DEPARTMENT OF PHYSICS

Curriculum and Syllabus for BSc Physics Programme

Under Credit Semester System

(Outcome Based Education with Effect from 2022 Admissions)

St Berchmans College
AUTONOMOUS
College with Potential for Excellence | Reaccredited by NAAC with A Grade
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India-686101

BOARD OF STUDIES

CHAIRMAN

Name	Official Address
Dr Gijo Jose	Head of the Department, St. Berchmans College, Changanacherry

SUBJECT EXPERTS NOMINATED BY THE COLLEGE ACADEMIC COUNCIL

Name	Official Address
Dr. Xavier Joseph	Associate Professor, Christ college, Irinjalakuda – University of Calicut
Dr. Vinoy Thomas	Assistant Professor, Christian College, Chengannur, - University of Kerala

EXPERT NOMINATED BY THE VICE-CHANCELLOR

Name	Official Address
Dr. Pramod Gopinath	Professor and Director, International School of Photonics, Cochin University of Science and Technology, Cochin

ALUMNI REPRESENTATIVE

Name	Official Address
Mr. Libin Scaria	Medical Physicist – C (Scientific), Tata Memorial Hospital, Under DAE, Govt. of India, Mumbai

REPRESENTATIVE FROM MEDIA/INDUSTRY AND ALLIED AREAS

Name	Official Address
Mr. Shyam Kumar S	Technical Head, Bharath Social Solutions, Karukachal, Kottayam

TEACHERS FROM THE DEPARTMENT NOMINATED BY THE PRINCIPAL TO THE BOARD OF STUDIES

Teacher's Name	**Area of Specialization**
Dr. Issac Paul	Crystallography- urinary crystals
Mr. Ajai Jose	Spectroscopy
Mr. Justin John	Nanomaterials – grapheme
Dr. Sajith Mathews T	Computational Physics
Dr. Joshy Jose	Nanomaterials
Mr. Benny Joseph	Cosmology
Dr. Lijo Jose	Space Physics
Dr. Sinu Mathew	Nanomaterials -2D materials
Dr. Loji K Thomas	Nanoscience - Scanning Tunneling Microscopy (STM)

PROGRAMME OUTCOMES

PO1: Develop in-depth conceptual knowledge in the discipline for vertical growth and scholarly pursuits

PO2: Identify historical, theoretical, scientific, technological, economic philosophical, cultural, aesthetic and ethical bases of different disciplines and relate them effectively.

PO3: Demonstrate problem solving skills, effective communication, interpersonal dynamics and resilience in global and local contexts

PO4: Transfer the knowledge of methods, skills, tools and systems of different disciplines for a sustainable and egalitarian world order

PO5: Generate need based innovative processes and products for personal and societal well-being

PROGRAMME SPECIFIC OUTCOMES

On successful completion of the programme, the graduates will be able to:

PSO1: Develop competency in theoretical and experimental physical sciences, mathematical skills and linguistic proficiency to **explore** the scientific world and **appreciate** natural phenomena.

PSO2: Explain and **summarize** principles and theoretical framework of classical physics, modern physics and applied physics.

PSO3: Apply the knowledge acquired to **solve** numerical and conceptual problems in related disciplines.

PSO4: Analyse theoretical and experimental data and **deduce** valid conclusions.

PSO5: Articulate knowledge through science enrichment programmes and **create** knowledge through projects.

PROGRAMME STRUCTURE

Semester I

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course I	4	3	100
3	Common Course II	4	4	100
4	Core Course	2	2	75
5	Core Course Practical	2	Evaluation in Semester II	
6	Complementary Course: Mathematics	4	3	100
7	Complementary Course: Chemistry	2	2	75
8	Complementary Course Practical: Chemistry	2	Evaluation in Semester II	
	Total	**25**	**18**	**550**

Semester II

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course I	4	3	100
3	Common Course II	4	4	100
4	Core Course	2	2	75
5	Core Course Practical	2	2	50
6	Complementary Course: Mathematics	4	3	100
7	Complementary Course: Chemistry	2	2	75
8	Complementary Course Practical: Chemistry	2	2	50
	Total	**25**	**22**	**650**

Semester III

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course II	5	4	100
3	Core Course	3	3	75

4	Core Course Practical	2	Evaluation in Semester IV	
5	Complementary Course: Mathematics	5	4	100
6	Complementary Course: Chemistry	3	3	75
7	Complementary Course Practical: Chemistry	2	Evaluation in Semester IV	
	Total	**25**	**18**	**450**

Semester IV

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course II	5	4	100
3	Core Course	3	3	75
4	Core Course Practical	2	2	50
5	Complementary Course: Mathematics	5	4	100
6	Complementary Course: Chemistry	3	3	75
7	Complementary Course Practical: Chemistry	2	2	50
	Total	**25**	**22**	**550**

Semester V

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Core Course	3	3	75
2	Core Course	3	3	75
3	Core Course	4	4	75
4	Core Course	4	3	75
5	Open course	3	3	100
6	Core Course Practical	2	Evaluation in Semester VI	
7	Core Course Practical	2		
8	Core Course Practical	2		
9	Core Course Practical	2		
	Total	**25**	**16**	**400**

Semester VI

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Core Course	4	3	75
2	Core Course	3	3	75
3	Core Course	3	3	75
4	Core Course	4	3	75
5	Choice Based Core Course	3	3	100
6	Core Course Practical	2	2	50
7	Core Course Practical	2	2	50
8	Core Course Practical	2	2	50
9	Core Course Practical	2	2	50
10	Project & Industry/Institution Visit	-	1	100
	Total	**25**	**24**	**700**
	Grand Total	**-**	**120**	**3300**

OUTLINE OF THE CORE COURSES

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
CBPH101	Foundation Course in Physics	2	36	2	20	55	75
	Mechanics and Properties of Matter Practical (P)	2	36	Evaluation in Semester II			
Semester II							
CBPH202	Mechanics and Properties of Matter	2	36	2	20	55	75
CBPH2P01	Mechanics and Properties of Matter Practical (P)	2	36	2	10	40	50
Semester III							
CBPH303	Basic Electronics	3	54	3	20	55	75
	Basic Electronics Practical (P)	2	36	Evaluation in Semester IV			
Semester IV							
CBPH404	Classical Mechanics and Relativity	3	54	3	20	55	75
CBPH4P02	Basic Electronics Practical (P)	2	36	2	10	40	50
Semester V							
CBPH505	Electricity and Electrodynamics	3	54	3	20	55	75
CBPH506	Physical Optics and Photonics	3	54	3	20	55	75
CBPH507	Environmental Science, Climate Change and Renewable Energy Sources	4	72	4	20	55	75
CBPH508	Basic Quantum Mechanics and Spectroscopy	4	72	3	20	55	75
	Electricity, Magnetism and Thermal Physics Practical (P)	2	36	Evaluation in Semester VI			
	Optics and Photonics Practical (P)	2	36				
	Computational Physics Practical (P)	2	36				
	Digital Electronics Practical (P)	2	36				
Semester VI							
CBPH609	Thermodynamics and Statistical Physics	4	72	3	20	55	75

CBPH610	Nuclear and Particle Physics	3	54	3	20	55	75
CBPH611	Condensed Matter Physics	3	54	3	20	55	75
CBPH612	Linear Integrated Circuits, Digital Electronics and C++ Programming	4	72	3	20	55	75
	Choice Based Core Course	3	54	3	25	75	100
CBPH6P03	Electricity, Magnetism and Thermal Physics Practical (P)	2	36	2	10	40	50
CBPH6P04	Optics and Photonics Practical (P)	2	36	2	10	40	50
CBPH6P05	Computational Physics Practical (P)	2	36	2	10	40	50
CBPH6P06	Digital Electronics Practical (P)	2	36	2	10	40	50
CBPH6PJ	Project & Industry/Institution Visit	-	-	1	20	80	100

CHOICE BASED CORE COURSES

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
CBPH6E01	Nanoscience and Nanotechnology	3	54	3	25	75	100
CBPH6E02	Astronomy Astrophysics and Cosmology	3	54	3	25	75	100

OUTLINE OF THE COMPLEMENTARY COURSE FOR BSc MATHEMATICS PROGRAMME

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
CDPM101	Mechanics, Elasticity and Fourier analysis	2	36	2	20	55	75
	General Physics Practical (P)	2	36	Evaluation in Semester II			
Semester II							
CDPM202	Electric and Magnetic Phenomena, Thermodynamics and Special Relativity	2	36	2	20	55	75
CDPM2P01	General Physics Practical (P)	2	36	2	10	40	50
Semester III							
CDPM303	Quantum Mechanics, Basic Electronics and Digital Electronics	3	54	3	20	55	75
	Optics and Electronics Practical (P)	2	36	Evaluation in Semester IV			
Semester IV							
CDPM404	Physical Optics, Laser Physics and Astrophysics	3	54	3	20	55	75
CDPM4P02	Optics and Electronics Practical (P)	2	36	2	10	40	50

OUTLINE OF THE COMPLEMENTARY COURSE FOR

BSc CHEMISTRY PROGRAMME

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
CDPC101	Mechanics and Properties of Matter	2	36	2	20	55	75
	General Physics Practical (P)	2	36	Evaluation in Semester II			
Semester II							
CDPC202	Electric and Magnetic Phenomena, Thermodynamics and Error Analysis	2	36	2	20	55	75
CDPC2P01	General Physics Practical (P)	2	36	2	10	40	50
Semester III							
CDPC303	Quantum mechanics, Spectroscopy, Nuclear Physics and Nuclear Medicine	3	54	3	20	55	75
	Optics and Electronics Practical (P)	2	36	Evaluation in Semester IV			
Semester IV							
CDPC404	Physical Optics, Laser Physics and Superconductivity	3	54	3	20	55	75
CDPC4P02	Optics and Electronics Practical (P)	2	36	2	10	40	50

OPEN COURSE

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
CBPH6E01	Nanoscience and Nanotechnology	3	54	3	25	75	100

SEMESTER I

CBPH101: FOUNDATION COURSE IN PHYSICS

Credit: 2 **Total Hours: 36**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Describe early scientific developments in Physics

CO2: Deduce different solutions of oscillator and wave equations for different initial and boundary conditions, and apply to different systems.

CO3: Describe the different applications of transverse and longitudinal waves.

CO4: Describe basic experimental procedures pertaining to measuring devices, oscillations and waves and apply them to solve problems

CO5: Apply vector calculus, error propagation, and basic statistical methods to solve relevant problems

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	-	-	-	1	2	1	3	-	-	-
CO2	Apply	3	3	1	2	-	2	-	3	-	-
CO3	Understand	2	2	1	1	-	2	2	1	2	-
CO4	Apply	2	2	1	-	-	2	-	2	-	-
CO5	Apply	3	3	2	3	-	3	-	3	-	-
Average		**2.50**	**2.50**	**1.25**	**1.75**	**2**	**2**	**2.50**	**2.25**	**2**	**-**

Module 1: Development of Physics (6 hours)

Development of Classical Physics in the last century– Galileo, Newton, Kepler, Coulomb, Ampere, Carnot (qualitative ideas) Classical to modern Physics - Max Planck, Compton, C V Raman (qualitative ideas), Modern Physics- Einstein, de Broglie, Heisenberg and Schrodinger, S N Bose (qualitative ideas)

Module 2: Oscillations and Waves (18 hours)

Types and classification of Motion of physical systems, Causes of oscillations, Description of SHM, Equation of Motion, SHM - Trigonometric solution and Exponential solution, Characteristics of SHM- amplitude, time period, phase, velocity, acceleration and total energy.

Linear SHM and Uniform circular motion. Representation of SHM -Rotating vector and complex exponential methods. Examples of SHM - mass and spring system -horizontal and vertical oscillations, Simple Pendulum, Compound Pendulum, Torsion Pendulum. Damped oscillations of a system with one degree of freedom - general solution and small damping, Steady state behaviour of a forced oscillator and resonance. Waves in a continuous medium - Transverse and Longitudinal waves, Mathematical description of Harmonic wave and Classical wave equation. Stretched string - Transverse wave - velocity and characteristic impedance. Longitudinal waves in uniform rod, in gases, Laplace's correction

Module 3: Experimental and Mathematical Foundations (12 hours)

Position vector, displacement vector and separation vector. Ordinary derivatives, gradient or del operator. Divergence and curl with geometrical interpretation. Integral calculus- line integral, surface integral and volume integral. Divergence Theorem and Stokes Theorem (No derivation).

Concept of uncertainty in measurement. Least Count - Vernier Calipers, Screw Gauge. Absolute error, Mean absolute error, Relative error, Percentage error. Propagation of errors. Mean, Mode, Median, Standard deviation

Text Books:

Module 1: Vignettes in Physics- G. Venkataraman, University Press

Module 2: The Physics of Waves and Oscillations- NK Bajaj, TMH, 1st Edition

Module 3: An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, John R. Taylor, Univ. Science Books

References

1. Bromley D. Allan,A Century of Physics, 1st Edition, Springer-Verlag New York Inc. 2002
2. D. Chattopadhyay, Vibration, Waves & Acoustics, 1st Edn–Books & Allied Pvt Ltd,
3. Charles Kittel, Berkeley Physics– volume 1– Mechanics-,3rd Edn, McGraw Hill
4. Feynman lectures on Physics- Feynman, Leighton, Sands (Pearson Education)
5. Arthur Beisser, Concepts of Modern Physics- (McGraw Hill Education)
6. David J Griffiths, Introduction to Electrodynamics- 3rd Edn By PHI
7. D. S. Mathur, Mechanics, S. Chand

Course designed by : Benny Joseph

SEMESTER II

CBPH202: MECHANICS AND PROPERTIES OF MATTER

Credit: 2 **Total Hours: 36**

On successful completion of the course, the students will be able to:

CO1: Describe the mathematical formulations pertaining to Rotational Mechanics, Fluid Motion, Elasticity and Motion under Central forces

CO2: Use different coordinate systems to represent dynamics of various physical systems

CO3: Apply the physical principles related to Central force motion, Elasticity, Fluid Motion and Rotational Mechanics

CO4: Describe the dynamics of Central force motion, Rotational dynamics and Fluid motion

CO5: Apply the methods of basic experimental procedures pertaining to Elasticity, Fluid Motion and Rotational Mechanics

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	2	2	-	-	-	3	-	-	-	-
CO2	Apply	3	2	3	-	-	3	2	3	-	-
CO3	Apply	3	2	3	-	-	3	-	3	-	-
CO4	Understand	2	2	-	-	-	2	-	-	-	-
CO5	Apply	3	2	3	-	-	3	-	3	-	-
Average		**2.6**	**2**	**3**	**-**	**-**	**2.8**	**2**	**3**	-	-

Module 1: Motion Under Central Forces (12hours)

Motion in plane polar coordinates - velocity and acceleration. Physics in rotating coordinate system -time derivative of a vector in rotating coordinate system, velocity and acceleration. Centrifugal and Coriolis force. Dynamics of a system of particles - center of mass and center of mass coordinates. Central forces. Central force motion as a one body problem and reduced mass. Motion under a central force – case of gravitational force. Equation of the orbit, energy diagram and possible trajectories

Module: 2 Elasticity (12hours)

Young's Modulus, Bulk Modulus, Modulus of Rigidity. Work done per unit volume - Longitudinal strain, volume strain and Shearing strain, Poisson's ratio. Relations connecting

elastic constants - Y,K&σ, Y,n&σ, K,n&σ, Y,K&n. Twisting couple on a cylinder - Rigidity modulus of Solid and Hollow cylinders. Uniform and non-uniform bending - axis of bending, plane of bending, neutral surface, neutral axis. Bending moment, Flexural rigidity. Expression for Bending moment. Cantilever - Young's Modulus (Weight of cantilever ineffective). Young's Modulus of a beam supported in a horizontal plane (weight of the beam ineffective). Young's Modulus of a beam - Koenig's method

Module 3: Rotational Mechanics and Fluid Motion (12hours)

Angular momentum, Rotational kinetic energy. Moment of Inertia, Theorems on Moment of Inertia. Moment of Inertia of thin uniform rod, ring, thin circular disc, annular disc, solid sphere, solid cylinder and Flywheel. Method of describing fluid motion , Types of fluid flow. Discharge, Continuity equation, Continuity equation in 3D, Equation of fluid motion. Euler's equation of motion, Bernaulli's equation from Euler's equation. Coefficient of viscosity of a fluid by capillary flow method and falling sphere method. Surface tension on liquid droplet, hollow bubble and liquid jet, Expressions for Capillary rise and Capillary fall

Text Books:

Module 1: Daniel Kleppner & Robert J. Kolenkow,An introduction to Mechanics- McGraw Hill

Module 2: D.S.Mathur, Elements of Properties of Matter,S.Chand 3rd Edn

Module 3: D.S.Mathur,Elements of Properties of Matter, S.Chand 3rd Edn

References

1. Halliday, Resnik and Walker, Fundamentals of Physics – (John Wiley & sons)
2. Berkeley Physics – volume 1 – Mechanics 3rd Edn
3. Brijlal and N. Subrahmaniam, Properties of Matter- – S. Chand 3rd Edn
4. C. L. Arora, B.Sc. Practical Physics

Course designed by : Justin John

Semester III

CBPH303: BASIC ELECTRONICS

Credits- 3 **Total Hours- 54**

On successful completion of the course, the students will be able to:

CO1: **Summarize** the basic concepts in semiconductor electronics

CO2: **Distinguish** the various biasing circuits for diodes and transistors

CO3: **Explain** the operation of diodes and transistors in order to design basic circuits

CO4: **Identify** and **apply** appropriate theoretical techniques to solve different problems in semiconductor electronics

CO5: **Apply** the concepts of basic electronic devices to design small signal amplifier circuits and oscillators for various practical applications

Course Mapping Table

	Cognitive Level	PSO 1	PS O2	PSO 3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	-	-	-	1	2	1	3	-	-	-
CO2	Apply	3	3	1	2	-	2	-	3	-	-
CO3	Understand	2	2	1	1	-	2	2	1	2	-
CO4	Understand	2	2	1	-	-	2	-	2	-	-
CO5	Apply	3	3	2	3	-	3	-	3	-	-
	Average	**2.5**	**2.5**	**1.25**	**1.75**	**-**	**2**	**2.5**	**2.25**	**2**	**-**

Module 1: P-N Junction Diodes and Diode Circuits (18 hours)

P-N junction diode — barrier formation in a P-N Junction diode — current flow mechanism - forward and reverse biased diodes — V-I characteristics — expression for diode current (no derivation) P-N junction diode static and dynamic resistances — Junction capacitance, ideal diode, Special type of diodes: Zener diode, Tunnel diode, Varactor – PIN diode - Schottky diode – LED - Photo diode.

Rectifiers: Half wave rectifiers — circuit diagram, working, input and output, centre tapped full wave — circuit diagram, working, input and output, bridge rectifiers — circuit diagram, working, input and output, comparison of rectifier circuits- expression for Idc and Irms — efficiency of a rectifier, Filter circuits: Shunt capacitor, series inductor filter — LC filter — CLC/ π filter.

Module 2: Diode circuits and introduction to transistor (18 Hours)

zener diode- avalanche breakdown - Zener diode characteristics, voltage regulator - Line regulation and Load regulation, Clipping and Clamping circuits: Positive clipper diagrams and working — input and output waveforms, negative clipper diagrams and working — input and output waveforms, biased clipper diagrams and working — input and output waveforms, combinational clipper diagrams and working — input and output waveforms, positive clamper and negative clamper — input and output waveforms.

Transistor construction — transistor action — working of NPN and PNP transistors, Common base, common emitter and common collector configurations, characteristics — active, saturation and cut off regions, current gains α , β , γ and their relationships, comparison of CE, CB and CC configurations. Transistor Biasing : Leakage currents — thermal runaway, need for biasing, load line — Q-point — factors affecting stability of Q- point, different methods of transistor biasing — fixed bias, fixed bias with emitter resistor, voltage divider bias, Transistor equivalent circuits – dc equivalent circuit – ac equivalent circuit, comparison of various biasing circuits

Basic Ideas of FET and MOSFET

Module 3: Transistor Applications (18 hours)

Transistor as an Amplifier — small signal operation of CE amplifier, phase reversal, ac and dc equivalent circuits, derivation of input resistance, output resistance, current gain, voltage gain,power-gain. Classification of power amplifiers, Feedback in amplifiers: Positive and negative feedback, effects on input impedance, output impedance and gain

Negative feedback in Transistor amplifiers -- CE amplifier without emitter bypass capacitor, Emitter follower, Transistor as an Oscillator: Sinusoidal oscillators — principle of oscillators — Barkhausen criterion for self sustained oscillations, Transistor as an Oscillator: Tuned collector oscillator — Hartley and Colpitt's Oscillators, expressions for frequency of oscillations , RC Phase shift oscillator, crystal oscillator

Text Books

1. R.S.Sedha:A Text Book of Applied Electronics- S.Chand Co.Revised Edn. (2008)
2. B.L.Theraja:Basic Electronics- S.Chand Co. (2007)

References

1. Albert Malvino and David J Bates; Electronic principles, 7th Edition, - TMH Edn. Pvt Ltd.
2. Allen Mottershead; Electronic Devices and circuits -PHI

3. V.K. Metha, Rohit Mehta, ,Principles of Electronics - 11th ed. ; S.Chand and Company Ltd, 2011
4. S K Sahdev, Electronic Principles-Dhanpat Rai & Co. (P) Ltd
5. Robert L Boylestad&Louis Nashelsky, Electronic Devices and Circuit Theory-; PHI, Pearson
6. Charles Schuler;Electronics: Principles and Applications-9th Edition McGrawHill
7. D Chattopadhyay,P.C.Rakshit,B Saha,N.N.Purkait;Foundations of Electronics-New age International Publishers
8. Sajeev Gupta;Electronic Devices and Circuits- Dhanpat Rai Publications
9. N.N.Bhargava,D.C.Kulshreshtha& S.C.Gupta ;Basic Electronics and Linear Circuits-Tata McGrawHill
10. Kevin & Brennan; Introduction to Semiconductor Devices - Cambridge Univ. Press
11. Paul Horowitz and Winfield Hill; The Art of Electronics, Cambridge Univ. Pres

Course designed by : Dr. Gijo Jose

SEMESTER IV

CBPH404: CLASSICAL MECHANICS AND RELATIVITY

Credit:3 **Total Hours: 54**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Apply basic concepts of classical mechanics in simple mechanical systems.

CO2: Explain and use the principle of virtual work, D'Alembert's Principle, Lagrange's equation and Hamiltonian dynamics

CO3: Describe the correspondence between D'Alembert's Principle, Lagrange's equations, Newton's equations, Hamilton's principle, Hamilton's equations

CO4: Explain the basic concepts in special theory of relativity and its applications to dynamical systems.

CO5: Describe Lorentz transformations on space-time and its consequences, Einstein's mass-energy equivalence, Lorentz transformation for force, momentum and energy, and apply them in relevant situations.

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Apply	2	3	2	-	-	2	1	2	1	-
CO2	Apply	2	3	3	1	-	2	-	2	1	-
CO3	Understand	2	2	-	-	-	2	1	-	1	-
CO4	Understand	2	2	2	2	-	1	1	1	-	-
CO5	Apply	2	2	3	2	-	1	1	2	-	-
	Average	**2**	**2.4**	**2.5**	**1.5**	**0**	**1.6**	**1**	**1.75**	**1**	**0**

Module 1: Lagrange Dynamics (20 Hours)

Degrees of freedom, Constraints-Holonomic-Non-Holonomic-examples, Forces of constraints, Difficulties introduced by constraints and their removal, Generalised coordinates, Principles of virtual work, D'Alembert's Principle, Lagrange's equations from D' Alembert's principle,

Newton's equations from Lagrange's equation, Applications of Lagrange's equation – one dimensional harmonic oscillator – planetary motion – Compound pendulum, L-C circuit - Atwood Machine, Hamilton's principle and Lagrange's equation, Superiority of Lagrangian mechanics over Newtonian approach.

Module 2: Hamiltonian Dynamics (16 Hours)

Generalised momentum and cyclic coordinates, Hamiltonian function and conservation of Energy, Hamilton's equations, Hamilton's equations in different coordinate systems, Examples in Hamiltonian dynamics: Harmonic Oscillator (1D and 2D)- motion of a particle in central force field - compound pendulum.

Module 3: Special Theory of Relativity (18 Hours)

Inertial and non-inertial frames of reference, Galilean transformation, Significance of Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformation – spatial contraction, time dilation and relativity of simultaneity, Velocity transformation equations and law of addition of velocities, Relativistic variation of mass, Einstein's mass-energy equivalence, Relativistic energy and momentum, Force in relativistic mechanics and Lorentz transformation for force.

Text Books

1. J C Upadhyaya, Classical Mechanics, Himalaya Publishing House (2019 Edition)
2. Arthur Beiser, Concepts of Modern Physics (6^{th} Edition), TMH Publishers

Reference

1. K. Sankara Rao, Classical Mechanics, Prentice Hall of India
2. Herbert Goldstein, Charles Poole & John Safk, Classical Mechanics - 3 rd Edition, Pearson Education
3. H S Hans & s P Puri, Mechanics,TMH Education
4. N C Rana & P S Joag, Classical Mechanics, TMH Education
5. Walter Greiner, Classical Mechanics-System of Particles and Hamiltonian Dynamics, Springer International Edition.
6. Vimal Kumar Jain, Classical Mechanics- Ane Books Pvt. Ltd.
7. David Morin, Classical Mechanics, Cambridge University Press
8. Dare A Wells, Schaum's Outline of Theory and Problems of Lagrangian Dynamic, MGH

Course designed by: Dr. Joshy Jose

SEMESTER V

CBPH505: ELECTRICITY AND ELECTRODYNAMICS

Credit:3 **Total hours: 54**

On successful completion of the course, the student will be able to:

CO1: **Describe** the fundamental laws in static electric and magnetic fields in vector form, potential of a charge distribution, and **Discuss** Laplace and Poisson equations in Cartesian coordinates

CO2: **Apply** Gauss's law to spherical conductor, Line charge, plane sheet and parallel plates

CO3: **Describe** charge conservation and energy conservation in electrodynamics, **Describe** Maxwell equations and propagation of EM waves

CO4: **Describe** electromagnetic induction, transient currents in LR, CR and LCR circuits, series and parallel resonance in AC circuits

CO5: **Apply** network theorems to DC electrical circuits

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Understand	3	3	-	-	-	2	-	-		
CO2	Apply	-	-	2	-	-	-	-	2		
CO3	Understand	-	3	-	-	-	2	-	-		
CO4	Understand	-	3	-	-	-	2	-	-		
CO5	Apply	-	-	1	-	-	-	-	2		
	Average	3	3	1.5			2		2		

Module 1: Electrostatics (18 hours)

Continuous charge distribution; Divergence and curl of electrostatic fields, electric potential, Gauss's law to find the field due to uniformly charged spherical conductor, Gauss's law to find the field due to Line charge , Gauss's law to find the field due to Infinite plane sheet of charge, parallel plates, Electric potential- Poisson's equation and Laplace's equation, Laplace equation in one- and two-dimension, The potential of a localized charge distribution

Module 2: Magnetostatics and Electrodynamics (18 hours)

Introduction, The divergence and curl of B (statement only), Ampere's law-straight wire carrying current, Faraday's law in vector form, The energy of a point charge distribution-derivation; energy of a continuous charge distribution – derivation Charge conservation-continuity equation, Energy conservation- Poynting's theorem, Electrodynamics before Maxwell, Maxwell's equations, Electromagnetic waves in vacuum- wave equations for electric and magnetic fields

Module 3: Transient Currents, Alternating currents & Network Analysis (18 hours)

Faraday's laws of electromagnetic induction, Self-inductance and mutual-inductance, Growth and decay of current in an LR circuit, charging and discharging of a capacitor through a resistor, Growth and decay of charge in an LCR circuit, RMS and peak values , AC through series LCR (acceptor circuit) and parallel LCR circuit (rejector circuit)-(Phasor diagram method) Q factor-power in AC-power factor, Thevenin's and Norton's theorems; Maximum power transfer theorem; Superposition Theorem

Textbook:

1. David J Griffiths, Introduction to Electrodynamics, PHI 3rd ed. Chapter 2, 5, 7, 8 & 9
2. D N Vasudeva, Fundamentals of Magnetism and Electricity, S. Chand, Chapter 21 & 22.

References

1. J.H.Fewkes& John Yarwood,Electricity and Magnetism, University tutorial press,Chapter6
2. R Murugeshan, Electricity and Magnetism, S. Chand & Company Ltd.
3. Dr E.D Dias, Santhosh P Jose, Electrodynamics made simple, Clare Publishers.
4. A S Mahajan and AA Rangwala, Electricity and Magnetism, TMH 4thEdn.
5. Matthew N Sadiku, Electromagnetics, Oxford 4th Edn.
6. Kraus/Fleish, Electromagnetics with applications,TMH, 5th Edn.
7. J A Edminister, Electromagnetics 2nd Edn, TMH
8. TVS Arunmurthi, Electromagnetic Fields, S. Chand

Course designed by: Dr. Loji K Thomas

CBPH506: PHYSICAL OPTICS AND PHOTONICS

Credit: 3 **Total hours: 54**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: **Describe** interference of light and **Apply** it to parallel or wedge-shaped films, Newton's rings

CO2: **Describ**e Michelson's interferometer, **Describe** diffraction and diffraction grating, **Discuss** the resolving power and dispersive power of a grating

CO3: **Describe** polarisation of light ,the principle and working of different optical instruments related to polarisation.

CO4: **Describe** working of different types of LASERs, optical Fibres and their applications.

CO5: **Apply** the principles to relevant situations.

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Apply	3	3	2	-	-	3	-	2	-	-
CO2	Understand	3	3	-	-	-	-	-	-	-	-
CO3	Understand	3	2	1	-	2	3	2	2	1	-
CO4	Understand	3	2	1	-	2	3	2	2	1	-
CO5	Apply	3	1	3	1	-	3	1	3	1	-
Average		**3**	**2.2**	**1.75**	**1**	**2**	**3**	**1.67**	**2.25**	**1**	-

Module 1 : Interference and Diffraction (18 hours)

Thin parallel film-interference due to reflected light , Thin parallel film-interference due to transmitted light, Haidinger fringes, Interference in wedge shaped film, Newton's rings, Michelson interferometer –construction and working; application- wavelength, thickness, Fresnel and Fraunhoffer Diffraction, Fraunhoffer diffraction at a single slit, double slit, N slits, Theory of plane diffraction grating- Determination of wavelength using grating, Dispersive power and resolving power of grating,

Module 2 : Polarization (18 hours)

Nature of Polarized light - Linear Polarization, Superposition of waves linearly polarized at right angles- Circular Polarization- Elliptical Polarization. Effect of polarizer on transmission of polarized light – Malus Law, Polarization by reflection – Brewster's law, Polarization by double refraction- Anisotropic crystals- Electromagnetic theory of double refraction, Phase difference between extra ordinary ray and ordinary ray -Retarders or wave plates- Quarter wave plate –Half wave plate, Superposition of extraordinary ray and ordinary ray - Production and detection of elliptically and circularly polarized light- Analysis of polarized light, Optical Activity -Fresnel's explanation of Optical Rotation (Analytical treatment not needed) – Specific Rotation. Applications of polarization - LCD

Module 3 : Photonics (18 hours)

Interaction of light with matter, Einstein`s Relations, Light Amplification- LASER, Requirements of LASER - Active medium Metastable states - Population inversion- - pumping mechanism- Optical resonant cavity, Pumping schemes (3 level and 4 level), Types of Lasers: He-Ne laser, Argon ion laser, semiconductor laser, Nd- YAG laser, CO_2 Laser, Applications of LASERs

Optical waveguides- optical fibre -Critical angle of propagation in an optical fibre, Numerical aperture, Acceptance angle and fractional change in refractive Index, Step index and Graded index fibres- Single mode and Multimode fibres, Applications of optical Fibres

Holograms-Distinction between Photograph and Hologram, Construction and Image retrieval in Hologram, Applications of Holography

Textbook:

1. Subramanyam, Brijlal, M N Avadhanulu, Optics, S.Chand, Chapter 14 and 15 & 17 and 18.
2. Ajay Ghatak Optics - - 6th Edition McGraw Hill Education (India) Private Limited chapter 21, 27 and 28

Reference

1. Ajoy Ghatak and K Thyagarajan,Optical Electronics – Cambridge
2. D P Khandelwal,Optics and Atomic Physics Himalaya Pub. House
3. Eugene Hecht , A R Ganesan,Optics – IV Edn, Pearson Education
4. S K Srivastava, Optics CBS Pub. N Delhi
5. S L Kakani, K L Bhandari, A Text book of Optics S Chand.

6. Arthur Beiser, Shobhit Mahajan, S Rai Choudhury Concept of Modern Physics (2010), Tata Mc Graw Hill Co Ltd, New Delhi
7. Frank L. Pedrotti, Leno M. Pedrotti, Leno S. Pedrotti, Introduction to Optics 3rd Edition
8. Prakash Chandra Mehta, Dr V V Rampal, Lasers and Holography, World Scientic Publishing Co Pvt Ltd 1993 https://books.google.co.in/?id=pLPsCgAAQBAJ
9. Bahaa E. A. Saleh, Malvin Carl Teich , Fundamentals of Photonics, Wiley 3rd Edition (2019)

Course designed by: Mr. Ajai Jose

CBPH507: ENVIRONMENTAL SCIENCE, CLIMATE CHANGE AND RENEWABLE ENERGY SOURCES

Credit: 4 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Describe environmental related issues, its impact and controlling measures

CO2: Discuss various levels and future of climate change

CO3: Explore different renewable and non-renewable energy sources and analyze their merits and demerits.

CO4: Explain the principle and methods for converting solar energy to useful energy

CO5: Illustrate the principle and applications of solar photovoltaic cells

Course Mapping Table

	Cognitive Level	**PSO 1**	**PSO 2**	**PSO3**	**PSO 4**	**PSO5**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO1	Understand	2	2	2	-	-	2	1	1	2	3
CO2	Understand	2	2	1	1	-	2	1	2	2	-
CO3	Understand	2	2	1	1	-	2	1	1	2	1
CO4	Understand	2	2	1	2	1	2	2	1	2	1
CO5	Apply	3	3	2	2	1	3	2	3	2	3
	Average	**2.2**	**2.2**	**1.4**	**1.5**	**1**	**2.2**	**1.4**	**1.6**	**2**	**2**

Module I: Environmental Science (18 hours)

Meaning and importance of environment, Biotic and abiotic components, Environment and development-Natural resources-renewable and non-renewable Concept of sustainable development Pollution: Air, Water, Soil, Marine and Noise, Solid waste management-causes, effects and control measures of urban and industrial waste, Biodegradable and non-degradable, 3R's in waste management and Role of an individual in prevention of pollution, Global warming and climate change, ozone depletion greenhouse effect and acid rain, Carbon trading,

carbon credit and carbon sequestration, IPCC/UNFCC, Nuclear accidents and nuclear holocaust, Sand mining, wetland reclamation, landscape changes, soil erosion, Deforestation and desertification, flood and drought, Overexploitation Treats to fresh water resources of Kerala and tourism and its impact on environment

Module 2: Climate Change (18 hours)

Framework of Climate Science: Overview of Climate Science Earth's Climate System Today Climate Archives, Data, and Models

Tectonic-Scale Climate Change: CO2 and Long-Term Climate, Plate Tectonics and Long-Term Climate Greenhouse Climate From Greenhouse to Icehouse: The Last 50 million Years Orbital-Scale Climate Change: Astronomical Control of Solar Radiation Insolation Control of Monsoons Insolation Control of Ice Sheets Orbital-Scale Changes in Carbon Dioxide and Methane Orbital-Scale Interactions, Feedbacks, and Unsolved Mysteries Glacial/Deglacial Climate Change: The Last Glacial Maximum Climate During and Since the Last Deglaciation Millennial Oscillations of Climate Historical and Future Climate Change: Humans and Preindustrial Climate, Climate Changes During the Last 1,000 Years Climatic Changes Since 1850, Causes of Warming over the Last 125 Years Future Climatic Change

Module 3: Renewable Energy Sources (18 hours)

Non-renewable energy sources: -Coal, Oil, Natural gas, Nuclear fission energy, Merits and demerits of non-renewable energy and Renewable energy sources, Biomass energy- Biogas plant - Fixed dome type and moving dome type, Wind energy, Tidal energy, Geothermal energy conversion, hydroelectric power, hydrogen energy, nuclear energy, Growing energy needs, use of alternate energy sources in India

Module 4: Solar Energy (18 hours)

Sun as a source of energy- Solar radiation, Solar Constant, Spectral distribution, Solar pond - Convective and salt gradient types; Flat plate collector; Solar water heater - Direct and indirect systems- Passive and active systems; Optical concentrator - Parabolic trough reflector - Mirror strip reflector - Fresnel lens collector; Solar desalination; Solar dryer - Direct and indirect type; Solar cooker; Solar heating of buildings; Solar greenhouses; Need and characteristics of photovoltaic (PV) systems; Solar cells - Principle, Equivalent circuits, V-I characteristics, fill factor, conversion efficiency; PV Sun tracking systems; Merits and demerits of solar energy.

Textbook

1. William F. Ruddiman, Earth's Climate: Past and Future. 2014. Third Edition.
2. Mckinney, M.L. and School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.

Reference

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad–380 013, India, Email:mapin@icenet.net
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
4. Clark R.S., Marine Pollution, Clanderson Press Oxford
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001,Environmental Encyclopedia, Jaico Publ. House, Mumbai
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press.
8. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural HistorySociety, Bombay
9. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. HimalayaPub. House, Delhi
10. Mhaskar A.K., Matter Hazardous, Techno-Science Publication
11. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co.
12. Rao M N. and Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co.Pvt. Ltd. 345p.
13. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
14. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliance And Standards, Vol I and II, Enviro Media
15. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-SciencePublication
16. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia,USA

Course designed by: Dr Lijo Jose

CBPH508: BASIC QUANTUM MECHANICS AND SPECTROSCOPY

Credit: 3 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: **Describe** the experiments that motivated the development of quantum mechanics and **apply** the basic principles to solve relevant problems.

CO2: **Describe** the mathematical methods and principles in quantum mechanics and **apply** the methods.

CO3: **Apply** Schrodinger equation for simple systems.

CO4: **Describe** the basics of atomic and molecular spectroscopic methods and **apply** them in relevant situations.

CO5: **Describe** the interaction of electromagnetic radiation with matter, experimental methods of interaction of electric and magnetic fields and their applications in spectroscopy.

Course Mapping Table

	Cognitive Level	**PS O1**	**PS O2**	**PS O3**	**P S O4**	**PS O5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Apply	3	2	3	2	-	2	2	2	1	-
CO2	Apply	3	3	3	2	-	3	1	3	1	-
CO3	Apply	3	2	3	2	-	2	1	3	1	-
CO4	Apply	3	2	3	3	2	3	2	2	1	-
CO5	Understand	3	3	2	3	2	3	2	3	1	-
Average		**3**	**2.4**	**2.8**	**2.4**	**2**	**2.6**	**1.6**	**2.6**	**1**	-

Module – 1: Quantum Mechanics I (18 Hours)

Blackbody Radiation, Planck's quantum hypothesis, Photoelectric Effect, Compton Effect, De-Broglie Hypothesis. Davisson-Germer Experiment. Wave Packets. Group and Phase Velocities

and relation between them, Heisenberg's Uncertainty Principle (proof not required): Applications- Ground state energy of hydrogen atom, Non- existence of electron in the nucleus. Schrodinger Wave Equation. Properties of wave function. Normalization of Wave Function. Probability interpretation. Probability Density. Probability current density.

Module 2: Quantum Mechanics II (18 hours)

Linear Operator- Commutator- Eigen values and Eigen functions- Scalar product – Orthonormal functions Hermitian Operators- Properties of Hermitian Operator Wave function, Operators, Expectation value, EigenValues, Time development of a quantum system -Time independent Schrödinger equation. Particle in a one-dimensional box, extension to two and three dimensions, Quantum Tunneling - Penetration of 1 dimensional rectangular potential barrier, Linear harmonic oscillator.

Module 3: Molecular Spectroscopy (18 hours)

Molecular energy levels. Electronic, rotational and vibrational energies Microwave Spectrum- rotational spectra of a diatomic molecule – explanation in terms of rigid rotator model Infrared Spectrum- vibrational spectra of a diatomic molecule – explanation in terms of harmonic oscillator Vibration Rotation spectrum of a diatomic molecule. Electronic energy levels – Fluorescence and phosphorescence Raman Effect – experimental arrangement and results - Classical theory and its failure – Quantum theory of Raman Effect.

Module 4: Atomic Spectra (18 hours)

Emission and absorption spectra, atomic spectra, wave number, Bohr atomic model, Vector atom model, quantum numbers associated with vector atom model, space quantization, electron spin, coupling of orbital and spin angular momentum, spectroscopic terms and their notation, selection rules. Magnetic dipole in external magnetic field; Larmors' precession. Spin orbit interaction energy of the single valence electron.

Coupling Schemes: LS Coupling Scheme and JJ coupling scheme, Interaction energy in L-S coupling (sp configuration), Lande interval rule, Interaction energy in JJ Coupling (sp configuration), comparison of spectral terms in L-S And J-J coupling. Hyperfine structure of spectral lines and its origin; isotope effect, nuclear spin. Zeeman Effect (normal and Anomalous), Lande g-factor, Paschen-Back effect of a single valence electron system. Stark effect of Hydrogen atom.

Textbook

1. Elements of Quantum Mechanics by Kamal Singh and S P Singh
2. Molecular Structure and Spectroscopy (2nd Edition) by G Aruldhas, PHI
3. Atomic Physics by J B Rajam, S. Chand

Reference

1. Introduction to Quantum Mechanics (2nd Edition)by Griffiths, Pearson
2. Quantum Mechanics by G Aruldhas, PHI
3. Concepts of Modern Physics by Arthur Beiser, TMH
4. Quantum Physics (2nd Edition) by HC Verma, Surya Publications
5. A text book of Quantum Mechanics by Mathews and Venkatesan , TMH
6. Quantum Mechanics Theory and Applications A.Ghatak & S Lokanathan , Macmillan
7. Fundamentals of Molecular Spectroscopy by C. Banwell and E. Mccash McGraw Hill
8. Introduction to Atomic Spectra by HE White, McGrawHill

Course designed by: Mr. Ajai Jose

SEMESTER VI

CBPH609: THERMODYNAMICS AND STATISTICAL PHYSICS

Credit: 3 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: **Explain** kinetic theory of gases and its applications in thermodynamics

CO2: Describe the basics of thermodynamics and apply to Carnot engine, Refrigerator and internal combustion engines to **solve** basic problems in the related area.

CO3: Solve thermodynamic problems related to Entropy, thermodynamic potentials, Maxwell's relations and laws of heat transfer.

CO4: Describe and **apply** the basic concepts and formulations of statistical Physics, thermodynamic probability, classical - quantum distribution functions and entropy-probability relation.

CO5: Identify and **apply** the mathematical tools related to thermal and statistical Physics

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Understand	3	3	-	-	-	2	--	2	-	-
CO2	Apply	3	3	2	-	-	3	-	2	-	-
CO3	Apply	3	3	2	-	-	2	-	2	-	-
CO4	Apply	3	3	2	-	-	2	-	2	-	-
CO5	Apply										
	Average	**3**	**3**	**2**			**2.25**		**2**		

Module 1: Kinetic Theory of Gases (18 hours)

Kinetic interpretation of pressure exerted by a gas, Ideal gas equation from kinetic theory, Boyle's law, Charles law, Mean kinetic energy of a molecule, Degrees of freedom for mono, di and tri-atomic molecules, Equipartition of energy, Specific heat and internal energy, Specific

heat of mono, di and tri-atomic gases, Real gases- van der Waals equation of state, Phase diagram; Comparison with experimental PV curve, critical constants, estimation of critical constants, Maxwell distribution of molecular speeds

Module 2: Thermal Physics (18 hours)

Thermodynamic systems Thermodynamic variables and equation of state, Zeroth law-thermodynamic equilibrium, First law, Isochoric process-isobaric process-adiabatic process-isothermal process-cyclic process, Adiabatic equation of a perfect gas-Indicator diagram-Work done during isothermal and adiabatic process-slopes of isothermals and adiabatic, Isothermal elasticity-adiabatic elasticity, Carnot's engine and cycle of operations-work done per cycle and efficiency- theory of refrigerator-coefficient of performance- Second law – Carnot's theorem Internal combustion engine - efficiency calculation of petrol (Otto engine)-Diesel engine-efficiency of diesel engine.

Module 3:Thermodynamic Relations and Heat Transmission (18 hours)

Entropy, Entropy changes in reversible and irreversible processes, Entropy – temperature diagrams and equations. Physical significance of entropy, Thermodynamic potentials: Enthalpy, Gibbs and Helmholtz functions, Maxwell's relations and applications, Clausius Clapeyron Equation, T.ds equations, Modes of heat transfer – Conduction, Convection and Radiation, Searle's & Lee's experiment, Black body radiation, Stefan Boltzmann Law, Wein's displacement law, Rayleigh -Jeans Law, Planck's law (no derivation).

Module 4: Statistical Mechanics (18hours)

Micro and Macro states, Thermodynamic Probability, Phase space, Ensembles. Maxwell-Boltzmann Distribution law Thermodynamics of an ideal monoatomic gas, Concept of entropy and thermodynamic probability. Quantum Statistics: Need of quantum statistics-Indistinguishability of particles- Spin and Statistics, Bose Einstein distribution law, Application of Bose Einstein distribution law to black body radiation, Fermi Dirac Statistics Application of Fermi Dirac Statistics to electron gas, Fermi Energy

Textbook

1. Heat, thermodynamics and statistical physics- Brijlal, N. Subrhmanyam and P. S. Hemne, S. Chand, 2001
2. Heat and Thermodynamics, Mark W Zemaskay and Richard H Dittman, Tata McGraw Hill Publishing Co. (Special Indian Edition)

Reference

1. Thermodynamics and Statistical Mechanics, Greiner, Springer
2. Thermal Physics, Kinetic Theory, Thermodynamics and Statistical Mechanics, Garg, S. C., R.M. Bansal, C.K. Ghosh, McGraw Hill Education, New Delhi, 1993
3. Berkeley Physics Course Volume 5; Statistical Physics; Frederick Reif. McGraw Hill.
4. A Treatise on Heat; Saha and Srivastava, The Indian Press, Allahabad.
5. Thermal and Statistical Physics, R.B. Singh, New Academic Science
6. The Feynman Lectures on Physics, Richard P. Feynman, Pearson

Course designed by: Dr Sajith Mathews T

CBPH610: NUCLEAR AND PARTICLE PHYSICS

Credit:3 **Total Hours: 54**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Describe the basic aspects of nuclear structure, fundamental concepts of radioactivity and their applications

CO2: Identify different types of nuclear reactions and associated particles

CO3: Discuss the principle and working of particle detectors

CO4: Appraise the principle and working of particle accelerators

CO5: Judge the classification of elementary particles, conservation laws and associated models

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Understand	1	2	2	-	-	1	-	-	-	-
CO2	Apply	1	2	3	1	-	1	-	2	-	-
CO3	Understand	1	2	1	-	1	1	2	-	-	1
CO4	Analyse	1	2	1	-	1	1	2	-	1	1
CO5	evaluate	1	2	2	1	1	1	1	1	-	-
	Average	**1**	**2**	**1.8**	**1**	**1**	**1**	**1.6**	**1.5**	**1**	1

Module 1: Nuclear Structure, Radioactivity and Nuclear Reactions (18hrs)

Nuclear Constituents Nuclear sizes and shapes Nuclear masses and binding energies Liquid drop model Shell model Radioactive decay Conservation laws in radioactive decay Alpha decay Beta decay Gamma decay Natural radioactivity Types of nuclear reactions Radioisotope production in nuclear reactions Low-energy reaction kinematics Fission and Fission reactors Fusion and Fusion reactors Fusion processes in stars Applications of radiation physics

Module 2: Particle Detectors and Accelerators (18hrs)

Particle Detectors , Wilson Cloud Chamber ,Ionization Chambers Proportional Counter Geiger-Muller Counter Scintillation Counters Semiconductor Counters Neutron Counting The Photographic Plate, Linear Accelerator Lawrence Cyclotron Synchrocyclotron Electron Accelerating Machines : Betatron The alternate-Gradient Synchrotron Intersecting Beam Accelerators, The Growth and Future of Large Accelerating Machines

Module 3: Elementary Particles (18hrs)

The four basic forces Particles and antiparticles Families of particles Conservation laws Particle interactions and decays Resonance particles Energetics of particle decays Energetics of particle reactions The Quark Model The Standard Model Basic ideas of quantum chromodynamics Higgs boson

Text books

Module 1: Kenneth S Krane, Modern Physics, 4thEdn, Wiley. (Chapter 12 &13)

Module 2: T. A. Littlefield and N. Thorley, Atomic and Nuclear Physics – An Introduction, 3rdEdn, Springer. (Chapter 17 &18)

Module 3: Kenneth S Krane, Modern Physics, 4thEdn, Wiley. (Chapter 14)

Reference

1. Concepts of Modern Physics, Arthur Beiser, Shobhit Mahajan and S Rai Choudhury, McGraw-Hill Book Co., Inc., New York
2. Nuclear Physics, Principles and applications-John Lilley, Wiley (2006)
3. Modern Physics – R Murugeshan, Er. KiruthigaSivaprasath S. Chand Publishing- 18th Edition
4. Modern Physics- Raymond S. Serway, Clement J Moser, Curt A Moyer- 3rdedition (Cengage Learning)
5. Introduction to modern Physics- H.S Mani & G.K Mehta (Affiliated East-West PVT LTD)
6. Introductory nuclear physics by Kenneth S. Krane. (John Wiley & Sons, 1988).
7. Introduction to the physics of nuclei and particles by R.A. Dunlap. (Singapore: Thomson Asia, 2004)
8. Nuclear Physics – Irving Kaplan, Narosa Publishers (2018)
9. Nuclear Physics D C Tayal, Himalaya publishing House (2011)

Course designed by: Dr. Issac Paul

BPH611: CONDENSED MATTER PHYSICS

Credit: 3 **Total Hours: 54**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Explain the different crystal structures, crystal systems and **apply** to calculate different crystal parameters.

CO2: Describe the free electron theory in metals and band theory of solids

CO3: Explain the basic theory of dielectric and magnetic properties of materials

CO4: Explain the phenomenon of superconductivity, the theory behind it and **apply** it to relevant problems.

CO5: Describe the properties and mechanisms associated with new materials

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Apply	-	-	-	1	2	1	3	-	-	-
CO2	Understand	3	3	1	2	-	2	-	3	-	-
CO3	Understand	2	2	1	1	-	2	2	1	2	-
CO4	Apply	2	2	1	-	-	2	-	2	-	-
CO5	Understand	3	3	2	3	-	3	-	3	-	-
	Average	**2.5**	**2.5**	**1.25**	**1.75**	**-**	**2**	**2.5**	**2.25**	**2**	-

Module 1: Crystal Structure, Bonding, Free Electron Theory and Band Theory of Solids (18 hours)

Crystalline Matter-unit cell, primitive cell, 14 Bravais Lattice and 7 Crystal Systems, Miller indices, Nomenclature of crystal directions and planes, spacing between planes, reciprocal lattice, Crystal structures of sc, bcc, fcc and hcp, X-ray diffraction-theory powder XRD and determination of lattice constants of simple cubic, Interatomic forces, binding energy, Madelung constant, Ionic Bond, Covalent bond, Van der Waal, Metallic Bonds, Hydrogen bonding, Free Electron model-free e gas and its comparison with ideal gas , Formation of

Energy Bands, Bloch Theorem (Statement), basic idea of Kronig-Penny model (no derivation), Brillouin Zones (qualitative), Effective Mass,

Module 2: Band Theory of Solids (4 hours)

Band Structure-Intrinsic and Extrinsic Semiconductors, Temperature Dependence of resistivity of intrinsic semiconductors, metals, Hall effect theory and applications.

Dielectric and Magnetic Properties of Solids (14 hours)

Dielectric Constant - Dipole Moment, Polarizability, Clausius-Mossotti Relation, Ferroelectricity, Classification of Magnetic Materials -Dia, Para, Ferro, Ferri, Anti Ferromagnets with examples, Langevin's theory, Paramagnetism, Curie-Weiss Law, Curie Temperature, Magnetic Domain Structure, Spintronics, Spin Waves (basic idea)

Module 3: Superconductivity and Material Science (18 hours)

Superconducting Phenomenon- Critical Temperature, Meissner Effect- Type I& II Superconductors, BCS theory (qualitative), London Equations, Josephson Effect and its application in SQUID, Isotope effect, Thermodynamics of superconductors, High Tc superconductors, Applications of Superconductors.

Amorphous semiconductors, Liquid crystals, Polymers, Thin films, Nanomaterials.

Textbooks

1. S O Pillai, Solid State Physics. New Age International Publications
2. A Goswami, Thin Film Fundamentals, New Age International,2008

Reference

1. H P Myers, Introductory Solid-State Physics (second edition) CRC Press
2. Ali Omar, Elementary Solid-State Physics, Pearson
3. R.K Puri and V K Babber, Solid State Physics, S. Chand
4. Guozhong Cao, Nanostructures and Nanomaterials Synthesis, Properties and Applications, Imperial College Press, 2004
5. Kittel C., Introduction to Solid State Physics, 8th edition, Wiley
6. Ashcroft N.W. & Mermin N.D, Solid State Physics, TMH
7. P K Palanisamy, Solid State Physics, Scitech publications
8. Blakemore J S, Solid State Physics, 2nd edition, Cambridge
9. Mircea S Rogalski & B Palmer, Solid State Physics
10. C L Arora, Solid State Physics, S Chand.
11. James F Annett, Superconductivity, Superfluids and Condensate, Oxford

Course designed by: Dr. Joshy Jose

CBPH612: LINEAR INTEGRATED CIRCUITS, DIGITAL ELECTRONICS, C++ PROGRAMMING

Credit: 3 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: **Explain** the basic concepts and various modes of operation /configurations of operational amplifiers to **realize** different mathematical circuits

CO2: **Identify** the circuits based on the difference in the external components connected to the operation amplifier.

CO3: **Identify** different number systems, Boolean laws and K-map and **apply** them to simplify different digital circuits

CO4: **Describe** different sequential and combinational logic circuits, **design** various counters and registers and **construct** elementary digital circuits using Arduino

CO5: **Describe** the concept of OOP and use the basic elements of C++ programming to **Develop** simple C++ programmes

Course Mapping Table

	Cognitive Level	PSO 1	PSO 2	PSO3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	3	2	-	-	-	3	1	2	-	-
CO2	Understand	3	2	-	-	-	3	1	-	-	-
CO3	Apply	3	2	3	-	-	3	-	3	-	-
CO4	Create	3	3	3	3	2	3	-	3	-	2
CO5	Create	2	-	1	1	1	2	1	2	-	1
Average		**2.8**	**2.25**	**2.3**	**2**	**1.5**	**2.8**	**1**	**2.5**	**-**	**1.5**

Module 1: Linear Integrated Circuits(18 hours)

Operation Amplifier - operational Overview, Op-Amp supply voltages, Op-amp parameters, Op-amp as Inverting Amplifier, Op-amp as Non inverting amplifier, Non inverting amplifier as a buffer, Op-amp as Summer Amplifier – Op-amp as Differential Amplifier, Op-amp as Comparators, Op-amp as – Integrator,Op-amp as – Differentiator, Voltage follower circuit – importance

Module 2: Binary Number system, Boolean Algebra Operations, Combinational Logic (20 hours)

Decimal Numbers, Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, Binary Addition , Subtraction, Multiplication and Division, Signed binary numbers - Sign-magnitude form, 1's complement form and 2's complement form, Decimal value of Signed binary numbers - Sign magnitude, 1's complement and 2's complement Binary Coded Decimal, BCD Addition, The AND,OR and NOT Gates- Symbol,Truth table, Operation with Wave form inputs, NAND,NOR Gates- Symbol, Truth table, Wave form input operations. NAND as negative OR, NOR as negative AND The Exclusive-OR and Exclusive-NOR Gates Boolean Operations and Expressions - variables, literals, sum term, product term, Boolean addition and multiplication, Laws and Rules of Boolean Algebra, DeMorgan's Theorems and Applications, Simplification Using Boolean Algebra, SOP form - AND /OR implementation, NAND /NAND implementation, Conversion of expressions to SOP form and Standard SOP form, POS form - implementation, Conversion of expressions to Standard SOP form, Standard SOP to Standard POS form, Karnaugh Maps. 3 and 4 variable Karnaugh Maps, Cell Adjacency, Mapping of standard and non standard SOP expressions, Karnaugh map simplification of SOP expressions, Universal Property of NAND and NOR gates. Combinational Logic using NAND/ NOR gates, Half Adder and Full Adder, Basic Binary Decoder, Binary to Decimal Decoder, Decimal to Binary Encoder, Multiplexers (Data Selectors), Demultiplexers

Module 3:Sequential Logic and Microcontroller basics (16 hours)

Sequential Logic circuits, Latches and Edge Triggered flip flops, SR flip flop - active high and active low, Clocked SR, D and JK flip flops, T and MS-JK flip flops , Asynchronous and synchronous counters , Design of Asynchronous counter, mod 8 and decade counter, Registers - Buffer registers and Shift Registers, SISO and SIPO shift registers, PISO and PIPO shift registers, Bidirectional Shift Register, Familiarisation of Arduino micro controlller architecture, Programming basics in IDE, Writing simple sketechs, Interfacing simple electronic devices with Arduino - LED, IR sensor
Arduino Shields, Basic concepts of IOT using Arduino

Module 4: C++ Programming (18 hours)

Introduction- C++ programming basics, Data types, Operators (arithmetic, relational, logical and assignment operators), Loops and decisions, Functions, Arrays, Basic ideas of structures. Objects and classes.

Textbooks

1. Ramakant A. Gayakwad,Op-amps and Linear Integrated Circuit Technology,Prentice-Hall, 1983

2. Brian W Evans,Arduino Programming Notebook
3. Thomas L. Floyd, Digital Fundamentals, Pearson, 9th Edition
4. Robert Lafore, Object oriented programming in Turbo C++, Edition, Galgotia Pub., Year of Publication

Reference

1. M Morris Mano, Digital design, PHI
2. R S Sedha, Applied Electronics, Revised Edition, , S Chand
3. Malvino, Leach and Saha, Digital principles and applications, 6thEdn, TMH
4. William H Gothmann, Digital Electronics,PHI
5. S Salivahanan and S Arivazhakan, Digital circuits and design,PHI
6. Sedha S, Digital Electronics, Chand
7. Millam and Taub, Pulse, Digital and switching wave forms –.
8. Malvino, Brown, Digital computer electronics, TMH
9. Tokheim, Digital electronics,TMH
10. R. Hubbard, Programming with C++ , John (McGraw Hill Pub.)

Course designed by: Mr. Justin John

CHOICE BASED CORE COURSES

CBPH6E01: NANOSCIENCE AND NANOTECHNOLOGY

Credits – 3 **Total Hours – 54**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Describe the basic concepts of structural and electronic bands of nano materials and surface characterisation techniques

CO2: Explain magnetic properties of nanomaterials and their applications

CO3: Describe basic ideas of clusters, their fabrication and characterisation

CO4: Describe the fabrication of carbon nanotubes and their electrical and mechanical properties

CO5: Explain the fabrication and applications of 0D, 1D and 2D nanomaterials

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Understand	-	-	-	1	2	1	3	-	-	-
CO2	Understand	3	3	1	2	-	2	-	3	-	-
CO3	Understand	2	2	1	1	-	2	2	1	2	-
CO4	Understand	2	2	1	-	-	2	-	2	-	-
CO5	Understand	**3**	**3**	**2**	**3**	**-**	**3**	**-**	**3**	-	-
	Average	**2.5**	**2.5**	**1.25**	**1.75**	**-**	**2**	**2.5**	**2.25**	**2**	**-**

Module-1. Basic Physical Properties of Nanostructures (23 Hours)

Crystal Structures -Face- Centered Cubic Nanoparticles , Energy Bands of conductors, insulators and semiconductors, Bandgap energy of semiconductors- Effective mass-Mobility-(electron and hole)-excitons. Particle Size determination using X-ray diffraction-basic principle and working of a typical powder XRD Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM)- basic principles, working Basics of Ferromagnetism and superparamagnetism Effect of nanostructuring on magnetic particles, Dynamics of

Nanomagnets Nanocarbon- Ferromagnets Ferrofluids Magneto resistance fundamental ideas-Giant and Colossal Magnetoresistance

Module-2. Gas Phase clusters and Carbon nanostructures (16 Hours)

Introduction-difference between atom, molecules, clusters and bulk material, Cluster formation- Pulser Arc, Laser vaporization, Supersonic Nozzle Source, Knudsen cell, Detection and analysis:- Wein filter, Quadrupole Mass filter, TOF Mass filter. Various cluster types-metal nanoclusters and magic numbers, optical properties, photofragmentation, Coulomb explosion of Semiconductor nanoclusters. Nature of the Carbon Bond and allotropes of carbon-graphite, CNT, diamond, grapheme, Fabrication (arc melting) and properties of carbon clusters, Structure of C60 and its single crystal- orientational ordering of C60, Fabrication (chemical vapor deposition, arc melting) of CNT Structure, electrical and mechanical properties of CNT

Module-3. Quantum Wells, Wire and Dots and Microelectromechanical Systems (15 Hours)

Particle in a box problem, Introduction to quantum wells, wires and dots with examples, Concept of Density of States(DOS), Single-Electron Tunneling, Micrelectromechanical Systems(MEMS) introduction, fabrication, Molecular Switches-schematic representation, one example each for light controlled and voltage controlled molecular switch

Text Book:

1. Introduction to Nanotechnology, Charles P. Poole Jr. and Frank J. Owens, Wiley, 2003

2. Nano: the essentials, T. PRADEEP,TMH ,2007.

3. Introduction to Nanoscience and Nanotechnology, K.K. Chattopadhay, A. N. Banerjee PHI India

References:

1. Nanoscience,Nanotechnologies and Nanophysics, C. Dupas, P. Houdy and M. Lahmani,Springer-Verlag , 2007.
2. Nanotechnology 101, John Mongillo, Greenwood Press, 2007.
3. What is What in the Nanoworld, A Handbook on Nanoscience and Nanotechnology, Victor E. Borisenko and Stefano Ossicini , WILEY-VCH Verlag, 2008.
4. Semiconductors for Micro and Nanotechnology—An Introduction for Engineers Jan G. Korvink and Andreas Greiner, WILEY-VCH Verlag ,2002.

Course designed by: Dr. Sinu Mathew

CBPH6E02: ASTRONOMY ASTROPHYSICS AND COSMOLOGY

Credit: 3 **Total Hours: 54**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: **Apply** basic astronomical techniques to measure the distances in the universe

CO2: **Discuss** stellar classification, evolutionary stages of stars, structure and energy production in stars.

CO3: **Discuss** internal structure and atmospheric features of Sun

CO4: **Apply** the basic principles of gravity and cosmology

CO5: **Examine** the Lambda-CDM model of cosmology

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Understand	2	2	2	-	-	2	2	1	1	-
CO2	Apply	1	2	2	-	-	1	-	1	-	-
CO3	Understand	2	2	2	-	-	2	2	1	1	-
CO4	Understand	1	2	2	-	-	1	1	-	-	-
CO5	Apply	1	2	2	-	-	1	1	-	1	-
Average		**1.4**	**2**	**2**	**-**	**-**	**1.4**	**1.5**	**1**	**1**	**-**

Module 1: Basic Tools of Astronomy (18 Hours)

Stellar distance: Relationship between stellar parallax and distance, Brightness and luminosity: Relationship between Luminosity, brightness and distance, Magnitudes: Apparent magnitude and brightness ratio, Relationship between apparent magnitude and absolute magnitude, Color and temperature of stars, Size and mass of stars, Relationship between flux, luminosity and radius, Cepheid variables and the period-luminosity relationship – Temperature and mass of Cepheids Star constituents: Stellar spectra – Stellar classification – Sun as a star –internal structure and atmosphere- photosphere- sunspots - chromospheres – corona –solar flares –

prominences. Energy production in Sun: Proton-proton chain – Energy transport from the core to the surface.

Module 2: Stellar Evolution and energy production (18 hours)

Stellar Structure, Hydrostatic equilibrium and structure equations, Type of stars – Classification and HR Diagram, Protostar, birth, maturity and Aging of stars, Death of small stars, Death of massive stars - supernova explosion , Pulsars and neutron stars, Black hole, Nuclear reaction in stars – Proton- Proton chain reaction and CNO cycle, Energy production in massive stars.

Module 3: Introduction to Cosmology (18 hours)

Drawbacks of Newtonian theory of gravity, Principle of equivalence, Consequences of principle of equivalence (bending of light, gravitational redshift and time dilation) Gravity as curvature of space-time Cosmological Principle Expansion of the Universe and Hubble's law FRLW model of the universe: FRLW metric, cosmological redshift, open, closed and flat universes Lambda CDM model of the Universe: Dark matter, dark energy and accelerated expansion, evolution scale factor in radiation, matter and dark energy dominated epochs. Basic ideas of primordial nucleosynthesis and CMBR.

Textbook

1. Astrophysics is Easy : An Introduction for the Amateur Astronomer by Mike Inglis
2. Modern Physics (2^{nd}Edn.) by Kenneth Krane
3. An Introduction to Modern Cosmology by Andrew Liddle

Reference

1. An introduction to Astrophysics – BaidyanathBasu, PHI
2. K. D. Abhyankar, Astrophysics of the Solar System, Universities Press
3. Concepts of Modern Physics – Arthur Beiser, Tata McGraw-Hill
4. The Big and the Small (Vol II) by G. Venkataraman, Universities Press (India)
5. Chandrasekhar and His Limit by G. Venkataramn. Universities Press (India)
6. A Brief History of Time by Stephen Hawking, Bantam Books
7. NPTEL video lectures available online

Course designed by: Dr Lijo Jose

PRACTICALS

SEMESTER I & II

CBPH2P01: MECHANICS AND PROPERTIES OF MATTER PRACTICAL

Credit: 2 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Identify and distinguish experiments pertaining to different branches of physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	3	-	-	-	-	3	-	-	-	-
CO2	Understand	3	3	-	-	-	3	-	-	-	-
CO3	Apply	3	-	3	-	-	3	-	3	-	-
CO4	Analysis	3	-	-	3	-	3	-	-	-	-
CO5	Evaluate	3	-	-	3	-	3	-	3	-	-
Average		**3**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	-	-

1. Vernier Callipers – Volume of a cylinder, sphere and hollow cylinder
2. Screw Gauge – Volume of a sphere and glass plate
3. Spherometer – Thickness of a glass plate, radius of curvature of a convex surface and a concave surface.
4. Measurement of density of a solid – Sensibility method to find mass using beam balance.
5. Travelling Microscope – Radius of a capillary tube.
6. Symmetric Compound Pendulum – Determination of acceleration due to gravity (g), radius of gyration(K) and moment of inertia (I)

7. Asymmetric Compound pendulum – Determination of acceleration due to gravity , radius of gyration and moment of inertia
8. Katter's Pendulum – Determination of acceleration due to gravity
9. Cantilever – Scale and Telescope – Determination of Young's modulus
10. Cantilever – Pin and microscope- Determination of Young's Modulus
11. Uniform Bending – Pin and Microscope – Determination of Young's Modulus
12. Non-Uniform bending – Pin and microscope- Determination of Young's Modulus
13. Non-Uniform Bending – Optic lever – Determination of Young's Modulus
14. Koenig's method – Determination of Young's Modulus
15. Torsion pendulum – Determination of Rigidity Modulus and moment of inertia
16. Torsion Pendulum – Rigidity modulus and Moment of Inertia - using identical masses
17. Static Torsion – Determination of Rigidity modulus
18. Vertical oscillations of a spring – Determination of Young's Modulus
19. Flywheel – Determination of Moment of inertia
20. Constant pressure head – Determination of viscosity of a liquid
21. Variable pressure head – Determination of viscosity of a liquid
22. Viscosity – Searle's Rotation Viscometer
23. Capillary rise method – Determination of surface tension
24. Melde's string – Determination of frequency of given tuning fork
25. Stokes method – determination of viscosity of liquid
26. Sonometer – Determination of frequency of ac.
27. Sonometer – Determination of frequency of given tuning fork, unknown mass and verification of laws of strings
28. Kundt's tube – Determination of velocity of sound
29. Planck's constant using LED's of at least 3 different colours
30. Ultrasonic waves – Determination of velocity

SEMESTER III & IV

CBPH4P02: BASIC ELECTRONICS PRACTICAL

Credit: 2 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Identify and distinguish experiments pertaining to electronics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	3	-	-	-	-	3	-	-	-	-
CO2	Understand	3	3	-	-	-	3	-	-	-	-
CO3	Apply	3	-	3	-	-	3	-	3	-	-
CO4	Analysis	3	-	-	3	-	3	-	-	-	-
CO5	Evaluate	3	-	-	3	-	3	-	3	-	-
Average		**3**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	-	-

1. Multimeter I – Measurement of resistance, potential difference, current
2. Multimeter II – Checking of capacitor, diode, inductance and transistor
3. Cathode Ray oscilloscope – Calibration and measurement of frequency and amplitude
4. Characteristics of LED – V-I characteristic for different colours
5. Characteristics of solar cell / photodiode – V- I characteristics
6. Characteristics of LDR.
7. Diode Characteristics – Forward and reverse characteristics
8. Zener characteristics – forward and reverse – Study of dynamic and static properties
9. Clampers – positive, negative and biased – Study of output waveforms
10. Clippers – positive, negative and biased – study of output waveforms
11. Transistor characteristics – Common Emitter configuration
12. Transistor Characteristics – Common Base configuration
13. Half wave rectifier – Study of ripple factor and with and without filter circuit

14. Full wave rectifier – (centre tap) – Study of ripple factor with and without filter circuit
15. Full wave rectifier – (bridge) – Study of ripple factor with and without filter circuit
16. Regulated power supply using IC 78XX/79XX etc – Study of line and load regulations
17. Voltage regulator using Zener diode – Study of line and load regulations
18. Voltage regulator using Zener diode and transistor – Study of line and load regulations
19. Regulated power supply using Zener diode and IC 741 – Study of line and load regulations
20. RC coupled common emitter amplifier – Study of frequency response and bandwidth
21. Schmitt trigger using IC 741
22. RC Phase shift oscillator
23. Wein bridge Oscillator using IC 741
24. Voltage multipliers – doubler & tripler
25. Characteristics of FET
26. Study of UJT Characteristics
27. OPAMP – adder and subtractor
28. OPAMP Characteristics – study of CMRR and open loop gain
29. OPAMP – inverter, non-inverter and buffer – study of gain

SEMESTER V & VI

CBPH6P03: ELECTRICITY, MAGNETISM AND THERMAL PHYSICS PRACTICAL

Credit: 2 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Identify and distinguish experiments pertaining to electricity, magnetism and thermal physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	3	-	-	-	-	3	-	-	-	-
CO2	Understand	3	3	-	-	-	3	-	-	-	-
CO3	Apply	3	-	3	-	-	3	-	3	-	-
CO4	Analysis	3	-	-	3	-	3	-	-	-	-
CO5	Evaluate	3	-	-	3	-	3	-	3	-	-
Average		**3**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	-	-

1. Carey Foster's Bridge – Measurement of resistivity
2. Carey Foster's Bridge – Temperature Coefficient
3. Andersons Bridge
4. Wave shaping RC circuits – Integrator and differentiator
5. Series LR circuits
6. LCR series and parallel resonant circuit analysis
7. Kirchhoff's Law
8. Verification of Thevenin and Norton theorems
9. Verification of Superposition theorem and Maximum power transfer theorem.
10. e/m – Thomson's apparatus – Bar magnet/magnetic focusing
11. To determine e/k using transistor

12. Determination of Dielectric constant of a thin sheet/a liquid
13. Potentiometer – Measurement of resistivity
14. Potentiometer – Calibration of an ammeter
15. Potentiometer – Calibration of low range voltmeter
16. Potentiometer – Standardization of the potentiometer wire.
17. Potentiometer – Calibration of ammeter
18. Tangent Galvanometer –Calibration of Ammeter
19. Field along the axis of a circular coil – variation of magnetic field and calculation of B_H.
20. Field along the axis of a circular coil – moment of magnet- Null method
21. Searle's Vibration Magnetometer – Magnetic moment
22. Deflection and vibration magnetometer (Box type) – m and Bh
23. Conversion of galvanometer into ammeter
24. Conversion of galvanometer into voltmeter
25. Electrochemical equivalent of Copper
26. Moving coil galvanometer – figure of merit
27. BG – Charge Sensitivity – Standard capacitor method
28. BG – Measurement of capacitance
29. BG – Measurement of High resistance by leakage method
30. Study of See beck effect/Peltier effect
31. Thermistor characteristics and temperature co-efficient of resistance
32. Thermal conductivity of rubber
33. Thermal conductivity of bad conductor – Lee's disc
34. Newton's law of cooling – Specific heat capacity of a liquid

CBPH6P04: OPTICS AND PHOTONICS PRACTICAL

Credit: 2 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Identify and distinguish experiments pertaining to different branches of physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	3	-	-	-	-	3	-	-	-	-
CO2	Understand	3	3	-	-	-	3	-	-	-	-
CO3	Apply	3	-	3	-	-	3	-	3	-	-
CO4	Analysis	3	-	-	3	-	3	-	-	-	-
CO5	Evaluate	3	-	-	3	-	3	-	3	-	-
Average		**3**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	-	-

1. Liquid Lens – Determination of optical constants of a convex lens
2. Liquid Lens – Determination of refractive index of a liquid – water and unknown liquid
3. Air wedge – Determination of thickness of thin wire
4. Newtons rings – Determination of wavelength of sodium light
5. Spectrometer – Angle of Prism
6. Spectrometer – Refractive index of material of prism
7. Spectrometer – Hollow Prism – Determination of refractive index of liquid
8. Spectrometer – Cauchy's constants
9. Spectrometer – Small angled Prism – Normal Emergence
10. Spectrometer – Resolving power of a prism.
11. Spectrometer – Grating – Wavelengths
12. Spectrometer – Grating – dispersive power
13. Spectrometer – small angled prism- Normal incidence
14. Spectrometer – Prism i_1-i_2 curve

15. Spectrometer – Prism i-d curve
16. Spectrometer – Dispersive power of a prism
17. Spectrometer – Quartz prism – Refractive indices of quartz for the ordinary and extra – ordinary rays
18. Laser – Grating – Determination of wavelength
19. Laser – Determination of spot size and divergence
20. Single slit diffraction using laser – Determination of slit width
21. Optical fibre – Determination of numerical aperture
22. Brewster's Angle determination

CBPH6P05: COMPUTATIONAL PHYSICS PRACTICAL

Credit: 2 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Identify and distinguish experiments pertaining to different branches of physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	3	-	-	-	-	3	-	-	-	-
CO2	Understand	3	3	-	-	-	3	-	-	-	-
CO3	Apply	3	-	3	-	-	3	-	3	-	-
CO4	Analysis	3	-	-	3	-	3	-	-	-	-
CO5	Evaluate	3	-	-	3	-	3	-	3	-	-
Average		**3**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	-	-

1. Computer programming in C++ – Resistance colour code to numerical value conversion
2. Computer programming in C++ – For different initial velocity and angle of projection, find out time of flight, horizontal range, Maximum height of a Projectile
3. Computer programming in C++ – sorting the numbers in ascending and descending order
4. Computer programming in C++ – Conversion of temperature scale
5. Computer programming in C++ – Solving a quadratic equation
6. Computer programming in C++ – Generation of Fibonacci series
7. Computer programming in C++ – Conversion of a decimal number into binary number
8. Computer programming in C++ – Simple Pendulum – Calculation of ‘g’ from experimental data
9. Computer programming in C++ – multiplication of two matrices
10. Computer programming in C++ - Solving a linear equation – bisection method
11. Computer Programming in C++ - Solving the differential equation – RK method II order
12. Computer Programming in C++ - Solving an equation by Newton – Raphson Method

CBPH6P06: DIGITAL ELECTRONICS PRACTICAL

Credit: 2 Total Hours: 72

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Identify and distinguish experiments pertaining to different branches of physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	3	-	-	-	-	3	-	-	-	-
CO2	Understand	3	3	-	-	-	3	-	-	-	-
CO3	Apply	3	-	3	-	-	3	-	3	-	-
CO4	Analysis	3	-	-	3	-	3	-	-	-	-
CO5	Evaluate	3	-	-	3	-	3	-	3	-	-
Average		**3**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	-	-

1. Realization of logic gates – AND, OR and NOT – using diodes, transistors etc.
2. Realization of logic gates – AND, OR and NOT – Using universal gates
3. Verification of truth table of NAND, NOR, XOR and XNOR gates- Using universal gates
4. Verification of De Morgan's theorems – Using IC 7400
5. BCD to 7 segment decoder
6. Realization of Half adder and Full adder using gates – Verification of truth table
7. Astable Multivibrator using Transistor
8. Astable Multivibrator using IC 555
9. Monostable Multivibrator using IC 555
10. Monostable Multivibrator using Transistor
11. Amplitude modulation using transistor
12. Pulse Width Modulation using IC 555
13. SR Flip Flops using IC 7400 – Verification of truth table
14. Digital counter using IC 7490 / 7495 / 74194 / 74151 – Verification of truth table

15. Bistable multivibrator using IC 555
16. Multiplexer using gates
17. Demultiplexer using gates
18. Shift register – SISO
19. Shift register – SIPO
20. 4-Bit Binary to Gray conversion
21. 4-Bit Gray to Binary conversion
22. JK Flip Flops using IC 7400 & 7410 – Verification of truth table
23. D/A converter using IC 741 – Using binary weighed resistor / R – 2R ladder type
24. A/D converter using IC 741
25. Realization of XOR and Ex NOR using transistor
26. Phase Shift Oscillator – Using transistors
27. LC Oscillator – Colpitts/Hartley – using transistors
28. Sweep wave generator using transistor

CBPH6PJ: Project & Industry/Institution Visit

Credit: 1

Course Outcome

Students able to:

CO1: Write a literature review of the topic of research to familiarize with the research problem. Prepare a report of the Institution/ Industry visited.

CO2: Define the scientific problem and state the hypothesis.

CO3: Design the experiment and identify the relevant variables associated with it.

CO4: Collect the list of instruments/ functions of the instruments found on visit or the data accessed through research and correlate the data to arrive at valid conclusions.

CO5: Write a coherent thesis and communicate the major findings to the scholarly community.

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Understand	-	-	2	-	1	2	1	1	1	1
CO2	Understand	-	-	-	-	1	1	-	-	-	-
CO3	Apply	-	-	1	-	2	2	1	1	-	2
CO4	Apply	-	-	1	2	2	2	1	1	-	2
CO5	Create	-	-	1	-	2	1	1	1	-	1
	Average	**-**	**-**	**1.25**	**2**	**1.6**	**1.6**	**1**	**1**	**1**	**1.5**

For the completion of degree programme every student shall do a project work under the supervision of a teacher and submit the project dissertation. The end semester assessment comprises of dissertation and viva. The mark distribution for dissertation is given below.

Introduction and review	15
Material and methods	5
Result	10
Discussion	15
Reference	5
Total	**50**

COMPLEMENTARY COURSES IN PHYSICS FOR

BSc MATHEMATICS PROGRAMME

SEMESTER – I

CDPM101 –MECHANICS, ELASTICITY AND FOURIER ANALYSIS

Credits – 2 **Total Hours: – 36**

Course Outcomes

On successful completion of the course, the student will be able to:

CO1: **Describe** rotational motion, moment of inertia of rigid bodies and **apply** the ideas to relevant problems

CO2: **Describe** the differential equation for SHM and **apply** it to find the energy of an oscillating system

CO3: **Describe** elasticity and **apply** it to bending and twisting of a bar or rod

CO4: **Describe** laboratory methods of finding the modulus of elasticity

CO5: **Describe** Fourier series and **apply** it to square wave analysis

	Cognitive Level	PS O1	PS O2	PS O3	PS O4	PS O5	PO1	PO2	PO3	PO4	PO5
CO1	Understand	-	3	2	-	-	2	-	2	-	-
CO2	Apply	-	3	-	-	-	2	-	2	-	-
CO3	Understand	-	3	2	-	-	2	-	2	-	-
CO4	Understand	-	2	2	-	-	2	-	1	-	-
CO5	Apply	-	2	3	-	-	2	-	2	-	-
Average		-	3	2.3	-	-	2	-	1.8	-	-

Module 1: Rotational dynamics of rigid bodies and Oscillations (18 hours)

Angular displacement; angular velocity; angular momentum, torque- conservation of angular momentum- angular acceleration, rotational kinetic energy, Moment of inertia- parallel and perpendicular axes theorems, Calculation of moment of inertia of rod, ring, disc, cylinder and sphere, Flywheel- moment of inertia and experimental set up, Simple harmonic motion, Differential equation- expression for displacement, velocity and acceleration- graphical

representation, Energy of a particle executing simple harmonic motion, Differential equation and solutions of forced and damped oscillators

Module 2: Elastic Properties of Materials and Fourier Analysis (18 hours)

Stress and strain; Hooke's law, Elastic moduli; Young's modulus- bulk modulus-rigidity modulus, Poisson's ratio, Work done in stretching, volume change and twisting Uniform and non-uniform bending, Bending moment-flexural rigidity, depression at the free end of a cantilever, Twisting couple- torsional rigidity, Determination of rigidity modulus using static and dynamic methods. Fourier's theorem, Evaluation of Fourier coefficients, Analysis of square wave.

Textbook:

1. Mechanics- H.S.Hans and S.P.Puri. (Tata McGraw-Hill)
2. Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
3. Mathematical methods for Physicists – G. B. Arfken and H.J. Weber (Academic press)

Referances

- Elements of properties of matter – D S Mathur, S. Chand (2010)
- Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Course designed by: Dr. Loji K Thomas

CDPM202: ELECTRIC AND MAGNETIC PHENOMENA, THERMODYNAMICS AND SPECIAL RELATIVITY

Credit: 2 **Total Hours: 36**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Describe the electric and magnetic properties of materials

CO2: **Classify** and **compare** different magnetic materials

CO3: **Describe** thermodynamic systems, processes and laws

CO4: Describe the principles of thermodynamics and **apply** them in different physical situations

CO5: **Describe** the mathematical formulation of special relativity and **apply** to physical situations

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	-	2	-	1	-	3	-	-	-	-
CO2	Understand	-	2	-	1	-	3	-	-	-	-
CO3	Remember	-	3	-	2	-	3	-	-	-	-
CO4	Apply	-	3	3	3	1	3	-	3	-	-
CO5	Apply	-	3	3	3	2	3	2	3	-	-
Average		-	2.6	3	2	1.5	3	2	3	-	-

Module 1: Dielectric and Magnetic Properties of Solids (10 Hours)

Review of Basic Equations, Dielectric Constant, Dipole Moment and Polarizability, Clausius-Mosotti Relation and Ferroelectricity, Classification of Magnetic Materials, Langevin's theory and paramagnetism, Curie-Weiss law and Curie temperature, Anti-ferromagnetism and Ferrimagnetism, Magnetisation and Magnetic Domain Structure.

Module: 2 Thermodynamics (12 hours)

Thermodynamic systems, Thermodynamic equilibrium, Thermodynamic processes – isothermal, process and adiabatic process, Work done in isothermal process and adiabatic process, Zeroth law of thermodynamics, First law of thermodynamics, The Carnot engine –

Carnot cycle, work done in a cycle and efficiency, Refrigerator – coefficient of performance, Concept of entropy, Second and third law of thermodynamics.

Module 3: Special Theory of Relativity (14 hours)

Introduction to relative motion, Inertial and noninertial frames of references, Galilean transformation, Concept of ether and Michelson-Morley experiment, Newtonian principle of relativity, Postulates special theory, Lorentz transformation, Length contraction, Time dilation, Relativity of simultaneity, Addition of velocities , Relativistic variation of mass and mass-energy relation

Text Books:

1. Elementary Solid-State Physics: Ali Omar (Pearson)
2. Heat and Thermodynamics- Brijlal and Subrahmanyam (S. Chand &Co)
3. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
4. Introduction to Special Relativity - Robert Resnick (John Wiley & Sons, 2007)

References

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta
2. Solid State Physics, P.K. Palanisamy, Scitech publications
3. Solid State Physics, R.K Puri & V.K. Babber, S. Chand
4. Modern Physics- R. Murugeshan (S. Chand and Co.)
5. Introduction of Electrodynamics- D.J. Griffiths (PHI Pvt. Ltd)
6. Modern Physics- G. Aruldas and P. Rajagopal (PHI Pub)
7. Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)

Course designed by : Benny Joseph

CDPM303 – QUANTUM MECHANICS, BASIC ELECTRONICS AND DIGITAL ELECTRONICS

Credits- 3 **Total hours- 54**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: **Describe** the basics of quantum mechanics and apply them to **solve** relevant problems

CO2: **Explain** the basic concepts in semiconductor electronics and **apply** them to electronic circuits

CO3: **Discuss** the operation of diodes and transistors in order to **design** basic circuits

CO4: **Identify** different logic gates, explain Boolean operations and **apply** them to simplify different digital circuits

CO5: **Describe** different sequential and combinational logic circuits and **design** various counters

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Apply	-	-	1	2	-	1	-	1	1	-
CO2	Apply	-	-	1	2	-	1	-	1	1	-
CO3	Create	-	-	1	2	-	1	-	1	1	-
CO4	Apply	-	2	2	-	-	3	2	2	-	-
CO5	Create	-	2	3	-	-	3	2	3	-	-
Average		**-**	**2**	**-**	**2**	**-**	**1.8**	**2**	**1.6**	**1**	**-**

Module 1: Elementary Quantum Theory (18 hours)

Introduction-Elementary Quantum theory, black body radiation and Planks Quantum hypothesis, Photoelectric effect-Einstein's explanation, de Broglie hypothesis-Matter wave Davison- Germer experiment, Uncertainty Principle(derivation not expected), Wave function-condition-normalization, Schrodinger equation-stationary state-non normalizable wave function, Box normalization

Module 2: Basic Electronics (18 hrs)

Semiconductors – introduction, P-type and N-type doping, P-N junction diode — barrier formation in a P-N Junction diode , P-N junction diode - forward and reverse bias — V-I

characteristics , P-N junction diode – static and dynamic resistances, Junction capacitance, Diode equation (qualitative treatment), Special type of diodes: Zener diode, LED, Photo diode. Zener diode as voltage regulator - Line regulation and Load regulation Rectifiers: Half wave rectifiers Rectifiers: Centre tapped full wave Rectifier, Rectifiers: Bridge rectifiers Comparison of rectifier circuits- expression for I_{dc} and I_{rms} and efficiency, Transistor construction — NPN and PNP transistors, Transistor action Common base, common emitter and common collector configurations Comparison of CE, CB and CC configurations. Relationships between different current gains Characteristics of CE amplifier — active, saturation and cut off regions Transistor as an Amplifier — small signal operation of CE amplifier Basic Ideas of FET and MOSFET

Module 3: Digital Electronics (18 hours)

Binary Coded Decimal, BCD Addition The AND, OR and NOT Gates- Symbol, Truth table, Operation with Wave form inputs NAND, NOR Gates- Symbol, Truth table, Wave form input operations. NAND as negative OR, NOR as negative AND The Exclusive-OR and Exclusive-NOR Gates Boolean Operations and Expressions - variables, literals, sum term, product term, Boolean addition and multiplication Laws and Rules of Boolean Algebra De Morgan's Theorems and Applications Simplification Using Boolean Algebra Universal Property of NAND and NOR gates. Combinational Logic using NAND/ NOR gates Half Adder and Full Adder Basic Binary Decoder, Binary to Decimal Decoder, Decimal to Binary Encoder Multiplexers (Data Selectors), Demultiplexers . Sequential Logic circuits, Latches and Edge Triggered flipflops SR flip flop - active high and active low Clocked SR, D and JK flip flops T and MS-JK flip flops Design of Asynchronous counter, mod 8 and decade counter Registers - SISO, SIPO, PISO and PIPO

Text Books

1. Quantum mechanics - G. Aruldhas, PHI Learning
2. Basic Electronics-B.L.Theraja: S Chand; Multicolor edition (1 December 2006)
3. Digital Fundamentals (9th Edition) - Thomas L Floyd, (Pearson International Edition)

Reference

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta
2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
3. Modern Physics- R. Murugeshan (S. Chand and Co.)
4. Quantum Physics- S. Gasiorowicz (John Wiley & Sons)

5. B. L. Theraja, Basic Electronics, S Chand, 2006.

6. Digital principles and applications- A. P. Malvino and P.Leach

Course designed by: Sijo Sebastian, Prijil Mathew, Justin John

CDPM404: PHYSICAL OPTICS, LASER PHYSICS AND ASTROPHYSICS

Credits – 3 Total Hours – 54

Course Outcomes

On successful completion of the course, the student will be able to:

CO1: Describe interference and **apply** it to Young's double-slit, Newton's rings and thin films diffraction

CO2: Describe diffraction and diffraction grating, its resolving power and dispersive power

CO3: Describe polarization of light and **apply** the concepts and rules associated with polarization to solve numerical problems and to suggest befitting methods and materials to solve practical problems

CO4: Describe the principle of lasers, types, properties and their applications

CO5: Describe the different formation of stars, and different stages in the life stage of stars

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Apply	-	3	2	-	-	2	-	2	-	-
CO2	Understand	-	3	2	-	-	2	-	2	-	-
CO3	Apply	3	3	3	2	2	3	2	3	1	-
CO4	Understand		3				2		2		
CO5	Understand		3				2		2		
	Average	**3**	**3**	**2.3**	**2**		**2.2**	**2**	**2.2**	**1**	

Module 1: Interference and Diffraction (18 hours)

Principle of superposition, Interference of light, Young's double slit experiment (division of wave front), Newton's rings by reflected light (division of amplitude), Radius of Newton's rings and measurement of wavelength, Interference in thin films- reflected light, Fresnel and Fraunhofer diffraction, Theory of plane transmission grating, Grating- Determination of wavelength (normal incidence), Grating- resolving power Grating- dispersive power

Module 2: Polarization (18 hours)

Introduction- polarized and unpolarized light- plane of vibration –plane of polarization, polarization by reflection- Brewster's law- polarization by refraction through pile of plates – law of Malus, Polarization by scattering, polarization by selective absorption, Uni-axial and biaxial crystals – double refraction- principal plane- polarization by double refraction, Polaroid, Elliptically and circularly polarized light, Quarter wave plate – Half wave plate

Module 3: Laser Physics and Astrophysics (18 hours)

Interaction of electromagnetic radiation with matter - stimulated absorption, spontaneous emission, stimulated emission, principle of laser, population inversion, Einstein's coefficients, Types of lasers- Ruby laser- Neodymium YAG laser- He-Ne laser, Properties of laser beams, Application of laser beams, Temperature and color of a star, brightness of a star, size of a star, elements present in a stellar atmosphere, mass of star, lifetime of a star, HR diagram, main sequence stars, evolution of stars, white dwarf- supernova explosion- neutron star- black hole

Textbook:

1. A text book of optics - N. Subrahmanyam, Brijlal and M.N.Avadhanulu , S.Chand
2. Baidyanath Basu, An introduction to Astrophysics, PHILearning

Reference

1. Optics – Eugene Hecht , A R Ganesan, IV Edn, Pearson Education
2. Satyaprakash, Optics, Ratan prakash Mandir
3. Ajoy Ghatak and K. Thyagarajan, Lasers: Fundamentals and Applications, 2nd Edition, Springer 2019
4. Arthur Beiser, Shobhit Mahajan, S Rai Choudhury Concept of Modern Physics (2010), Tata Mc Graw Hill Co Ltd, New Delhi

Course Designed by: Dr. Loji K Thomas

PRACTICAL

SEMESTER I & II

CDPM2P01: GENERAL PHYSICS PRACTICAL

Credit: 2 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Identify and distinguish experiments pertaining to different branches of physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	1	-	-	2	-	-	-	1	2	-
CO2	Understand	1	-	-	2	-	-	-	1	2	-
CO3	Apply	1	-	-	2	-	-	-	1	2	-
CO4	Analysis	1	-	-	2	-	-	-	1	2	-
CO5	Evaluate	1	-	-	2	-	-	-	1	2	-
Average		**1**	**-**	**-**	**2**	**-**	**-**	**-**	**1**	2	-

1. Vernier Calipers -- Volume of cylinder (solid and hollow), sphere.
2. Screw gauge – Radius of wire, volume of sphere and glass piece
3. Beam balance - Mass of a solid (sensibility method)
4. Spectrometer – Angle of the Prism
5. Hare’s Apparatus, U Tube – density of liquids
6. Coefficient of viscosity of the liquid – Constant Pressure head method
7. Coefficient of viscosity Variable Pressure head method
8. Surface Tension – Capillary rise method
9. Determination of Young’s Modulus- Cantilever (Scale and Telescope)
10. Fly wheel – Moment of Inertia
11. Torsion pendulum -Rigidity modulus

12. Determination of moment of inertia of rotationally symmetric body (solid sphere OR cylinder OR disc) from their period of oscillation on a torsion axle
13. Spring constant - Hooke's law - oscillation
14. Resistivity of the material of the wire- Ohm's law and verification by multimeter
15. Poisson's ratio of rubber
16. Symmetric Compound pendulum – Acceleration due to gravity
17. Temperature dependence of capacitance- polymer and ceramic capacitors.
18. Potentiometer – standardization
19. Static Torsion - Rigidity modulus
20. Deflection and Vibration Magnetometer-m & Bh
21. Field along the axis of circular coil- determination of Bh
22. Searle's Vibration Magnetometer - magnetic moment
23. Resistance of a galvanometer and its figure of merit
24. Determination of Young's Modulus- Cantilever (Pin & Microscope)
25. Determination of Youngs Modulus – Non-Uniform bending (Scale & Telescope)
26. Asymmetric Compound Pendulum- Determination of moment of inertia and Acceleration due to gravity (g)
27. Symmetric Compound Pendulum - Determination of Radius of gyration and moment of inertia
28. Torsion pendulum (Equal mass method) - Rigidity modulus and Moment of Inertia
29. Conversion of Galvanometer into voltmeter
30. Carey Foster's Bridge -Measurement of resistivity
31. Tangent Galvanometer – Ammeter calibration
32. Potentiometer-Calibration of low range ammeter
33. Potentiometer – Resistance of a wire

SEMESTER III & IV

CDPM2P02: OPTICS AND ELECTRONICS

Credit: 2 **Total Hours: 72**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Identify and distinguish experiments pertaining to different branches of physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	1	-	-	2	-	-	-	1	2	-
CO2	Understand	1	-	-	2	-	-	-	1	2	-
CO3	Apply	1	-	-	2	-	-	-	1	2	-
CO4	Analysis	1	-	-	2	-	-	-	1	2	-
CO5	Evaluate	1	-	-	2	-	-	-	1	2	-
Average		**1**	**-**	**-**	**2**	**-**	**-**	**-**	**1**	2	-

1. Spectrometer – Dispersive power of prism
2. Spectrometer – Grating - wavelengths
3. Newton’s rings -Wave length
4. Construction of full wave rectifier (center-tap) with and without filter – Ripple factor
5. Construction of regulated power supply using Zener diode- line and load regulation
6. Spectrometer - Refractive Index of material of prism.
7. Diode characteristics- ac and dc resistance
8. Characteristics of Zener diode
9. Construction of half wave rectifier with and without filter – Ripple factor
10. Laser- Transmission OR Reflection Grating- Determination of wavelength
11. Liquid lens – optical constants of a lens

12. Laser diffraction- width of single slit OR thickness of wire
13. Refractive index of liquid- Liquid Lens
14. Air wedge-thickness of wire
15. Gates – AND, OR, NOT- verification of truth tables

COMPLEMENTARY COURSES IN PHYSICS FOR

BSc CHEMISTRY PROGRAMME

SEMESTER – I

CDPC101 – MECHANICS AND PROPERTIES OF MATTER

Credits – 2 **Total hours – 36**

Course Outcomes

On successful completion of the course, the student will be able to:

CO1: Describe rotational motion, moment of inertia of rigid bodies and **apply** the ideas to relevant problems

CO2: Describe the differential equation for SHM and **apply** it to find the energy of an oscillating system

CO3: Describe elasticity and **apply** it to bending and twisting of a bar or rod

CO4: Describe laboratory methods of finding the modulus of elasticity

CO5: Describe fluid flow and **apply** Bernoulli's equation to fluids

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Apply	-	3	2	-	-	2	-	2	-	-
CO2	Apply	-	3	-	-	-	2	-	2	-	-
CO3	Apply	-	3	2	-	-	2	-	2	-	-
CO4	Understand	-	3	-	-	-	2	-	1	-	-
CO5	Apply	-	3	3	-	-	2	-	2	-	-
Average		**-**	**3**	**2.3**	**-**	**-**	**2**	**-**	**1.8**	**-**	**-**

Module 1: Rotational dynamics of rigid bodies and Oscillations (18 hours)

Angular displacement; angular velocity; angular momentum, torque- conservation of angular momentum- angular acceleration, rotational kinetic energy, Moment of inertia- parallel and perpendicular axes theorems, Calculation of moment of inertia of rod, ring, disc, cylinder and sphere, Flywheel- moment of inertia and experimental set up, Simple harmonic motion, Differential equation- expression for displacement, velocity and acceleration- graphical

representation, Energy of a particle executing simple harmonic motion, Differential equation and solutions of forced and damped oscillators

Module 2: Elastic Properties of Materials and Hydrodynamics (18 hours)

Young's modulus- bulk modulus-rigidity modulus, Uniform and non-uniform, Bending moment-flexural rigidity, Bending- cantilever method, Twisting couple- torsional rigidity, Rigidity modulus using static and dynamic methods, Streamline flow, Viscosity, Bernoulli's theorem, Torricelli's theorem, Venturi tube, The siphon

Textbook:

1. H.S.Hans and S.P.Puri, Mechanics, Tata McGraw-Hill
2. Brijlal and N. Subrahmanyam, Properties of Matter, S. Chand and Co.
3. M.D. Raisinghania, Fluid dynamics: with complete hydrodynamics and boundary layer theory, S. Chand, 12/e

Referances

- Elements of properties of matter – D S Mathur, S. Chand (2010)
- Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

Course designed by: Dr. Loji K Thomas

CDPC202: ELECTRIC AND MAGNETIC PHENOMENA, THERMODYNAMICS AND ERROR ANALYSIS

Credit: 2 **Total Hours: 36**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: Describe the electric and magnetic properties of materials

CO2: **Classify** and **compare** different magnetic materials

CO3: **Describe** thermodynamic systems, processes and laws

CO4: Describe the principles of thermodynamics and **apply** them in different physical situations

CO5: **Evaluate** errors and uncertainties in experimental measurements

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Remember	3	-	-	-	-	3	-	-	-	-
CO2	Understand	3	3	-	-	-	3	-	-	-	-
CO3	Remember	3	-	-	-	-	3	-	-	-	-
CO4	Apply	3	-	2	-	-	3	-	3	-	-
CO5	Evaluate	3	-	-	-	-	3	-	3	-	-
Average		**3**	**3**	**2**	**-**	**-**	**3**	**-**	**3**	**-**	-

Module 1: Dielectric and Magnetic Properties of Solids (12 Hours)

Review of Basic Equations, Dielectric Constant, Dipole Moment and Polarizability, Clausius-Mossotti Relation and Ferroelectricity, Classification of Magnetic Materials, Langevin's theory and paramagnetism, Curie-Weiss law and Curie temperature, Antiferromagnetism and Ferrimagnetism, Magnetisation and Magnetic Domain Structure

Module: 2 Thermodynamics (12 hours)

Thermodynamic systems, Thermodynamic equilibrium,Thermodynamic processes – isothermal process and adiabatic process,Work done in isothermal process and adiabatic process, Zeroth law of thermodynamics, First law of thermodynamics, The Carnot engine – Carnot cycle, work done in a cycle and efficiency, Refrigerator – coefficient of performance, Concept of entropy, Second and third law of thermodynamics

Module 3: Error Analysis (12 hours)

Basic ideas of uncertainties and measurements, Dominant errors,random errors and systematic errors, Significant figures, Absolute, relative and percentage errors, Standard deviation , Estimating and reporting errors - best estimate, Error bars and graphical representation - checking relationships with a graph, Propagation of errors – sum and differences, products and quotients, powers, multiplying by constants, Independent uncertainties in sum and product, Least count of instruments

Text Books:

1. Elementary Solid-State Physics: Ali Omar (Pearson)
2. Heat and Thermodynamics- Brijlal and Subrahmanyam (S. Chand &Co)
3. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, John R. Taylor - Univ. Science Books

References

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta
2. Solid State Physics, P.K. Palanisamy, Scitech publications
3. Solid State Physics, R.K Puri & V.K. Babber, S. Chand
4. Modern Physics- R. Murugeshan (S. Chand and Co.)
5. Introduction of Electrodynamics- D.J. Griffiths (PHI Pvt. Ltd)
6. Modern Physics- G. Aruldas and P. Rajagopal (PHI Pub)
7. Thermodynamics- Zemansky and Dittmann (Tata McGraw-Hill)

Course designed by : Benny Joseph

CDPC303: QUANTUM MECHANICS, SPECTROSCOPY, NUCLEAR PHYSICS AND NUCLEAR MEDICINE

Credits – 3 **Total hours – 54**

Course Outcomes

On successful completion of the course, the students will be able to:

C01: **Explain** the basics of Quantum mechanics and apply them to **solve** relevant problems, different atom models and its application in spectroscopy

C02: **Explain** the basics of rotational and vibrational spectroscopy, theory and applications of Raman spectroscopy.

C03: **Describe** various properties of atomic nuclei and nuclear forces

C04: **Describe** radioactivity, laws governing radioactivity, nuclear fission and fusion and its applications

C05: **Explain** Biological Effects of radiation and its application in Nuclear medicine

Course Mapping Table

	Cognitive Level	**PS O1**	**PS O2**	**PS O3**	**PS O4**	**PS O5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Apply	3	2	3	1	-	3	2	-	-	-
CO2	Apply	2	3	2	1	1	1	1	2	-	1
CO3	Understand	2	2	1	1	-	2	2	1	1	-
CO4	Understand	2	2	1	1	-	2	2	1	1	1
CO5	Understand	3	2	1	2	-	1	3	-	2	-
		2.4	**2.2**	**1.6**	**1.2**	**0.2**	**1.8**	**2**	**0.8**	**0.8**	0.4

Module-1 Elementary Quantum theory (23 hours)

Failure of classical mechanics and need for quantum mechanics-stability of atom, blackbody radiation associated laws, Planck's explanation, Photoelectric effect, Compton effect, de Broglie hypothesis, matter wave- Davisson-Germer experiment, uncertainty principle

(derivation not expected) - description of a wave, wave packet, Operators in quantum mechanics,wave function-properties, Formulation of Schrodinger equation time independent and time dependent Solution of Schrodinger equation, Particle in 1D box, 3D box-derivation of wave function, energy, brief discussion on applications in quantum dots.

Atom models- Thomson's model-Rutherford's nuclear atom model, Bohr atom model-Somerfeld's relativistic atom model, Vector atom model- Fine structure of Hydrogen atom, Rotational and vibrational spectra of rigid diatomic molecules, Raman effect-classical explanation, Raman spectrometer, usage in materials science.

Module-2. Atomic nucleus and radioactivity(12 hours)

Nuclear constituents, Different nuclear types, Properties of nuclei- size, mass, charge, density Binding energy- packing fraction Nuclear stability Spin - Magnetic dipole moment, Electric quadrupole moment Properties of nuclear forces Radioactivity Radiations - law of radioactive decay Half-life, Mean life, Radioactivity units, Radioactive series Radioactive dating- carbon dating Artificial radioactivity

Nuclear Fission and Fusion (9 hours)

Nuclear fission, Energy release in fission reactions, Liquid drop model of fission chain reaction, Nuclear reactor, power and breeder reactor- atom bomb, nuclear fusion, Energy production in stars, Thermonuclear reactions in sun- p-p chain - C-N cycle

Module-3.Biological Effects of radiation and Physics of Medicine (10 hours)

Ionizing Radiation and nonIonizing Radiation,Factors affecting biological activity of radiations, Dose, Dose Rate and dose distribution, Damage to Critical Tissues, Human exposure to radiation, Nuclear medicine: Projection imaging,: Physics of medicine-X-ray radiography, Gamma Camera, Imaging with internal radiation, Computed Tomography, Magnetic resonance imaging (MRI), Radiation therapy using e beam, neutrons,

Text Book:

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta

2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

3. Nuclear Physics, Principles and applications-John Lilley, Wiely 2006

Reference

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)

2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
3. Modern Physics- R. Murugeshan (S. Chand and Co.)
4. Quantum Physics- S. Gasiorowicz (John Wiley & Sons)

Course designed by: Dr Sinu Mathew,

CDPC404 – PHYSICAL OPTICS, LASER PHYSICS AND SUPERCONDUCTIVITY

Credits – 3 Total hours **– 54**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: **Explain** superposition principle, interference and diffraction of electromagnetic radiation and **apply** interference to thin films, diffraction to optical phenomena occurring in glass

CO2: **Explain** superposition principle and recognize the various light interference processes

CO3: **Explain** the concepts, features, technical terms, different methods, techniques, materials and types of polarization of light and **apply** the concepts and rules to solve numerical problems

CO4: **Discuss** the basic concept, working and applications of LASER

CO5: **Discuss** the basic properties of Superconductors, BCS theory and applications of Superconductors

Course Mapping Table

	Cognitive Level	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	Apply	2	1	2	1	-	2	2	2	-	1
CO2	Apply	2	1	2	1	-	2	1	2	-	1
CO3	Apply	2	-	-	1	-	2	-	2	-	-
CO4	Understand	2	2	1	-	-	2	2	1	1	-
CO5	Understand	2	2	1	-	-	2	2	1	1	-
Average		2	1.5	1.5	1	-	2	1.75	1.6	1	1

Module-1. Interference and Diffraction (18hrs)

Interference of light-Principle of superposition, Coherent sources- Young's double slit experiment, Newton's rings theory Newton's rings- experimental details, applications, Interference in thin films-Reflected light, Diffraction basic ideas, Fresnel and Fraunhofer diffraction-Theory of plane transmission grating, Resolving power- Dispersive power of microscope

Module-2. Polarization (18hrs)

Introduction- polarized and unpolarized light- plane of vibration –plane of polarization, polarization by reflection- Brewster's law-polarization by refraction through pile of plates – law of Malus, Polarization by scattering, polarization by selective absorption, Uni-axial and biaxial crystals – double refraction- principal plane- polarization by double refraction, polaroid-Elliptically and circularly polarized light, Quarter wave plate – Half wave plate

Module-3 Laser Physics and Superconductivity(18hrs)

Interaction of electromagnetic radiation with matter, Stimulated absorption, spontaneous emission, stimulated emission. Principle of laser-population inversion, Einstein's Coefficients, - Types of lasers- Ruby laser -Neodymiun YAG laser- He-Ne laser- Properties of laser beams- Application of laser beams

Superconducting phenomenon- Occurrence, BCS theory (qualitative) , Meissner Effect- Type I and Type II superconductors, Josephson effects, High temperature superconductors- Applications of Superconductivity

Text Book:

1. A text book of optics- N. Subrahmanyam, Brijlal and M.N.Avadhanulu S Chand & Co Ltd

2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

Reference

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
2. Optics- A. Ghatak (Tata McGraw-Hill)

Course designed by: , Mr. Justin John

PRACTICAL

SEMESTER I & II

CDPC2P01: GENERAL PHYSICS PRACTICAL

Credit: 2 **Total Hours: 72**

On successful completion of the course, the students will be able to:

CO1: Identify and distinguish experiments pertaining to different branches of physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	1	-	-	2	3	-	-	1	2	-
CO2	Understand	1	-	-	2	3	-	-	1	2	-
CO3	Apply	1	-	-	2	3	-	-	1	2	-
CO4	Analysis	1	-	-	2	3	-	-	1	2	-
CO5	Evaluate	1	-	-	2	3	-	-	1	2	-
Average		**1**	**-**	**-**	**2**	**3**	**-**	**-**	**1**	2	-

1. Vernier Calipers -- Volume of cylinder (solid and hollow), sphere.
2. Screw gauge – Radius of wire, volume of sphere and glass piece
3. Beam balance - Mass of a solid (sensibility method)
4. Spectrometer – Angle of the Prism
5. Hare’s Apparatus, U Tube – density of liquids
6. Coefficient of viscosity of the liquid – Constant Pressure head method
7. Coefficient of viscosity Variable Pressure head method
8. Surface Tension – Capillary rise method
9. Determination of Young’s Modulus- Cantilever (Scale and Telescope)
10. Fly wheel – Moment of Inertia
11. Torsion pendulum -Rigidity modulus
12. Determination of moment of inertia of rotationally symmetric body (solid sphere
13. OR cylinder OR disc) from their period of oscillation on a torsion axle

14. Spring constant - Hooke's law - oscillation
15. Resistivity of the material of the wire- Ohm's law and verification by multimeter
16. Poisson's ratio of rubber
17. Symmetric Compound pendulum – Acceleration due to gravity
18. Temperature dependence of capacitance- polymer and ceramic capacitors.
19. Potentiometer – standardization
20. Static Torsion - Rigidity modulus
21. Deflection and Vibration Magnetometer-m & Bh
22. Field along the axis of circular coil- determination of Bh
23. Searle's Vibration Magnetometer - magnetic moment
24. Resistance of a galvanometer and its figure of merit
25. Determination of Young's Modulus- Cantilever (Pin & Microscope)
26. Determination of Youngs Modulus – Non-Uniform bending (Scale & Telescope)
27. Asymmetric Compound Pendulum- Determination of moment of inertia and
28. Acceleration due to gravity (g)
29. Symmetric Compound Pendulum - Determination of Radius of gyration and moment of inertia
30. Torsion pendulum (Equal mass method) - Rigidity modulus and Moment of Inertia
31. Conversion of Galvanometer into voltmeter
32. Carey Foster's Bridge -Measurement of resistivity
33. Tangent Galvanometer – Ammeter calibration
34. Potentiometer-Calibration of low range ammeter
35. Potentiometer – Resistance of a wire

SEMESTER III & IV

CDPC2P02: OPTICS AND ELECTRONICS

Credit: 2 **Total Hours: 72**

On successful completion of the course, the students will be able to:

CO1: Identify and distinguish experiments pertaining to different branches of physics

CO2: Describe the experimental goals, process, data, results, and conclusions

CO3: Collect data and revise the experimental procedure iteratively and responsively

CO4: Analyse the process and outcomes of an experiment quantitatively and qualitatively

CO5: Draw inferences from analyses conducted

Course Mapping Table

	Cognitive Level	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	Remember	1	-	-	2	3	-	-	1	2	-
CO2	Understand	1	-	-	2	3	-	-	1	2	-
CO3	Apply	1	-	-	2	3	-	-	1	2	-
CO4	Analysis	1	-	-	2	3	-	-	1	2	-
CO5	Evaluate	1	-	-	2	3	-	-	1	2	-
Average		**1**	**-**	**-**	**2**	**3**	**-**	**-**	**1**	2	-

1. Spectrometer – Dispersive power of prism
2. Spectrometer – Grating - wavelengths
3. Newton’s rings -Wave length
4. Construction of full wave rectifier (center-tap) with and without filter – Ripple factor
5. Construction of regulated power supply using Zener diode- line and load regulation
6. Spectrometer - Refractive Index of material of prism.
7. Diode characteristics- ac and dc resistance
8. Characteristics of Zener diode
9. Construction of half wave rectifier with and without filter – Ripple factor
10. Laser- Transmission OR Reflection Grating- Determination of wavelength
11. Liquid lens – optical constants of a lens
12. Laser diffraction- width of single slit OR thickness of wire
13. Refractive index of liquid- Liquid Lens
14. Air wedge-thickness of wire

15. Gates – AND, OR, NOT- verification of truth tables

OPEN COURSE

COPH501 – PHYSICS IN DAILY LIFE

Credits- 3 **Total hours- 54**

Course Outcomes

On successful completion of the course, the students will be able to:

CO1: **Describe** the basic concepts in linear and rotational dynamics and apply them to various real-life situations,

CO2: Explain the basic concepts and laws related to work, energy and power

CO3: Describe the fundamentals phenomenon and laws associated with light and optical instruments

CO4: **Explain** the basic laws and rules in connection with electricity, electrical energy and power and **apply** them to solve simple problems

CO5: **Explain** the basic laws and rules of fluids and fluid motion and **apply** them to solve simple problems

Module 1: Motion and Waves (18 hours)

Velocity, acceleration, momentum, Idea of inertia, force laws of motion, Newton's law of gravitation, acceleration due to gravity, mass and weight, apparent weight, weightlessness, Work-power kinetic energy-potential energy-conservation of energy, Rotational motion, Moment of inertia, torque, centripetal and centrifugal force, banking of curves, centrifugal pump, roller coasters, transverse and longitudinal waves, sound waves, Doppler Effect.

Module 2: Light (18 hours)

Reflection, refraction, interference, diffraction and scattering, Apparent depth, blue colour of sky, twinkling of stars, Total internal reflection-optical fiber, mirage, sparkling of diamond, rainbow, Mirrors, lenses, prism, dispersion, Myopia, hypermetropia, presbyopia and astigmatism, Fluorescence, phosphorescence, laser, Electromagnetic waves, radar, microwave oven.

Module 3: Electricity and Energy, Fluids and Heat (18 hours)

Voltage and Current, Ohm's Law, Electric Energy, Electric Power, Calculation of energy requirement of electric appliances, Transformers and Generators, Hydroelectric power generation – wind power – solar power – nuclear power, Phases of matter, Fluids, Surface

Tension, Viscosity, Capillary rise, Bernoulli's theorem and Applications, Heat Energy and Temperature, Temperature scales – Degree Celsius, Fahrenheit and Kelvin

Text Books

1. Fundamentals of Physics with Applications by Arthur Beiser, TMH
2. Conceptual Physics by Paul G Hewitt, Pearson

References

1. Everyday Physics by Ho Hermaus, UIT Cambridge
2. The Physics of everyday things by James Kakalios, Crown Publishers, 2017, New York
3. From Physics to daily life by Beatrice Bressan, John Wily & Sons
4. Fundamentals of Physics by Halliday, Resnik and Walker, John Wiley & sons

Programme Articulation Table

Course Code	Course Title	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5
Core Courses											
CBPH101	FOUNDATION COURSE IN PHYSICS	2.50	2.50	1.25	1.75	2.00	2.00	2.50	2.25	2.00	0.00
CBPH202	MECHANICS AND PROPERTIES OF MATTER	2.6	2	3			2.8	2	3		
CBPH303	BASIC ELECTRONICS	2.5	2.5	1.25	1.75		2	2.5	2.25	2	
CBPH404	CLASSICAL MECHANICS AND RELATIVITY	2	2.4	2.5	1.5	0	1.6	1	1.75	1	0
CBPH505:	ELECTRICITY AND ELECTRODYNAMICS	3	3	1.5			2		2		
CBPH506:	PHYSICAL OPTICS AND PHOTONICS	3	2.2	1.75	1	2	3	1.67	2.25	1	-
CBPH507:	ENVIRONMENTAL SCIENCE, CLIMATE CHANGE AND RENEWABLE ENERGY SOURCES	2.2	2.2	1.4	1.5	1	2.2	1.4	1.6	2	2
CBPH508:	BASIC QUANTUM MECHANICS AND SPECTROSCOPY	3	2.4	2.8	2.4	2	2.6	1.6	2.6	1	-
CBPH609:	THERMODYNAMICS AND STATISTICAL PHYSICS	3	3	2			2.25		2		
CBPH610:	NUCLEAR AND PARTICLE PHYSICS	1	2	1.8	1	1	1	1.6	1.5	1	1
BPH611:	CONDENSED MATTER PHYSICS	2.5	2.5	1.25	1.75		2	2.5	2.25	2	
CBPH612:	LINEAR INTEGRATED CIRCUITS, DIGITAL ELECTRONICS, C++ PROGRAMMING	2.8	2.25	2.3	2	1.5	2.8	1	2.5		1
CBPH6E01	NANOSCIENCE AND NANOTECHNOLOGY	2.5	2.5	1.25	1.75		2	2.5	2.25	2	
CBPH6E02:	ASTRONOMY ASTROPHYSICS AND COSMOLOGY	1.4	2	2			1.4	1.5	1	1	
CBPH2P01:	MECHANICS AND PROPERTIES OF MATTER	3	3	3	3		3		3		
CBPH4P02:	BASIC ELECTRONICS PRACTICAL	3	3	3	3		3		3		
CBPH5P03:	ELECTRICITY, MAGNETISM AND THERMAL PHYSICS PRACTICAL	3	3	3	3		3		3		
CBPH5P04:	DIGITAL ELECTRONICS PRACTICAL	3	3	3	3		3		3		
CBPH6P05:	COMPUTATIONAL PHYSICS PRACTICAL	3	3	3	3		3		3		
CBPH6P06:	OPTICS AND PHOTONICS PRACTICAL	3	3	3	3		3		3		

Complementary Course: (Mathematics)

CDMP101	MATHEMATICS FOR PHYSICS I	2	1	1.4	1	-	1.8	1.6	1.6	1	-
CDMP202	MATHEMATICS FOR PHYSICS II	2	1.6	1.6	1	-	1.8	1.4	1.8	1	-
CDMP303	MATHEMATICS FOR PHYSICS III	1.4	1.2	1.6	1.4	-	2	1	2	1	-
CDMP404	MATHEMATICS FOR PHYSICS IV	1.6	1	1.6	2	-	1	1		1	-
Complementary Course: (Chemistry)											
CDCP101	BASIC ANALYTICAL AND MATERIAL CHEMISTRY	1.60	1.00	1.33	1.00	1.50	1.80	1.60	1.50	-	1.00
CDCP202	BASIC ORGANIC CHEMISTRY	1.60	1.00	1.50	1.00	1.00	2.00	1.00	1.33	-	-
CDCP2P01	VOLUMETRIC ANALYSIS (P)	1	1	1	1	1	1	1	1.5	1	1.5
CDCP303	ADVANCED PHYSICAL CHEMISTRY - I	1.6	1.00	1.5	1.00	0	1.6	1.75	1.66	1.00	-
CDCP404	ADVANCED PHYSICAL CHEMISTRY - II	1.40	1.67	1.00	1.00	-	1.40	1.60	1.40	1.00	-
CDCP4P02	PHYSICAL CHEMISTRY EXPERIMENTS	1	1	1.2	1.6	1	1	1	1.6	1.2	1.6
Common Course English											