representation.	1	1, 2, 5
2.3	Energy of a particle executing simple harmonic motion - damped oscillation	2	1, 5
2.4	Forced oscillation and resonance.	2	1, 5
3.0	**Astrophysics**	**8**	**1, 2**
3.1	Temperature and color of a star- elements present in a stellar atmosphere	1	1, 2
3.2	Mass of star, life time of a star- main sequence stars-HR diagram	2	1
3.3	Evolution of stars- white dwarf	2	1
3.4	Supernova explosion- neutron star- black hole	3	1

References:

1. Elements of properties of matter, D S Mathur
2. Mechanics- D S Mathur
3. Solid State Physics- P K Palanisamy
4. Properties of Matter- Brijlal and N. Subrahmanyam
5. A text book on oscillations waves and acoustics- M.Ghosh
6. Modern Physics- Murugeshan
7. Introduction to Astrophysics-Baidyanath Basu

23. Semester III (Complementary Physics for Mathematics)

PH3CMT01: Modern Physics and Electronics

Sl No.	Course Outcome	Cognitive Level	PSO
1	Understand and list the basic features of Bohr atom model, and the different coupling schemes.	Understand	1
2	Understand the basic properties of atomic nucleus and nuclear forces.	Understand	1
3	Understand the features of radioactivity and to compute the disintegration of radioactivity.	Understand, Apply	2,5
4	Explain the failures of classical mechanics and the emergence of quantum mechanics by illustrating black body spectrum, photo electric efect and Compton effect.	Understand	1
5	Understand the Schrodinger equations and to solve the problems related to it.	Understand, Apply	1,5
6	Explain different modes of molecular excitations.	Understand	1
7	Understand the basics of diodes and its applications.	Understand	1
8	Explain different number systems and to find the output of different logic gates and solve complex circuits using logic gates.	Understand Apply	1,5

Course Description

Module	Course Description	Hrs	CO
1.0	**Modern Physics**	**18**	**1,2,3**
1.1	Basic features of Bohr atom model-formula for energy	1	1
1.2	Vector atom model- various quantum numbers	2	1
1.3	Coupling schemes-LS and JJ coupling	1	1
1.4	Pauli's exclusion principle-magnetic moment of orbital electrons	2	1
1.5	Atomic nucleus classification-basic properties of nucleus-charge, mass, spin, magnetic moment binding energy and packing fraction	4	2

1.6	Nuclear forces-salient features	1	2
1.7	Radioactivity- properties of alpha, beta and gamma- Soddy Fajan's displacement law	2	3
1.8	Law of radioactive disintegration -decay constant	1	3
1.9	Half life and mean life	2	3
1.10	radioactive equilibrium - measurement of radioactivity Radio carbon dating	2	3
2.0	**Quantum Mechanics ,Spectroscopy**	**18**	**4,5,6**
2.1	Inadequacies of classical physics-experimental evidences	4	4
2.2	Evidences for quantum theory-Planck's hypothesis	1	4
2.3	Foundation of quantum mechanics-wave function & probability density	3	4
2.4	Schrödinger equation-time dependent and time independent	3	5
2.5	Particle in a potential box.	1	5
2.6	Optical spectra- spectral terms, selection rules	1	6
2.7	hyperfine structure; molecular spectra-rotational, vibrational and electronic spectra	2	6
2.8	Raman effect- experimental study, quantum theory	1	6
2.9	fluorescence and phosphorescence; comparison of Raman, fluorescence and IR spectra; NMR	1	6
3.0	**Electronics**	**8**	**7**
3.1	Current-voltage characteristics of a diode-forward and reverse bias	1	7
3.2	Breakdown mechanism of p-n junction diode	1	7
3.3	Zener diode and its characteristics	1	7
3.4	Half wave and full wave rectifiers- bridge rectifier-ripple factor, efficiency	3	7
3.5	Construction and operation of a bipolar junction transistor	2	7
4.0	**Digital Electronics**	**10**	**8**
4.1	Different number systems – decimal, binary, octal, hexa decimal number systems	1	8
4.2	Conversion between different number systems	2	8
4.3	Binary mathematics – addition, subtraction (1's compliment and 2's compliment methods)	3	8

4.5	Basic theorems of Boolean algebra- de Morgan's theorems	1	8
4.6	Simplification of Boolean equations - AND, OR, NOT, NAND, NOR, XOR gates- truth tables	2	8
4.6	Half adder- full adder	1	8

References

1. Modern Physics- R. Murugeshan, Er. Kirthiga Sivaprasad
2. Principles of electronics, V K Mehta,
3. Digital principles and applications- A. P. Malvino and P. Leach
4. Concepts of Modern Physics: Arthur Beiser
5. Basic Electronics , B L Thereja

24. Semester IV (Complementary Physics for Mathematics)

PH4CMT02: Optics and Electricity

Sl. No.	Course Outcome	Cognitive Level	PSO
1	Understand the basic ideas of optics – Interference, Diffraction, Polarization.	Understand	1
2	Illustrate the principles of laser.	Understand	1
3	Understand the working principle of optic fibers and to classify it.	Understand	1
4	Explain various features of dielectrics.	Understand	1
5	Understand the basics of varying current in various circuits.	Understand	1
6	Solve the problems related to optics, laser, fiber optics, dielectrics and varying current.	Understand, Apply	1,5

Course Description

Module	Course description	Hr	CO
1.0	**Interference, Diffraction and Polarization**	**22**	**1,6**
1.1	Introduction-Interference, light waves, phase difference, coherence, optical path and phase change.	1	1
1.2	Principle of superposition, young's double slit experiment, conditions for interference.	1	1
1.3	Conditions for sustained interference patterns, constuctive and destructive interference.	1	1
1.4	Thin film interference- reflected system, colour of thin films, fringes of equal inclination and equal thickness.	1	1
1.5	Newtons's rings – Reflected system – measurement of wavelength, Problems	2	1,6
1.6	Introduction – Diffraction – Fresnel and Fraunhoffer diffractions, Fresnels theory of rectilinear propagation of light, Problems	3	1,6

1.7	Fraunhoffer diffraction at single slit, width of central bright maxima.	1	1
1.8	Intensity in Fraunhoffer diffraction pattern. Problems	1	1,6
1.9	Introduction – Grating, construction and working of plane transmission grating	1	1
1.10	Determination of wavelength of light using grating.	1	1
1.11	Dispersive and resolving power of grating. Problems	2	1,6
1.12	Prism and grating spectra, rayleigh's criterion for resolution.	1	1
1.13	Introduction- Polarization, CPL, EPL and PPL	1	1
1.14	Brewster's law, Dichroism	1	1
1.15	Birefringence- E ray and O ray	1	1
1.16	Polarizer and analyser	1	1
1.17	Malu's law, optical activity	2	1
2.0	**Laser and Fiber Optics**	**10**	**2,3,6**
2.1	Introduction – Laser – Principle of operation of laser	1	2
2.2	Population inversion, metastable state, optical resonator	1	2
2.3	Components of laser – active medium, pump, optical resonant cavity	1	2
2.4	Principal pumping schemes	1	2
2.5	Three level and four level systems	1	2
2.5	Laser beam characteristics, applications of laser	1	2
2.6	Light propagation in optical fibres, Types of optical fibers- step index and graded index fibers	2	3
2.7	Acceptance angle, Numerical aperture, derivation and problems	3	3,6
3.0	**Dielectrics**	**10**	**4,6**
3.1	Dielectrics – Introduction, Polar and non polar dielectrics	1	4
3.2	Polarization, sources of polarization	1	4
3.3	Gauss's law in dielectrics	1	4
3.4	Permittivity, dielectric displacement vector, dielectric constant	1	4
3.5	Susceptibility, ferro electricity, problems	1	4,6
4.0	**Varying Currents**	**12**	**5,6**

4.1	Transient currents – Growth and decay of current in an inductive circuit.	1	5
4.2	Charging and discharging of a capacitor through a resistance	1	5
4.3	Peak, mean, rms and effective values of AC, problems	4	5,6
4.4	AC circuits – AC through RC, LC, LR and LCR series circuits	3	5,6
4.5	Resonance, sharpness of resonance, power factor, problems	3	5,6

References:

1. Optics - Brijlal and N. Subrahmanyam,
2. Electricity and Magnetism , D C Tayal
3. Electricity and Magnetism- J. H. Fewkes & John Yarwood
4. Electricity and Magnetism – R. Murugeshan
5. Nuclear physics –Irvin Kaplan
6. Lasers – theory & applications- Thyagarajan & Ghatak
7. Concepts of Modern Physics- A. Beiser
8. Laser Physics and Applications, V K Jain
9. Optical Fiber Communications, John M Senior

25. Semester I (Complementary physics for Chemistry)

PH1CMT02: Properties of Matter and Thermodynamics

Sl.No.	Course Outcome	Cognitive Level	PSO
1	Understand the elastic behaviour of materials	Understand	1
2	Calculate the elevation and depression of beams &rigidity modulus using different methods	Apply	5
3	Understand the basic theories of surface tension and it's applications in daily life	Understand Apply	1,5
4	Solve problems to find viscosity using different methods.	Analyse	5
5	Differentiate different thermodynamics processes and study the significance of laws of thermodynamics	Understand	1
6	Differentiate different thermodynamics processes and study the significance of laws of thermodynamics	Understand	1

Course Description

Sl. No.	Course description	Hrs.	CO
1.0	**Elasticity**	**13**	**1, 2, 5, 6**
1.1	Stress- strain- Hooke's law- Elastic moduli- Poisson's ratio- twisting couple	2	1, 5
1.2	Determination of rigidity modulus- static and dynamic methods-	1	1
	static torsion- torsion pendulum		
1.3	Bending of beams- Cantilever, uniform and non-uniform bending	4	1, 2
1.4	I - section girder	1	2, 5
2.0	**Surface tension and Hydrodynamics**	**10**	**1, 2, 5**
2.1	Molecular theory of surface tension - surface energy -	2	1, 2

	excess pressure in a liquid drop		
2.2	Factors affecting surface tension - applications	1	1, 2, 5
2.3	Streamline and turbulent flow - critical velocity - Coefficient of viscosity	2	1, 2,5
2.4	Derivation of Poiseuille's equation,	2	
2.5	Stokes equation-Determination of viscosity by Poiseuille's method.	2	1, 5
2.6	Brownian motion – Viscosity of gases – Bernoulli's theorem.	1	1, 2, 5
3.0	**Thermodynamics**	**13**	**1, 2, 5**
3.1	Thermodynamic systems- thermodynamic equilibrium	1	1, 2,5
3.2	Thermodynamic processes isothermal process- adiabatic process- zeroth law of thermodynamics	2	1, 5
3.3	First law of thermodynamics- heat engine- the Carnot engine- refrigerator,	4	1, 2, 5
3.4	Concept of entropy, Second law of thermodynamics, Third law of thermodynamics	4	1,5
3.5	Maxwell's thermodynamic Maxwell's thermodynamic	2	1, 5

References:

1. Mechanics - H.S.Hans and S.P.Puri
2. Properties of Matter - Brijlal and N. Subrahmanyam
3. Mechanics - J.C. Upadhyaya
4. Heat and Thermodynamics – Mark W Zemanski
5. Elements of properties of matter, D S Mathur
6. Heat and Thermodynamics-Brijlal & Subrahmanyam

26. Semester II (Complementary physics for Chemistry)

PH2CMT02: Mechanics and Superconductivity

Sl.No	Course Outcome	Cognitive Level	PSO
1	Understand different types of pendulum and compute the acceleration due to gravity.	Understand	1,
2	Identify different types of motion.	Apply	1, 2
3	Determine moment inertia of symmetric rigid bodies applying parallel and perpendicular axes theorem.	Remember, Understand Apply	1,5
4	Classify different types of waves.	Understand	1
5	Understand different phenomena related to progressive waves.	Understand	1, 5
6	Understand the phenomena of superconductivity and its applications.	Understand	1

Course Description

Sl. No.	Course description	Hrs.	CO
1.0	**Motion under gravity and rotational dynamics**	**15**	**1, 2, 5, 6**
1.1	Velocity- acceleration- force – acceleration due to gravity	2	1, 5
1.2	Compound pendulum (symmetric and asymmetric), radius of gyration	1	1, 5
1.3	Kater's Pendulum		1
1.4	Centripetal acceleration and force - centrifugal force	4	1, 2
1.5	Angular velocity- angular momentum- torque- conservation of angular momentum	1	2, 5, 6
1.6	Angular acceleration- moment of inertia- parallel and perpendicular axes theorems		1, 2, 5
1.7	Moment of inertia of rod, ring, disc, cylinder and sphere		1, 5
1.8	Theory of Flywheel		1, 5
2.0	**Oscillations and Waves**	**13**	**1, 2, 5**

2.1	Periodic and oscillatory motion- simple harmonic motion- differential equation,	2	1, 2
2.2	Expression for displacement, velocity and acceleration- graphical representation.	1	1, 2, 5
2.3	Energy of a particle executing simple harmonic motion - damped oscillation	2	1, 5
2.4	Forced oscillation and resonance.	2	1, 2, 5
3.0	**Superconductivity**	**8**	**1, 5**
3.1	Super conducting phenomenon- Occurrence	2	1, 5
	BCS theory, Meissner Effect	2	1
3.2	Type I and Type II superconductors- Josephson effects -	2	1
3.3	High temperature superconductors- Applications of Superconductivity	2	1

References:

8. Elements of properties of matter, D S Mathur- S Chand
9. Mechanics- D S Mathur- S Chand
10. Solid State Physics- P K Palanisamy
11. Properties of Matter- Brijlal and N. Subrahmanyam
12. A text book on oscillations waves and acoustics- M.Ghosh
13. Modern Physics- Murugeshan
14. Elementary Solid State Physics-Ali Omar

27. Semester III (Complementary Physics for Chemistry)

PH3CMT02: MODERN PHYSICS AND MAGNETISM

Sl No.	Course Outcome	Cognitive Level	PSO
1	Understand and list the basic features of Bohr atom model, and the different coupling schemes.	Understand	1
2	Understand the basic properties of atomic nucleus and nuclear forces.	Understand	1
3	Understand the features of radioactivity and to compute the disintegration of radioactivity.	Understand, Apply	2,5
4	Explain the failures of classical mechanics and the emergence of quantum mechanics by illustrating black body spectrum, photo electric efect and Compton effect.	Understand	1
5	Understand the Schrodinger equations and to solve the problems related to it.	Understand,Apply	1,5
6	Explain different modes of molecular excitations.	Understand	1
7	Understand the basics of diodes and its applications.	Understand	1
8	Differentiate magnetic materials	Understand	1

Course Description

Module	Course Description	Hrs	CO
1.0	**Modern Physics**	**18**	**1,2,3**
1.1	Basic features of Bohr atom model-formula for energy	1	1
1.2	Vector atom model- various quantum numbers	2	1
1.3	Coupling schemes-LS and JJ coupling	1	1
1.4	Pauli's exclusion principle-magnetic moment of orbital electrons	2	1
1.5	Atomic nucleus classification-basic properties of nucleus-charge, mass, spin, magnetic moment binding energy and	4	2

	packing fraction		
1.6	Nuclear forces-salient features	1	2
1.7	Radioactivity- properties of alpha, beta and gamma- Soddy Fajan's displacement law	2	3
1.8	Law of radioactive disintegration -decay constant	1	3
1.9	Half life and mean life	2	3
1.10	radioactive equilibrium - measurement of radioactivity Radio carbon dating	2	3
2.0	**Quantum Mechanics ,Spectroscopy**	**18**	**4,5,6**
2.1	Inadequacies of classical physics-experimental evidences	4	4
2.2	Evidences for quantum theory-Planck's hypothesis	1	4
2.3	Foundation of quantum mechanics-wave function & probability density	3	4
2.4	Schrödinger equation-time dependent and time independent	3	5
2.5	Particle in a potential box.	1	5
2.6	Optical spectra- spectral terms, selection rules	1	6
2.7	hyperfine structure; molecular spectra-rotational, vibrational and electronic spectra	2	6
2.8	Raman effect- experimental study, quantum theory	1	6
2.9	fluorescence and phosphorescence; comparison of Raman, fluorescence and IR spectra; NMR	1	6
3.0	**Electronics**	**8**	**7**
3.1	Current-voltage characteristics of a diode-forward and reverse bias	1	7
3.2	Breakdown mechanism of p-n junction diode	1	7
3.3	Zener diode and its characteristics	1	7
3.4	Half wave and full wave rectifiers- bridge rectifier-ripple factor, efficiency	3	7
3.5	Construction and operation of a bipolar junction transistor	2	7
4.0	**Magnetism**	**10**	**8**
4.1	Properties of magnetic materials, Paramagnetism, Diamagnetism, Ferromagnetism, Hysteresis	3	8
4.2	Ferrites, Magnetostriction	2	8

4.3	Earth's magnetism-elements of earth's magnetism-dip, declination, horizontal and vertical components	3	8
4.5	Magnetic maps-magnetographs-cause of earth's magnetism	2	8

References

1. Modern Physics- R. Murugeshan, Er. Kirthiga Sivaprasad
2. Principles of electronics, V K Mehta,
3. Electricity and magnetism, D C Tayal
4. Functional Electronics, Ramanan
5. Electricity and magnetism - Brijlal and N. Subrahmanyam

28. Semester IV (Complementary Physics for Chemistry)

PH4CMT02: Optics and Solid State Physics

Sl. No.	Course Outcome	Cognitive Level	PSO
1	Understand the basic ideas of optics – Interference, Diffraction, Polarization.	Understand	1
2	Illustrate the principles of laser.	Understand	1
3	Understand the working principle of optic fibers and to classify it.	Understand	1
4	Explain various features of dielectrics.	Understand	1
5	Understand the basics of crystallography.	Understand	1
6	Solve the problems related to optics, laser, fiber optics, dielectrics and crystallography.	Understand, Apply	1,5

Course description

Module	Course description	Hr	CO
1.0	**Interference, Diffraction and Polarization**	**22**	**1,6**
1.1	Introduction-Interference, light waves, phase difference, coherence, optical path and phase change.	1	1
1.2	Principle of superposition, young's double slit experiment, conditions for interference.	1	1
1.3	Conditions for sustained interference patterns, constuctive and destructive interference.	1	1
1.4	Thin film interference- reflected system, colour of thin films, fringes of equal inclination and equal thickness.	1	1
1.5	Newtons's rings – Reflected system – measurement of wavelength, Problems	2	1,6
1.6	Introduction – Diffraction – Fresnel and Fraunhoffer diffractions, Fresnels theory of rectilinear propagation of light, Problems	3	1,6
1.7	Fraunhoffer diffraction at single slit, width of central bright maxima.	1	1
1.8	Intensity in Fraunhoffer diffraction pattern. Problems	1	1,6
1.9	Introduction – Grating, construction and working of plane	1	1

	transmission grating		
1.10	Determination of wavelength of light using grating.	1	1
1.11	Dispersive and resolving power of grating. Problems	2	1,6
1.12	Prism and grating spectra, rayleigh's criterion for resolution.	1	1
1.13	Introduction- Polarization, CPL, EPL and PPL	1	1
1.14	Brewster's law, Dichroism	1	1
1.15	Birefringence- E ray and O ray	1	1
1.16	Polarizer and analyser	1	1
1.17	Malu's law, optical activity	2	1
2.0	**Laser and Fiber Optics**	**10**	**2,3,6**
2.1	Introduction – Laser – Principle of operation of laser	1	2
2.2	Population inversion, metastable state, optical resonator	1	2
2.3	Components of laser – active medium, pump, optical resonant cavity	1	2
2.4	Principal pumping schemes	1	2
2.5	Three level and four level systems	1	2
2.5	Laser beam characteristics, applications of laser	1	2
2.6	Light propagation in optical fibres, Types of optical fibers- step index and graded index fibers	2	3
2.7	Acceptance angle, Numerical aperture, derivation and problems	3	3,6
3.0	**Dielectrics**	**10**	**4,6**
3.1	Dielectrics – Introduction, Polar and non polar dielectrics	1	4
3.2	Polarization, sources of polarization	1	4
3.3	Gauss's law in dielectrics	1	4
3.4	Permittivity, dielectric displacement vector, dielectric constant	1	4
3.5	Susceptibility, ferro electricity, problems	1	4,6
4.0	**Crystallography**	**12**	**5,6**
4.1	Crystal structure, crystal lattice and translation vectors	1	5
4.2	Unit cell, types of lattices, Miller indices	2	5
4.3	Lattice directions and planes, interplanar spacing, problems	3	5,6

4.4	Simple crystal structures- sc, fcc, bcc, hcp close packed structures	2	5
4.5	Sodium chloride structure	1	5
4.6	X-ray crystallography- diffraction of X-rays, Bragg's law, problems	3	5,6

References:

1. Optics - Brijlal and N. Subrahmanyam
2. Electricity and Magnetism-D C Tayal
3. Solid State Physics- S O Pillai
4. A text book of Applied Physics – A .K Jha
5. Electricity and Magnetism – R. Murugeshan
6. Solid state physics-P. K Palanisami
7. Lasers – theory & applications-Thyagarajan &Ghatak

29. Semester I &II (Complementary Physics Practical)

PH2CMP01 –Complementary Physics Practical 1

Sl. No.	Course Outcome	Cognitive Level	PSO
1.	Apply the knowledge of different types of pendulum to determine 'g'.	Understand, Apply	2,3,4,6
2.	Determine surface tension of liquid using capillary rise method.	Understand, Apply	2,3,4,6
3.	Determine moment of inertia of fly wheel.	Understand, Apply	2,3,4,6
4.	Determine the rigidity modulus of a material using static and dynamic method.	Understand, Apply	2,3,4,6
5.	Determine Young's modulus of a material.	Understand, Apply	2,3,4,6

Course Description

Sl. No	Course Description	Hrs	CO
1	Symmetric, asymmetric compound pendulum and Kater's pendulum-determination of 'g'.	4	1
2	Determination of Young's modulus of a material by uniform and non-uniform bending methods using pin and microscope method	4	5
3	Torsion pendulum-Determination of rigidity modulus	2	4
4	Determine surface tension by capillary rise method	1	2
6	Fly wheel-Determination of moment of inertia	1	3
7	Cantilever- Determination of Young's modulus	2	5
8	Static torsion- Determination of rigidity modulus	1	4

30. Semester III & IV (Complementary Physics Practical)

PH4CMP02: Complementary Physics Practical 2

Sl. No.	Course Outcome	Cognitive Level	PSO
1	Determine Young's modulus.	Apply	1,3,4,5
2	Calculate moment of inertia, rigidity modulus and accceleration due to gravity using different methods.	Apply	1,3,4,5
3	Determine the optical constants using different methods.	Apply	1,3,4,5
4	Carry out calibration of ammeter and voltmeter.	Apply	1,3,4,5
5	Execute and analyze characteristics of semiconducting devices and circuits.	Apply, Analyze	1,3,4,5
6	Calculate resistiviy of given material.	Apply	1,3,4,5
7	Determine the magnetic parameters.	Apply	1,3,4,5
8	Execute and differentiate logic gates.	Apply, Analyze	1,3,4,5

Course Description

Sl. No	Course description	Hrs	CO
1	Determination of Young's Modulus- Cantilever (Pin & Microscope) OR Uniform bending (pin and microscope)OR Non-uniform bending (optic lever)	2	1
2	Asymmetric Compound Pendulum- Determination of moment of inertia and Acceleration due to gravity (g)	2	2
3	Torsion pendulum (Equal mass method) - Rigidity modulus and Moment of Inertia	2	2
4	Spectrometer – Dispersive power of prism	2	3
5	Spectrometer – Dispersive power of a Grating	2	3
6	Newton's rings -Wave length	2	3

7	Characteristics of Zener diode- ac and dc resistance	2	5
8	Conversion of Galvanometer into voltmeter	2	4
9	Carey Foster's Bridge -Measurement of resistivity	2	6
10	Tangent Galvanometer – Ammeter calibration	2	4
11	Potentiometer-Calibration of low range ammeter OR voltmeter	2	4
12	Construction of full wave rectifier (center-tap OR bridge) with and without filter –Ripple factor	2	
13	Construction of regulated power supply using Zener diode- line and load regulation	2	5
14	Laser diffraction- width of single slit OR thickness of wire	2	3
15	Refractive index of liquid- Liquid Lens OR Spectrometer and Hollow Prism	2	3
16	Air wedge-thickness of wire	2	3
17	Static Torsion - Rigidity modulus	2	2
18	Deflection and Vibration Magnetometer-m & Bh	2	7
19	Field along the axis of circular coil- determination of Bh	2	7
20	Searle's Vibration Magnetometer - magnetic moment	2	7
21	Gates – AND, OR, NOT- verification of truth tables	2	8