GOVERNMENT COLLEGE FOR WOMEN
(AUTONOMOUS)
KUMBAKONAM-612 001

PG & RESEARCH DEPARTMENT OF PHYSICS

PROGRAMME : M.Sc.,PHYSICS

PROGRAMME CODE :PSPH

SYLLABUS

2021 - 2022 - I YEAR

2022 - 2023 - II YEAR

PROGRAMME OUTCOMES (POs)

1. Knowledge Development.
2. Employability skills.
3. Developing new projects and designs.
4. Experimental Skills.
5. Grooming the candidates to explore knowledge independently.
6. Design and conduct of demos/create models to analyze/interpret data.
7. Acquire the expertise to solve any dynamical system.
8. Develop skills to contribute to R&D.
9. Groomed to collate information from different sources and gain coherent understanding of the subject.
10. Groomed to become professionally competent to develop independent thinking.
11. Inculcate the skills to exploit learning resources including libraries, e-resources etc.to stay abreast of recent developments.
12. To help the students accomplish tasks either individually or as member of a group in multidisciplinary settings.
13. Framing of the curriculum, to inculcate ethical values, social responsibility professional competence, pragmatic wisdom, commitment to nation in the area of science and technology.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Problem solving skills
2. Learn basics of core and applied physics.
3. Exposure to classical,quantum,mathematical,statistical, condensed matter, electromagnetic theory and nuclear physics.
4. Specialized understanding of advanced topics like Nonlinear Dynamics, crystal growth, thin films and nano materials.
5. Expertise to develope coding skills and numerical simulation.
6. Developing extra disciplinary/interdisciplinary skills to understand natural phenomena.
7. Research aptitude towards experimental and theoretical physics.
8. Explore avenues of research in Institute of Plasma Research (IPR),Physical Research Laboratory(PRL),Institute of Physics (IOP),Saha Institute of Nuclear Physics(SINP), Raman Research Institute(RRI), IISc,IISER,CECRI,etc.

GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS) KUMBAKONAM

(Curriculum – M.Sc., PHYSICS – 2021 – 2022)

Department: PHYSICS **ProgrammeCode : PSPH**

SEMESTER - I									
Course Type		**Course Code**	**Title of the Course**	**Hrs/ Week**	**Credits**	**Exam Hrs**	**Marks**		
							CIA	**ESE**	**Total**
Core - I		P21PHC101	Classical Dynamics & Relativity	6	5	3	25	75	100
Core - II		P21PHC102	Mathematical Physics	6	5	3	25	75	100
Core- III		P21PHC103	Numerical Methods	5	5	3	25	75	100
Core - IV		P21PHC104P	General Experiments	6	3	4	40	60	100
Major Based Elective - I	Choice I	P21PH1MBE1:1	**1.Analog Electronics,Microprocessor and Microcontroller**	5	4	3	25	75	100
	Choice II	P21PH1MBE1:2	2.Advanced Microprocessor and its Applications						
	Choice III	P21PH1MBE1:3	3. Digital Electronics and Basic of microprocessors						
Skill Enhancement (Theory)		P21PH1SE1	Document Preparation System - Latex (Theory)	2	2	2	25	75	100
Total				**30**	**24**				**600**

SEMESTER - II									
Course Type		**Course Code**	**Title of the Course**	**Hrs/ Week**	**Credits**	**Exam Hrs**	**Marks**		
							CIA	**ESE**	**Total**
Core - V		P21PHC205	Statistical Mechanics	5	5	3	25	75	100
Core - VI		P21PHC206	Quantum Mechanics	5	5	3	25	75	100
Core - VII		P21PHC207	Programming in C++	5	5	3	25	75	100
Core - VIII		P21PHC208P	Electronic Experiments	6	3	4	40	60	100
Major Based Elective - II	Choice I	P21PH2MBE2:1	**1. Experimental Techniques and Instrumentation**	5	4	3	25	75	100
	Choice II	P21PH2MBE2:2	2. Data Acquisition and control Systems						
	Choice III	P21PH2MBE2:3	3. Advanced Measurement and Instrumentation						
Extra Disciplinary Course (EDC)		P21PH2ED	Reactor Physics	2	2	3	25	75	100
Skill Enhancement (Practical)		P21PH2SE2P	Document Preparation System - Latex (Practical)	2	1	2	40	60	100
Self study Course – I		P212SS1	General Studies for Research Fellowships and Lectureship	-	2	2	-	100	100
			Total	**30**	**25**				**800**
NCGPA (Internship)		INT			**2**		**-**	**-**	**-**

SEMESTER - III									
Course Type		**Course Code**	**Title of the Course**	**Hrs/ Week**	**Credits**	**Exam Hrs**	**Marks**		
							CIA	**ESE**	**Total**
Core - IX		P21PHC309	Atomic and Molecular Spectroscopy	6	5	3	25	75	100
Core - X		P21PHC310	Electromagnetic Theory	6	5	3	25	75	100
Core - XI		P21PHC311	Nuclear and Particle Physics	6	5	3	25	75	100
Core - XII		P21PHC312P	Digital Electronics - I	6	3	4	40	60	100
Major Based Elective - III	Choice I	P21PH3MBE3:1	1. **Communication Electronics** 2. Integrated Electronics 3. Antenna theory and Radio wave propagation	6	4	3	25	75	100
	Choice II	P21PH3MBE3:2							
	Choice III	P21PH3MB3:3							
			Total	**30**	**22**				**500**
Self study Course – II		P21PH3SS2	Any Course on MOOC/NPTEL	-	2	2	-	100	100

SEMESTER - IV									
Course Type		**Course Code**	**Title of the Course**	**Hrs/ Week**	**Credits**	**Exam Hrs**	**Marks**		
							CIA	**ESE**	**Total**
Core - XIII		P21PHC413	Condensed Matter Physics	6	6	3	25	75	100
Core - XIV		P21PHC414P	Program with Microprocessor, Microcontroller and C++ Program	6	3	4	40	60	100
Core - XV		P21PHPW415	Project	12	6	-	25	75	100
Major Based Elective - IV	Choice I	P21PH4MBE4:1	1. **Crystal Growth, Thin film and Nanoscience** 2. Thin film science and Technology 3. Nano photonics	6	4	3	25	75	100
	Choice II	P21PH4MBE4:2							
	Choice III	P21PH4MBE4:3							
			Total	**30**	**19**				**400**

COURSE STRUCTURE ABSTRACT FOR

M.SC., PROGRAMME 2020 – 2021 ONWARDS

PART	COURSE	TOTAL NO PAPERS	HOURS	CREDIT	MARKS
III	Core Course (CC)	14	80	63	1400
III	Core Project	1	12	6	100
III	Major Based Elective Course (MBEC)	4	22	16	400
III	Extra Disciplinary Course (EDC)	1	2	2	100
III	Skill Enhancement Course	2	4	3	200
	Total	**22**	**120**	**90**	**2200**
Extra Credit Courses					
Self Study Course (SSC)		2	-	4	200
Internship (NCGPA Course)		--	---	2	---
Value Added Course		1	--	2	100
Total		3		**98**	**2500**

CORE COURSE (CC)-I -CLASSICAL DYNAMICS AND RELATIVITY

Theory Hours	**: 6**	**Course Code**	**: P21PHC101**
Practical Hours	**: -**	**Credits**	**: 5**
Exam Hours	**: 3**	**Marks**	**:CIA ESE**
			25 75

OBJECTIVES:

- To introduce different formulations of classical dynamics with linear and Non-linear oscillations.
- To understand the importance of concepts such as generalized coordinates and constraints.
- To study the dynamics of rigid body in detail and obtain regarding Euler's equation of motion.
- To solve any dynamical system using Lagrangian and Hamiltonian formulations.
- To introduce the concepts of nonlinearity and ubiquitous nature.
- To understand the theory of relativity and its ramifications.

UNIT –I: FUNDAMENTAL PRINCIPLES AND LAGRANGIAN FORMULATION

Mechanics of a particle and system of particles- Conservation laws-Constraints-Generalised coordinates-D'Alembert's principle and Lagrange's equation with holonomic constrains - Application- Atwood's Machine - Simple pendulum.

UNIT - II: LAGRANGIAN FORMULATION: APPLICATIONS

a) Rigid body dynamics

Euler angles- Moments and products of inertia-Euler's equations-Symmetrical top.

b) Oscillatory Motion

Theory of small oscillations-Normal modes and frequencies- Two coupled harmonic oscillators-Linear triatomic molecule.Wave motion-Wave equation - Dispersion - Phase velocity-group velocity.

UNIT - III: HAMILTON'S FORMULATION

Hamilton's canonical equations of motion-Hamiltonian Principle -Hamilton's equations fromthevariational principle-Principle of Least action-Canonical transformations -Poisson brackets - Hamilton- Jacobi method - Kepler problem.

UNIT- IV: NONLINEAR DYNAMICS

Dynamical systems-Mathematical implications of nonlinearity - regular and chaotic motion-linear and nonlinear oscillators, Phase trajectories– Classification of fixed points and limit cycles-Period doubling bifurcation and onset of chaos in Duffing Oscillator

Solitons - Derivation of cnoidal waves (solitary waves) of K-dv equation – AKNS eigen value problem and derivation of K-dV, MKdV equation.

UNIT - V: RELATIVITY

Lorentz transformation - need of special theory of relativity-four vectors– Minkowski's four dimensional spaces-Lorent's transformation as rotation– Minkowski's space Lagrangian formulation in relativistic mechanics– Invariance of Maxwell's equations under Lorentz transformation.

BOOKS FOR STUDY:

1. Classical Dynamics, Gupta Kumar, PragatiPrakashan Publication (2012).
2. Mathematical Physics with Classical Mechanics, SathyaPrakash,Sultan Chand and Sons Publication; Sixth edition (2014).
3. Nonlinear Dynamics,M.Lakshmanan& S. Rajasekar,Springer edition (2002)
4. Classical Mechanics - J. C. Upadhyaya.Himalaya publishing House,(2014)
5. Classical Mechanics- N.C.Rana and P.S.Joag., , Tata Mc Graw Hill, New Delhi. (2015)
6. Dynamics – P.S. Puranik& R.G. Takwale, Tata Mc Graw Hill (1979).

BOOKS FOR REFERENCE:

1. Classical Mechanics, H.Goldstein, Narosa Book Distributors, New Delhi (1980).

COURSE OUTCOMES (COs):

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

CO1: Acquire fundamental knowledge of classical dynamics.

CO2: Use D'Alemberts principle to drive the lagrange equations of motion.

CO3: Understand theory of small oscillations in normal modes and their frequencies.

CO4: UnderstandtheLagrangian and Hamiltonian methods.

CO5: Understand the basic ideas of Solutions.

CO6: Gain the knowledge of relativity and its consequences.

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓		✓	✓	
	CO 2	✓		✓		✓		✓		✓		✓			✓		✓		✓	✓	✓	
	CO 3	✓		✓	✓	✓	✓	✓				✓			✓	✓	✓		✓	✓	✓	
	CO 4	✓		✓		✓	✓				✓	✓		✓	✓	✓	✓		✓	✓	✓	
	CO 5	✓		✓	✓			✓				✓					✓	✓	✓	✓	✓	
	CO 6	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓			✓	✓	✓	✓	✓	✓	

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)

Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

CORE COURSE (CC)-II-MATHEMATICAL PHYSICS

Theory Hours	**: 6**	**Course Code**	**: P21PHC102**
Practical Hours	**: -**	**Credits**	**: 5**
Exam Hours	**: 3**	**Marks**	**:CIA ESE**
			25 75

OBJECTIVES:

- To develop expertise in mathematical techniques required in physics.
- To enhance problem solving skills and determine the solutions for variation problems arising in physics.
- To provide extensive mathematical formalism for understanding and interpreting various physical problems.

UNIT I: VECTOR FIELDS AND VECTOR SPACES

Gauss Theorem, Green's Theorem, Stoke's Theorem and applications – Orthogonal curvilinear coordinates – Expressions for Gradient, Divergence, Curl and Laplacian in Cylindrical, Spherical and Rectangular co-ordinates – Linear dependence and Linear independence of vectors – Change of Basis – Schmidt's orthogonalisation process– Schwartz inequality.

UNIT II: TENSORS AND MATRIX THEORY

Transformation of coordinates – Summation convention – Contravariant, covariant and mixed tensors – Rank of a tensor – Symmetric and antisymmetric tensors – contraction of tensor – Characteristic equation of a matrix – Eigen values and eigenvectors – Cayley – Hamilton theorem-Reduction of a matrix to diagonal form – Jacobi method – Sylvester's theorem.

UNIT III: COMPLEX ANALYSIS

Functions of complex variables – Differentiability – Cauchy–Riemann conditions – Complex integration – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series – Residues and singularities –Cauchy's residue theorem – Evaluation of definite integrals.

UNIT IV: SPECIAL FUNCTIONS

Gamma and Beta functions –Legendre, Bessel, and Hermite differential equations:– Rodriguez formula – Generating functions – Orthogonality relations – Important recurrence relations.

UNIT V: GROUP THEORY

Multiplication table – Subgroups, Cosets and Classes – Direct Product groups – Point groups – Space groups – Representation theory – Homomorphism and isomorphism– Reducible and irreducible representations – Schur's lemma – The great Orthogonality theorem – Character table – C3v and D3h as examples – Elementary ideas of rotation groups.

BOOKS FOR STUDY:

1. Mathematical Physics - Sathyaprakash, Sultan Chand and sons, 6th revised edition, New Delhi, (2014).
2. Mathematical Physics -H. K. Dass, S. Chand and Co., New Delhi, 2003.
3. Mathematical Physics - B.D.Gupta, Vikas publishing house Pvt.Ltd.(1995).
4. Mathematical Physics - B.S.Rajput, 20th Edition, PragathiPrakashan (2008).
5. Matrices and Tensors in Physics - A.W.Joshi, Wiley Eastern Ltd., New Delhi, (1975).
6. Mathematical Physics - P.K.Chattopadhyay, Wiley Eastern Ltd., New Delhi (1990).
7. Chemical Applications of Group Theory - F.A. Cotton, (Wiley Eastern, New Delhi, 1990, 3rd Edition).

BOOKS FOR REFERENCE:

1. Mathematical Physics- Eugene Butkov, Addison Wesley, London (1973).
2. Applied Mathematics for Engineers and Physicists - L.A.Pipes and L.R. Harvill, McGraw Hill Company, Singapore (1967).
3. Mathematical Methods for Physicists - G.Arfken and H.J. 4thed. Physicists (Prism Books, Bangalore, (1995).
4. Mathematical Physics – V.Balakrishnan. Ane Books Pvt. Ltd.(2018)

COURSE OUTCOMES (COs):

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

CO1: Acquire Knowledge of vector calculus for application to problems in Electromagnetic theory, Fluid dynamics etc.
CO2: Basics of Tensors and its applications.
CO3: Understand the use of complex variables for solving definite integrals.
CO4: Expertise of special functions and their application in Initial value problems and Boundary value problems.
CO5: Knowledge of group theory and its application tospectroscopy and Nuclear Physics.
CO6: Acquisition of relevant mathematical skills to predict the dynamics of physical systems.

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)
Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	CO 2	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		
	CO 3	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	CO 4	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	CO 5	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

CORE COURSE (CC) - III-NUMERICAL METHODS

Theory Hours	**: 5**	**Course Code**	**: P21PHC103**
Practical Hours	**: -**	**Credits**	**: 5**
Exam Hours	**: 3**	**Marks**	**:CIA ESE**
			25 75

OBJECTIVES:

- T o give a glimpse of curve fitting methods.
- Solve the algebraic and transcendental equations using various methods.
- T o impart the knowledge of interpolation and its methods.
- To solve the numerical problems using numerical differentiation and numerical Integration.

UNIT - I: METHODS OF CURVE FITTING

Principle of least Squares Method -Fitting a straight line - Parabola - Exponential curve - Error and Their types- Approximation and residuals.

UNIT - II: SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

Bisection method - Newton Raphson method -convergence of Newton Raphson method - Matrix inversion method - Gauss elimination method - Gauss Seidal method - Theory and Problems.

UNIT - III: INTERPOLATION

Newton forward and Backward interpolation formula - Theory and Problems- Gauss forward and Backward interpolation formula -Theory and Problems - Stirlings and Bessel's formula - Theory and Problems.

UNIT - IV: NUMERICAL DIFFERENTIATION AND INTEGRATION

Newton forward difference formula and Newton backward difference formula -Numerical Integration - Trapezoidal Rule - Simpson 1/3 Rule - Simpson 3/8 Rule - Theory and Problems.

UNIT - V: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Taylor Series - Euler's method - Modified Euler's method - Second and Fourth order RungeKutta method - Theory and Problems.

BOOKS FOR STUDY:

1. Numerical Method in Science and Engineering, M.K. Venkatraman, National Publishing Company – Chennai (1991).
2. Introductory methods of Numerical Analysis- S.S. Sastry. Prentice Hall, (2005).
3. Numerical methods for Scientific and Engineering Computation, M.K.Jain, S.R.K.Iyangar and R.K.Jain, 3rd Edition, Willey Easterm Ltd., (1993).
4. Numerical Methods - Dr. P. Kandasamy, Dr. K. Thilagavathi and Dr. K. Gunavathi 2014, S. Chand Publishing, New Delhi.

BOOKS FOR REFERENCE:

1. Numerical Method in Scientists and Engineers (Dover Books on mathematics), R.W. Hamming, Dover Publication, (1987).
2. Numerical solution of Engineering Problems, K.Nandakumar, University of Alberta, (1998).
3. Numerical Analysis for Engineering, Douglas W. Harder, Richard Khoury, University of Waterloo, (2010).

COURSE OUTCOMES (COs):

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

CO1: Solve curve fitting for straight line, parabola and logarithmic curves.
CO2: Expertise in numerical solving skills.
CO3: Understand Physical problems using interpolation methods.
CO4: Understand numerical differentiation and integration.
CO5: Correlate numerical solution with analytical solution.
CO6: Acquire knowledge to solve any quantum mechanical/dynamical system.

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)
Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓		✓	✓	✓	
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓		✓	✓	✓	
	CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓		✓	✓	✓	
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓		✓	✓	✓	
	CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓		✓	✓	✓	
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓		✓	✓	✓	

CORE PRACTICAL (CP) - IV - GENERAL EXPERIMENTS

Theory Hours	**: -**	**Course Code**	**: P21PHC104P**
Practical Hours	**: 6**	**Credits**	**: 3**
Exam Hours	**: 4**	**Marks**	**:CIA 40 ESE 60**

OBJECTIVES:

- To understand the basic laws/principles and theoretical background of the physical instruments.
- To provide a hands - on learning experience.
- To calculate various physical parameters.

ANY 12 EXPERIMENTS

1. Determination of **q,η ,σ**- Elliptical Fringes.
2. Determination of**q,η , σ** - Hyperbolic Fringes.
3. Determination of Stefan's Constant.
4. 'g' factor Determination-ESR Spectrometer.
5. e/m - Magnetron method.
6. e/m -Thomson method.
7. Planck's constant -Photoelectric effect.
8. Biprism - Wavelength of the light.
9. Spectrometer - Hydrogen Spectrum - Rydberg's constant.
10. Spectrometer -Polarisability of liquids.
11. Spectrometer - Charge of an electron.
12. Biprism - Determination of Refractive index.
13. Polarimeter -Determination of Specific rotatory power of a liquid.
14. Four probe method -Determination of resistivities of the given samples.
15. Cu-Hg spectrum (visible region).
16. Cu-salt spectrum (visible region).
17. Iron arc spectrum.
18. Brass arc spectrum.
19. Michelson's interferometer - Determination of wavelength of monochromatic source.
20. Ultrasonic Interferometer - Velocity,Wavelength,Adibatic compressibility.
21. Self inductance of a coil -Anderson's method.
22. Susceptibility of salt solutions / Solids - Guoy method.
23. Susceptibility of Liquid mixture- Quincke's method.
24. Hysteresis loop Tracer.
25. G.M counter - Absorption coefficient of a Foil.

COURSE OUTCOMES (COS):

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

CO1: Understand the fundamentals of physics.
CO2: Application of simple concepts to perform experiments.
CO3: Apply the theory to determine various properties of the materials given.
CO4: Familiarity to handle the instruments.
CO5: Conduct of demos to interpret data.
CO6: Expertise to develop experimental skills.

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓

MAJOR BASEDELECTIVE COURSE (MBEC) - I
ANALOG ELECTRONICS, MICROPROCESSORS AND MICROCONTROLLER

Theory Hours	**: 5**	**Course Code**	**:P21PH1MBE1:2**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA ESE**
			25 75

OBJECTIVES :

- To understand the basics of operational amplifier and its applications.
- Acquire knowledge of instruction sets and addressing modes of microprocessor 8085.
- To learn the architecture of microprocessor 8086.
- To gain in depth understanding of pinconfiguration and programming of microcontroller 8051.
- To understandthe basics of interfacing devices.

UNIT- I: ANALOG CIRCUITS

Operational amplifier - Characteristics - Inverter - Multiplier - Differentiator - Integrator - Comparator - log and antilog amplifiers - Wien bridge Oscillator - Phase shift oscillator - Schmitt trigger –AstableMultivibrator - D/A conversion [Weighed Resistor Method - R-2R Method].

UNIT - II:MICROPROCESOR - 8085

Architecture of 8085 - Instruction set-Addressing modes- Programming in 8085 - 16-bit addition and subtraction - Ascending and descending order of N numbers - Largest and Smallest element of N numbers.

UNIT-III: MICROPROCESSOR- 8086

Architecture of 8086 - Instruction set - Addressing modes - Data transfer- Arithmetic - Logical - Shift and rotate instruction - Compare - Jump - CALL - RET and stack instructions - Assembler directives.

UNIT-IV: MICROCONTROLLER - 8051

Introduction to Microcontroller - Difference between Microprocessor and Microcontroller - Architecture - Instruction Set - Addressing modes - Simple Programs - 8bit-Addition - 8 bit-Subtraction - 8 bit-Multiplication - 8 bit-Division.

UNIT- V: INTERFACING DEVICES

Programmable peripheral interface[8255A]-8253 Timer interface-DMA controller-Programmable interrupt controller [8259]- Programmable communication interface [8251].

BOOKS FOR STUDY:

1. Op - Amp and liner integrated circuits,R.A.Gayakwad, Prentice Hall India Pvt Ltd,(1999).
2. Microprocessor architecture, Programming and Application - R.Goankar, Wiley Eastern, New Delhi, (1985).
3. Fundamentals of Microprocessors and Microcomputers - B. Ram, Dhanpat Rai Publications, New Delhi,(2001).
4. The 8051 Microcontroller and Embedded Systems - Muhammed Ali Mazidi and Janice Gillespie Mazidi, 2004, Fourth Indian Reprint, Pearson Education.
5. Linear Integrated circuit - Roy Choudary and Nigam,New age international publishers.(2009).
6. Microprocessors - R.S. Goenkar,Wiley Eastern,2013.
7. Advanced Microprocessors and Interfacing - Badri Ram, Tata McGraw Hill ,2006.

BOOKS FOR REFERNCE:

1. Advanced Microprocessors and Interfacing - Badri Ram, Tata McGraw Hill ,(2006).
2. Microprocessor and its Applications - R. Thiagarajan, S. Dhanasekaran and S.Dhanapal, New Age International, New Delhi,(2000).
3. Microprocessors and Interfacing Programming and Hardware Douglas V. Hall,Tata Mc Graw Hill,(2001).
4. The 8051 Micro Controller Architecture, Programming and Applications - Kenneth J. Ayala - 3rd Edition, Penram International,(2000).

COURSE OUTCOMES (COs):

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

CO 1 :Understand the basic ideas of operational amplifier and its applications.

CO 2 : Acquire knowledge of microprocessor 8085, 8086 and microcontroller 8051.

CO3 :Gain knowledge about interfacing devices.

CO 4 :Learn and write the assembly language programs.

CO 5 :Apply the circuit theory to design sequential logic circuits.

CO 6 :Construction of ALU as a midway to build a digital computer.

QUESTION PAPER PATTERN

Maximum Marks **:** 75
Exam Duration **:** 3 hours
Part A **:** 20 × 1 = 20 Answer **ALL** Questions (Two Questions from each unit)
Part B **:** 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question From Each Unit)
Part C **:** 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	

MBEC II :Advanced Microprocessor and its Applications

Theory Hours	**: 5**	**Course Code**	**: P21PH1MBE1:2**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA ESE**
			25 75

OBJECTIVES

This course enables the students:

- The first module introduces architecture of 8085 and 8086 Microprocessor.The module-2 is compilation of information about I/O communication Interface.
- Microcontrollers (8051), its architecture and working is subject of module-3
- The 4th module contains Real time control sequences and programming of 8051-microcontroller.
- The AVR RISC microcontroller architecture is covered in module-5.

Unit 1. 8086 Architecture

Introduction to 8085 Microprocessor, 8086 Architecture-Functional diagram. Register Organization, Memory Segmentation. Programming Mode!. Memory addresses. Physical memory organization. Architecture of 8086, signal descriptions of 8086-common function signals. Minimum and Maximum mode signals. Timing diagrams. Interrupts of 8086. Instruction Set and Assembly Language Programming of 8086: Instruction formats, addressing modes, instruction set, assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.

Unit – 2. I/O and Communication Interface:

8255 PPI various modes of operation and interfacing to 8086. Interfacing keyboard, display, stepper motor interfacing, D/A and A/D converter. Memory interfacing to 8086, Interrupt structure of 8086, Vector interrupt table, Interrupt service routine, Introduction to DOS and BIOS interrupts, Interfacing Interrupt Controller 8259 DMA Controller 8257 to 8086. Communication interface: Serial communication standards, Serial data transfer schemes. 8251 USART architecture and interfacing, RS-232, IEEE-4-88, Prototyping and troubleshooting.

Unit -3Introduction to Microcontrollers:

Overview of 8051 microcontroller. Architecture. I/O Ports. Memory organization, addressing modes and instruction set of 8051, simple program.

Unit -48051 Real Time Control:

Interrupts, timer/ Counter and serial communication, programming Timer Interrupts, programming external hardware interrupts, programming the serial communication interrupts, programming 8051 timers and counters.

Unit -5The AVR RISC microcontroller architecture:

Introduction, AVR Family architecture,Register File, The ALU. Memory Access and Instruction execution. I/O memory. EEPROM. I/O ports. Timers. UART. Interrupt Structure.

BOOK FOR STUDY:

1 D. V. Hall. Micro processors and Interfacing, TMGH. 2'1 edition 2006.

2 Kenneth. J. Ayala. The 8051 microcontroller , 3rd edition, Cengage learning, 2010

REFERENCE BOOKS:

1. Advanced Microprocessors and Peripherals -A. K. Ray and K.M. Bhurchandani, TMH, 2nd edition 2006.
2. The 8051 Microcontrollers, Architecture and programming and Applications -K.Uma Rao, AndhePallavi,,Pearson, 2009.
3. Micro Computer System 8086/8088 Family Architecture. Programming and Design -By Liu and GA Gibson, PHI, 2nd Ed.,

4 .Microcontrollers and application, Ajay. V. Deshmukh, TMGH. 2005.

COURSE OUTCOMES (COs):

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

After the completion of this course, students will be:

1. The course intends to impart knowledge of Microprocessors and microcontrollers to enable learnersgain the knowledge of basics of Modern computation.
2. Knowledge of 8085/8086 architecture would make learners rich about working and design ofmicroprocessors and microcontrollers.
3. The course also includes information about microcontrollers, real time control of 8051 and AVR RISCmicrocontroller architecture.
4. This would enable learners to understand fundamentals of microcontrollers and implement it to design / use microcontroller for new environments.

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)
Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	

MBEC III: DIGITAL ELECTRONICS AND BASIC OF MICROPROCESSORS

Theory Hours	**: 5**	**Course Code**	**: P21PH1MBE1:3**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA ESE**
			25 75

OBJECTIVES

- To understand the concepts of microprocessors and microcontrollers.
- To comprehend the ideas about the digital electronics

UNIT I LOGIC GATES

Logic gates - block diagram - truth table- Ex OR gate - equivalent functions - combinational logic - half adder / subtract or - full adder / subtracted - DeMorgan's laws-Boolean algebra - Karnaugh maps - max and min terms - encoders and decoders - multiplexers and demultiplexers.

UNIT II COUNTERS

Sequential logic – flip – flops – sequential circuit analysis – state diagram – state equation – registers – counters – up – down counters – timing sequences – the memory MODULE – Random Access Memory (RAM) – Magnetic core memory.

UNIT III INTRODUCTION TO MICROPROCESSOR

Common microprocessor characteristic - pin diagram and functions for generic microprocessor - microprocessor architecture - the intel 8085 microprocessor - the 8085 pin diagram and functions - 8085 architecture - different addressing modes - 8085 instruction set - arithmetic, logical and branch instructions – the 8085 stack, I/O and control instructions.

UNIT IV 8085 MICROPROCESSOR

Programming the 8085 microprocessor - 8 bit addition, subtraction, multiplication and division - looping programs - sum of data - maximum, minimum values of the given array - ascending / descendmg - data transfer- 16 bit addition – relay generation – multiple precision arithmetic – decimal arithmetic - subroutine programs - ASCII to decimal multiple precision addition subroutine.

UNIT V MICROPROCESSOR INTERFACING

Timining diagram - instruction cycle, machine cycle, R/W cycle – interfacing the microprocessor - interfacing with ROM - interfacing with RAM - I/O interfacing basics.

BOOK FOR STUDY:

1. Jain R.P, Digital Electronics and Microprocessors, Fourth Edition, Tata – McGraw Hill, 2010.
2. Anokh Singh, A.k.Chhabra, Fundamental of Digital Electronics and Microprocessors, 2nd Edition, S. Chand Limited, 2005.
3. Anokh Singh, Chhabra A.k, Fundamental of Digital Electronics and its application, S. Chand Limited, 2005.

REFERENCE BOOKS:

1. Sumit Kumar Singh, Fundamental of Digital Electronics and Microprocessors, Coronet Books Incorporated, 2008.
2. Jain R.P, Modern Digital Electronics, 4th Edition, Tata McGraw Hill, 2010.

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)
Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

COURSE OUTCOMES (COs):

After the completion of this course, students will be:

- The working of digital electronic devices.
- The concepts of working model of microprocessors and microcontrollers

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				✓	✓	
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 5	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				✓	✓	
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	

CORE COURSE (CC)- V- STATISTICAL MECHANICS

Theory Hours	**: 5**	**Course Code**	**: P21PHC205**		
Practical Hours	**: -**	**Credits**	**: 5**		
Exam Hours	**: 3**	**Marks**	**:CIA**	**ESE**	
			25	**75**	

OBJECTIVES:

- To give an insight into basics of Statistical Mechanics and Thermodynamics.
- To provide the basic ideas of probability to the students.
- To introduce Maxwell Boltzmann, Bose-Einstein, Fermi-Dirac statistics and their applications.

UNIT – I: THERMODYNAMICS

Energy and First law of thermodynamics-Heat content and heat capacity – Specific heat – Entropy and the second law of thermodynamics – Thermodynamic potentials and the reciprocity relations –Thermodynamic equilibrium – Nernst heat theorem.

UNIT – II: KINETIC THEORY

Postulates of kinetic theory of gases – Maxwell – Boltzmann's law of distribution of velocities – Experimental test of Maxwell's law – Width of spectral lines – Zartman and Ko's experiment – Transport phenomena – Boltzmann transport equation – Mean free path – Ising model.

UNIT – III: CLASSICAL STATISTICAL MECHANICS

Phase space – Ensembles and their types – Density of distribution in phase space – Liouville's theorem – Statement and proof – Maxwell Boltzmann distribution equation – Partition function – Principle of equipartition of energy – Canonical and grand canonical ensemble – Connection between partition function and thermodynamic quantities – Gibb's paradox.

UNIT – IV: QUANTUM STATISTICAL MECHANICS

Basic concepts - Bose Einstein and Fermi Dirac statistics - Distribution laws - Application of B-E Statistics to Photon gas - Application of F-D statistics to free Electron inside conductors.

UNIT – V: APPLICATIONS OF QUANTUM STATISTICAL MECHANICS

Black body - Planck's radiation law - Impacts and utility of Planck's law - Liquid Helium and its properties - Liquid He^4 as an example of Bose Einstein condensation.

Ideal Fermi gas: Properties -Degeneracy -Electron gas - Pauli's theory of Paramagnetism

BOOKS FOR STUDY:

1. Statistical Mechanics. S.L. Gupta and V. Kumar, PragatiPrakashan, 2010.
2. Statistical Mechanics, B.K. Agarwal and Melvin Eisnor, New Age Publisher, 2011
3. Thermal and Statistical Physics, R.B. Singh, New Age International (P) Ltd., 2010.
4. Statistical Mechanics, Satya Prakash, KedarNath, Ramnath Publishers, Meerut, 2009.
5. Statistical Mechanics - R.K Pathira and Paul D. Beale (Academic press, 2011)
6. Statistical Physics, Thermodynamics & Kinetic Theory – V.S. Bhatia, Vishal Publishing,(2006).

BOOKS FOR REFERENCE:

1. Fundamentals of Statistical Mechanics, Laud, New Age International (P) Ltd., (2009).
2. Statistical and Thermal Physics – F. Reif, Mc Graw Hill Book co., 1992
3. Statistical Physics, Thermodynamics & Kinetic Theory, V.S. Bhatia, Vishal Publishing Co,(2006).

COURSE OUTCOMES (COs):

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

CO1: Understand the laws of thermodynamics and give an account of the relevant quantitiesused to describe the macroscopic system, thermodynamic potentials etc.
CO2: Describe the Reciprocity theorem, Thermodynamic Equilibrium and Nernst Heat theorem.
CO3: Give an account of kinetic theory of gases.
CO4: Give a flavor of MB Statistics, Boltzmann transport equation and mean free path.
CO5: Introduce the concept of ensembles and phase space.
CO6: Describe Maxwell Boltzmann distribution and its applications.
CO7: Illustrate the role of Partition function and their applications.
CO8: Describe the importance and consequences of Quantum Statistics for microscopic particles.
CO9: Explain Bose Einstein Condensation and Debye's Theory of Specific heat of solids.
CO10: Understand other applications of Quantum Statistics.

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)
Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
COURSE OUTCOMES	CO 1	✓		✓		✓	✓			✓	✓		✓	✓	✓	✓	✓				✓	
	CO 2	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	
	CO 3	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	
	CO 4	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	
	CO 5	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		
	CO 6	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	
	CO 7	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	
	CO 8	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	
	CO 9	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	
	CO 10	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓

CORE COURSE (CC) VI:QUANTUM MECHANICS

Theory Hours	**: 5**	**Course Code**	**: P21PHC206**
Practical Hours	**: -**	**Credits**	**: 5**
Exam Hours	**: 3**	**Marks**	**:CIA 25 ESE 75**

OBJECTIVES:

- To understand the fundamental concepts of quantum mechanics.
- To drive time dependent, independent Schrodinger equations and their applications.
- To study the operator formulation and their consequences.
- To learn basic idea of Time dependent and Time independent Perturbation theories.
- To study scattering theory and its ramification in nuclear physics.

UNIT – I: SCHRODINGER EQUATION AND GENERAL FORMULATION

Schrödinger Equation – Physical meaning and conditions on the wave function – Expectation values and Ehrenfest's theorem – Hermitian operators and their properties – Commutator relations – Uncertainty principle – Bra and Ket vectors – Hilbert space – Schrodinger, Heisenberg and interaction pictures

UNIT – II: EXACTLY SOLVABLE SYSTEMS

Linear harmonic oscillator – Solving the one dimensional Schrodinger equation – Zero point energy – Particle in a box – Square well potential – Rectangular barrier potential – Rigid rotator – Hydrogen atom.

UNIT – III: APPROXIMATION METHODS

Time independent Perturbation theory **-**Non-degenerate Perturbation and degenerate Perturbation theories, (first order) –Stark Effect – WKB approximation – Application to tunneling problem.

Time dependent Perturbation theory - Harmonic perturbation-transition probability - Fermi golden rule.

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UNIT – IV: SCATTERING THEORY AND ANGULAR MOMENTUM

Scattering theory: Scattering cross section – Green's function approach – Born Oppenheimer approximation – Particle wave analysis.

Angular momentum: Angular momentum of system of particles – Commutation rules – Matrix representations of J^2 and Jz - Spin angular momentum – Pauli's spin matrices – Eigen values of J^2 and Jz – Addition of angular momenta – Clebsch-Gordan coefficients (basic ideas only).

UNIT – V: RELATIVISTIC QUANTUM MECHANICS

Klein-Gordan equation for a free particle and in an electromagnetic field – Partial wave solutions – Dirac equation for a free particle – Probability and current densities – Dirac matrices – Plane wave solutions – Negative energy states – Spin angular momentum – Spin – Orbit coupling.

BOOKS FOR STUDY:

1. Quantum Mechanics – V. Devanathan –Wily Eastern, (2005).
2. Qauntum Mechanics – V.K. Thankappan –II edition – New Age International (P) Ltd. Publishers, (1996).)
3. Advanced Quantum Mechanics- Sathyaprakash-Kedarnath Ram nath-New delhi(,2005).
4. Quantum Mechanics – G. Aruldhas –Prentice Hall of India, (2002).
5. Quantum Mechanics –Sathya Prakash, Swati Saluja, Kedarnath Ram nath&Co -New delhi ,(2003).

BOOKS FOR REFERENCE:

1. A text book of Quantum Mechanics – P.M. Mathews and K. Venkatesan – Tata McGraw Hill Publishing Company, New Delhi, (2002).
2. Quantum Mechanics – L.I. Schiff – McGraw Hill – Tokyo – (2000).
3. Quantum Mechanics - A. ZettiliWiley India, (2016)
4. Relativistic Quantum Mechanics And Quantum Field Theory, Devanathan. Alpha Science,(2011)

COURSE OUTCOMES (COs):

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

CO1: Understand the fundamental concepts of quantum mechanics.
CO2: Understand the importance Schrodinger equation and their simple applications.
CO3: Understand approximation methods like time independent degenerate,non-degenerate Perturbation theories, variation methods etc.
CO4: Study scattering theory and calculate scattering amplitude and cross section.
CO5: Understand the basic ideas of Clebsch-Gorden coefficients.
CO6: Understand the basics of relativistic quantum mechanics and its wide ramifications.

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)
Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓				✓		✓		✓				✓	✓		✓	✓	✓	
	CO 2	✓		✓		✓	✓	✓		✓		✓			✓	✓	✓		✓	✓	✓	
	CO 3	✓						✓				✓			✓	✓	✓		✓		✓	
	CO 4	✓		✓	✓		✓	✓			✓	✓	✓		✓	✓	✓			✓	✓	
	CO 5	✓		✓				✓		✓		✓			✓	✓	✓		✓	✓		
	CO 6	✓		✓		✓		✓			✓	✓			✓	✓	✓		✓	✓	✓	

CORE COURSE (CC) -VII-PROGRAMMING IN C++

Theory Hours	**: 5**	**Course Code**	**: P21PHC207**
Practical Hours	**: -**	**Credits**	**: 5**
Exam Hours	**: 3**	**Marks**	**:CIA ESE 25 75**

OBJECTIVES:

- To learn the principles of object oriented programming(OOP)
- Acquire knowledge about structures and functions in C++.
- Understand the concepts of classes and objects in C++ language.
- Acquire knowledge about various types of inheritance and pointers in C++programming.
- To practice the various programs in C++.

UNIT - I: INTRODUCTION

Principles of Procedure oriented Programming(POP)-Principles of object oriented programming (OOP)-Software Evolution-object oriented programming paradigm - Basic concepts of oops :Introduction to C++-Tokens-Keyword's - Identifiers - variables - Operators-Manipulators Expressions.

UNIT -II: CONTROL STRUCTURES

Control structures in C++-Functions in C++-Main function-Function Prototyping-Call by Reference-Return by Reference-Function overloading

.

UNIT- III: CLASSES , FUNCTION AND OPERATOR OVERLOADING

Classes and objects: Passing objects as function arguments -Friend functions-Constant member functions - Special member functions.

Constructors –Destructors-Operator overloading - Rules for overloading operator-Type conversions.

UNIT- IV: INHERIANCE AND FILES

Inheritance: Single Inheritance-Multilevel Inheritance-Multiple Inheritance-Hierarchal Inheritances.

Pointers-Virtual function and polymorphism-Managing console I/O Operators. Working with files: Classes for file stream operators-Opening and Closing a file-End of file.

UNIT - V: PROGRAMS

1. Arranging words in alphabetical order
2. Picking largest and of a set of numbers
3. Solving Quadratic equation
4. Multiplication of two square Matrix
5. Least square curve fitting
6. Integration-Simpson's rule
7. Trapezoidal Rule
8. Euler's Rule
9. Solution of differential equation by RungeKutta4th order method
10. To solve simultaneous equation by Gauss Elimination method

BOOKS FOR STUDY:

1. Object oriented Programming in C++-Balagurusamy. MC Graw- Hill (2017)
2. Object oriented Programming in C++-Schaum Series. MC Graw- Hill Education (2000)

BOOKS FOR REFERENCE:

1. Object oriented Programming in C++-YashwantKanetkar. BPP Publications (2019)

COURSE OUTCOMES (COs):

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

CO1: Understand the difference between the top-down and bottom up approach.
CO2:Describe the object oriented programming approach in connection with C++.
CO3:Apply the concepts of object oriented programming and procedural programming
CO4:Illustrate the process of data file manipulations using C++.
CO5:Apply virtual and pure virtual function and complex programming situations.
CO6:To apply object oriented (or) non-object oriented techniques to solve bigger computing problems.
CO7:Understand dynamic memory management techniques using pointers,constructors,destructors etc.,
CO8:Describe the concepts of function overloading ,virtual functions and polymorphism.
CO9:Classify inheritances.
CO10:To code mathematical problems in C++.
CO11:Develop the expertise to write source codes in C++.

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)
Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
COURSE OUTCOMES	CO 1	✓		✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓		✓		✓	
	CO 2	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓		✓		✓	
	CO 3	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓		✓	✓
	CO 4	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓	✓		✓		✓	
	CO 5	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓	✓		✓		✓	
	CO 6	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓		✓	
	CO7	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓		✓	
	CO8	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	
	CO9	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓		✓		✓	
	C10	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓		✓		✓	
	C11	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓		✓		✓	

CORE PRACTICAL (CP) - VIII -ELECTRONICS EXPERIMENTS

Theory Hours	**: -**	**Course Code**	**: P21PHC208P**
Practical Hours	**: 6**	**Credits**	**: 3**
Exam Hours	**: 4**	**Marks**	**:CIA 40 ESE 60**

OBJECTIVES:

- Understand the basic laws/ principles of semiconductor devices.
- To learn the applications of active devices (BJT, UJT, FET, SCR)
- Acquire practical knowledge of electronic devices/components.
- To provide a hands-on learning experience.

ANY 12 EXPERIMENTS

1. Dual power supply-Construction.
2. Common Source FET amplifier.
3. Operational amplifier filters
4. Operational Amplifier - Parameters(Input impedance,Output impedance, Offset voltage)
5. Operational Amplifier (Mathematical Operations - I) - Inverter, Multiplier, Divider, Adder and Averager.
6. Operational Amplifier (Mathematical Operations - II) - Subtractor, Differentiator Integrator and voltage follower.
7. Characteristics of UJT.
8. SCR characteristics.
9. Phase shift Oscillator.
10. Feed - back Amplifier.
11. Characteristics of LDR.
12. Wein's Bridge Oscillator - Op - amp.
13. Relaxation Oscillator - UJT
14. AstableMultivibrator using IC 555.
15. AstableMultivibrator - BJT.
16. R-C coupled amplifier - BJT
17. Solving simultaneous equations - Op - Amp
18. D/A Converter - Weighed Resistor Method.
19. D/A Converter - R- 2R Ladder Method.
20. Schmitt trigger - Op - Amp.

BOOKS FOR REFERENCE:

1. Electrical and Electronic Science Laboratory Experiments, Narosa Publishing Home, (2011).
2. Advanced Practical Electronics, R. K. KAR, Books and Allied (p) Ltd, (2010).

COURSE OUTCOMES(COs):

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

CO1: Learn the working of semiconductor devices and its applications.
CO2: Explore the applications of Transistors.
CO3: Design the analog circuits independently.
CO4: Expertise in hands-on learning.
CO5: Create models and demos using electronic devices.
CO6: Expertise in analog/digital electronic circuits and their branches.

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	
	CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	
	CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	

MAJOR BASED ELECTIVE COURSE – II(MBEC)- EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION

Theory Hours	**: 5**	**Course Code**	**: P21PH2MBE2:1**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA 25 ESE 75**

OBJECTIVES:

- To enable the students understand the importance of measurements.
- To understand different types of transducer for voltage measurements.
- To make the students understand the principle behind the recorders and printers.
- To develop knowledge in digital, analytical and biomedical instruments for different applications.
- To understand the operation of medical imaging instruments.

UNIT-I: TRANSDUCERS

Inductive, Capacitive and Resistive transducers - Force, Pressure, Temperature, Humidity, Light, Magnetic and Ultrasonic flow sensors. Principle and working of LVDT, Potentiometer, High pressure sensor, Thermocouples, Thermistor, Piezoelectric transducer, Flow sensor, Hall probe, Solar cell and Photodiode.

UNIT - II: DIGITAL INSTRUMENTATION

Principle, block diagram and working of Digital frequency counter, digital multimeter, digital pH meter, digital conductivity meter, digital storage oscilloscope and Q meter.

UNIT-III: MATERIALS CHARACTERIZATION

Single crystal XRD, Micro hardness, Thermal analysis - Thermo gravimetric analysis (TGA), Differential Thermogram (DTA), Optical analysis - FTIR - UV Absorbance, Transmittance and reflectance, Morphological analysis - SEM.

UNIT - IV: BIOMEDICAL INSTRUMENTATION

Bio potentials- Measurements- Resting and Action potentials- Characteristics of resting potentials. Bioelectric potentials- Types of bioelectric signal and their characteristics.Component of the biomedical instrument system-Electrodes: Equivalent circuit-Theory-Types. Principle, Block diagram and functioning of ECG, EEG, EMG and MRI.

UNIT-V: RECORDERS AND PRINTERS

Different types of Recorders- Pen and Strip chart recorders-XY recorders-Digital recorders- Printers - Printer mechanism - Classification - Dot matrix, Ink jet and laser printers.

BOOKS FOR STUDY:

1. Electrical and Electronic measurements and Instruments- A.K.Sawhney, Dhanpath Rai and Co.Pvt.Ltd., (2000)
2. Instrumentation Measurements and Analysis- B.C. Nakra, and K. K. Chaudry. MC graw- Hill (2003)
3. Electronic Measurements and Instrumentation - Dr. Rajendra Prasad, Khanna Publishers, (2002).
4. Biomedical Instrumentation-M. Arumugam, Anuradha Publishers, (2001).
5. Electronic Measurements and Instrumentation- S.Ramabhadran, Khanna Publications.(1989)
6. Engineering Physics-V. Rajendran.
7. Spectroscopy - B. K. Sharma (Krishna Prakasham Publications, (1981).

BOOKS FOR REFERENCE:

1. Instrumental Methods of Analysis - Willard.D.Merritt et.al.,CBS Publisher, (2004).
2. Modern electronic Instrumentation and Measurement Techniques- Aslber D. Helfrock and William D cooper, Prentice Hall of India, (2005).
3. Hand Book of Bio medical Instrumentation- R. S. Khandpur, TMH, (2004).
4. Biomedical Electronics and Instrumentation, S.K.Venkata Ram, Galgotia Publications Pvt. Ltd. (2001).

COURSE OUTCOMES (COS):

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

CO1: Identify the various transducers involved in measurement and select types of transducer for particular measurement.

CO2: Understand the role of digital instruments for different applications.

CO3: Usefulness of materials characterization and analysis.

CO4: Understand the role of biomedical instrumentation for specific applications and the operation of medical imaging instruments.

CO5: Knowledge of the different types of recorders and understand the principle behind printers.

CO6: Awareness of different types of errors while making measurements and means of avoiding them.

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
	CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)

Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAJOR BASED ELECTIVE COURSE –II(MBEC)-

DATA ACQUISITION AND CONTROL SYSTEM

Theory Hours	**: 5**	**Course Code**	**: P21PH2MBE2:2**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA ESE**
			25 75

OBJECTIVES:

This course enables the students:

- Course on *Instrumentation and control* intends to impart knowledge of measurement, data acquisition and control for experiments.
- The first module of the course addresses basics of measurements like range, resolution, reproducibility, accuracy and precision.
- Module-2 of the course introduces various types of sensors and their working to record changes in the different physical parameters.
- The techniques of signal conditioning and noise reductions for acquired data are subject of Module-3.
- Last two units covers working and theory of different types of correction and regulating elements used in control systems.

UNIT-1 MEASUREMENT BASICS:

Range, resolution, linearity, hysteresis, reproducibility and drift, calibration, accuracy and precision.

UNIT-2 SENSORS

Sensor Systems, characteristics, Instrument Selection, Measurement Issues and Criteria, Acceleration, Shock and Vibration Sensors, 1092 Interfacing and Designs, Capacitive and Inductive Displacement control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

Sensors, Magnetic Field Sensors, Flow and Level Sensors, Load Sensors, Strain gauges, Humidity Sensors, Accelerometers, Photosensors, Thermal Infrared Detectors, Contact and Non-contact Position sensors, Motion Sensors, Piezoresistive and Piezoelectric Pressure Sensors, Sensors for Mechanical Shock, Temperature Sensors (contact and non-contact)

UNIT-3 SIGNAL CONDITIONING

Types of signal conditioning, Amplification, Isolation, Filtering, Linearization, Classes of signal conditioning, Sensor Signal Conditioning, Conditioning Bridge Circuits, D/A and A/D converters for signal conditioning, Signal Conditioning for high impedance sensors Grounded and floating signal sources, single-ended and differential measurement, measuring grounded signal sources, ground loops, signal circuit isolation, measuring ungrounded signal sources, system isolation techniques, errors, noise and interference in measurements, types of noise, noise minimization techniques

UNIT-4 ACTUATORS

Correction and regulating elements used in control systems, pneumatic, hydraulic and electric correction elements.

UNIT-5 CONTROL SYSTEM

Open loop and closed loop (feedback) systems and stability analysis of these systems, Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of linear time invariant (LTI) control systems and frequency response. Tools and techniques for LTI

Text books:

1. Electronic Instrumentation -H. S. Kalsi, Tata McGraw-Hill Education, 2010
2. Electronic Instrumentation -W. Bolton
3. Instrumentation: Electrical and Electronic Measurements and Instrumentation -A. K. Sawhney,
4. Modern Electronic Instrumentation & Measurement Techniques -Helfrick& Cooper.

COURSE OUTCOMES (COS):

After the completion of this course, students will be:

CO1. Learners would develop understanding of various experimental parameters of measurements like range, resolution, reproducibility and precision.

CO2. Through this course, students would develop an insight into fundamentals of sensors / transducers, data acquisition and processing, noise minimization and control systems for automation.

CO3. This course is expected to enable students to design and understand hardwaresusedfor developing equipment for data acquisition, data conditioning and control.

4. Course would enable students to grasp understanding of instrumentation for automation of various physical process monitoring and control.

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
	CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)

Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAJOR BASED ELECTIVE COURSE –II(MBEC)- ADVANCED MEASUREMENT AND INSTRUMENTATION

Theory Hours	**: 5**	**Course Code**	**: P21PH2MBE2:3**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA 25 ESE 75**

OBJECTIVES:

• To enable the students understand the importance of measurements.

• To make the students understand the principle behind instrumentation for measurement.

UNIT I PHYSICAL MEASUREMENT

Measurement – result of a measurement – uncertainty and experimental error – systematic error – random error – repeated measurements – data distribution functions; mathematical description, derivation and properties – propagation error – analysis of data – multiparameter experiments.

UNIT II INSTRUMENTATION SYSTEM DESIGN

Experiment design – transducers – characteristics of transducers – selection of transducer – modeling external circuit components – instrument probes – power measurements – measurement methods – dc and ac bridge measurements – LCR bridges – Q meter – Megger.

UNIT III BRIDGES, RECORDERS AND TRANSDUCERS

Wheatstone's bridge – Kelvin's bridge – double bridge – bridge controlled circuits – digital readout bridges – AC bridges – bridges for capacitance and inductance comparison – Wien bridge – resonance bridge – types of detectors – strip chart recorders – X-Y recorders – digital data recording – recorder specifications – applications – electrical, resistive transducers – strain gauges– RTD – thermistor – LVDT – pressure inductive transducers – capacitive transducer (pressure) – load cell (pressure cell) – piezo electric, photoelectric and photo-voltaic transducers – photo diode and photo transistor – temperature and frequency generating transducers – flow measurements.

UNIT IV INSTRUMENTATION ELECTRONICS

Op-amps – instrumentation amplifier – signal conditioning – filters – analog signal processing – high speed A/D conversion – D/A conversion – digital logic levels – digital instrumentation – frequency measurements – FFT – sampling time and analyzing – IEEE 488 interface bus – LabView (basics) – nuclear instrumentation.

UNIT V ADVANCED MEASUREMENTS

Spectroscopic instrumentation – visible and IR spectroscopy – spectrometer design – refraction and diffraction – lenses and refractive optics – dispersive elements – lasers – fiber optics – X-ray fluorescence: line spectra and fine structure – absorption and emission processes – X-ray production – X-ray diffraction and crystallography –neutron diffraction – TEM – SEM – atomic force and tunneling scanning microscope.

BOOK FOR STUDY :

1. M. Sayer and A. Mansingh, "Measurement, instrumentation and experiment design in physics and engineering", Prentice-Hall India Pvt. Ltd., New Delhi, 2000.
2. H.S. Kalsi, 'Electronic instrumentation', (2nd Edition), Tata McGraw Hill Publication Co.Ltd., New Delhi, 2004.
3. R.F. Coughlin and F.F. Driscoll, "Operational amplifiers and linear integrated circuits", Pearson Education, New Delhi, 2001.
4. E.O. Doebelin, "Measurement systems: Applications and design", McGraw-Hill, New York, 2002.Rangan Sharma and Mani, "Instrumentation devices and systems", Tata McGraw-Hill, New Delhi, 2000.

COURSE OUTCOMES (COS):

At the end of the course, the students will be able to

CO1. Acquire the knowledge about the different errors occurring during measurement

CO2. Understand the principle behind the instrumentation for measurement.

CO3. Identify the various transducers involved in measurement.

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	CO 3	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓
	CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)

Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

EXTRA DISCPILINARY COURSE (EDC) – REACTOR PHYSICS

Theory Hours	**: 2**	**Course Code**	**: P21PH2ED**		
Practical Hours	**: -**	**Credits**	**: 2**		
Exam Hours	**: 3**	**Marks**	**:**	**CIA**	**ESE**
				25	**75**

OBJECTIVE:

- To expose the students to the physics of neutronsand fuel inside a reactor.
- Also the construction of a nuclear reactor and precautions to be taken in its operation will be dealt in this paper.

UNIT-I NUCLEAR ENERGY

Nuclear mass - Binding energy-Radioactivity - Nuclear reactions - Nuclear fission - Mechanism of fission - Fuels - Products of fission - Energy release from fission - Reactor power - Fuel burn up - Consumption.

UNIT-II NEUTRON DIFFUSION

Multiplication factor - neutron balance and conditions for criticality - Conversion and breeding - Classification of reactors.

Diffusion of neutrons: Flux and current density - Equation of continuity - Fick's law - Diffusion equation - Boundary conditions and solutions - Diffusion length - Reciprocity theorem.

UNIT-III NEUTRON MODERATION

Energy loss in elastic collision - moderation of neutrons in Hydrogen - lethargy - Space dependent slowing down - Fermi's age theory - Moderation with absorption.

Fermi theory of Bare thermal reactor: Criticality of an infinite reactor - One region finite thermal reactor - Critical equation - Optimum reactor shape.

UNIT-IV REACTOR KINETICS

. Infinite reactor with and without delayed neutrons - Stable period - Prompt jump - Prompt criticality - Negative reactivity - Changes in reactivity - Temperature coefficient - Burn up and conversion.

UNIT-V CONTROL AND SHIELDING

. Reactor control : Road worth - One control rod - modified one group, two group theory - ring of rods.

Radiation shielding : Reactor safeguards - Reactor properties over life- core life estimation.

BOOKS FOR STUDY:

1. John R. Lamarsh, Introduction to Nuclear Reactor Theory, American Nuclear Society (2002)
2. Samuel Glasstone, Milton C. Edlund, The Elements of Nuclear Reactor Theory, Van Nostrand, (1965)
3. H.S. Isbin, Introductory Nuclear Reactor Theory, Reinhold, New York (1963)
4. www.ans.org/PowerPlants
5. npcil.nic.in/main/AllProjectOperationDisplay.aspx
6. www.world-nuclear.org/info/inf53.html

QUESTION PAPER PATTERN

Maximum Marks	**:** 75**Exam Duration** **:** 3 hours
Part A	**:** 5× 15 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)

SKILL ENHANCEMENT

DOCUMENT PREPARTION SYSTEM - LATEX (PRACTICAL)

Theory Hours	**: 2**	**Course Code**	**: P20SEP**
Practical Hours	**: -**	**Credits**	**: 1**
Exam Hours	**: 2**	**Marks**	**:CIA ESE**
			40 60

List of Experiments:

1. Creating a LaTeX Document.
2. Mathematical Environments in LaTeX.
3. Table Creation in LaTeX.
4. Graphics in the LaTeX Document.
5. MS-Excel Chart in the LaTeX Document.
6. Landscape Figure in LaTeX Environment.
7. Thesis prepration using LaTeX Documents

SELF STUDY COURSE (SSC) - I
GENERAL STUDIES FOR RESEARCH FELLOWSHIPS ANDLECTURERSHIP

Theory Hours	**: -**	**Course Code**	**: P20SSC1**		
Practical Hours	**: -**	**Credits**	**: 2**		
Exam Hours	**: 2**	**Marks**	**:CIA**	**ESE**	
			25	**75**	

UNIT – I:TEACHING APTITUDE

Teaching - Nature, Objectives, Characteristics and basic requirements. Learners.

Characteristics, Factors affecting teaching, Methods of teaching, Teaching aids Evaluation systems.

UNIT – II: RESEARCH APTITUDE

Research - Meaning, Characteristics and types, Steps of research, Methods of Research, Research Ethics. Paper, Article, Workshop, Seminar, Conference and Symposium. Thesis Writing - Its Characteristics and format.

UNIT –III: MATHEMATICAL REASONING

Series - Completion and its Types; Classification - Verbal, Letter, Number; Coding and decoding.

UNIT –IV LOGIC - METHODOLOGY AND DATA ANALYSIS

Statement; Premises; Term - Types of Syllogism, Prepositions, Logical inferences; Fallacies or Possible errors in Logical conclusions - Types of Tables and Graphs, Interpretation of data - Sources, acquisition and interpretation, Qualitative and quantitative data, Graphical representation and mapping of data.

UNIT –V INFORMATION AND COMMUNICATION TECHNOLOGY

Overview of Computer - Hardware, Software, Internet, and e-mailing.

EDUSAT - Space Science and Communication - Milestones, Space Transportation - Earth Observations.

TEXT BOOK:

1. UGC - NET/JRF/SET Teaching & Research Aptitude by Dr. M.S. Ansari & RPH Editorial Board, 2014. Ramesh Publishing House, New Delhi.

REFERENCE BOOKS:

1. Dr. K. Kautilya, 2013 UGC - NET/JRF/SET Teaching Research & Aptitude, UpkarPrakashan, Agra - 2.
2. Sajit Kumar & M. Gagan (2011) UGC - NET/HRF/SET Teaching Research & Aptitude. Damika Publishing Company, New Delhi.
3. Dr. M.S. Ansari (2011) UGC - NET/JRF/SET Teaching Research & Aptitude. Ramesh Publishing House, New Delhi.
4. Dr. Lal, Jain & Dr. K.C. Vashiatha(2011) UGC - NET/JRF/SET Teaching Research & Aptitude, UpkarPrakashan, Agra - 2.
5. Editorial board: PratiyogitaDarpan (2010) UGC - NET/JRF/SET Teaching Research & Aptitude, UpkarPrakashan, Agra - 2.

Question Paper Pattern

Maximum Marks	: 100
Exam Duration	: 1 and ½ hours
Pattern	: Muliple Choice Questions
Maximum Questions	: 60

Minimum Question to attend: 50 (50 × 2 = 100)

CORE COURSE (CC) - IX-ATOMIC AND MOLECULAR SPECTROSCOPY

Theory Hours	**: 6**	**Course Code**	**: P21PHC309**
Practical Hours	**: -**	**Credits**	**: 5**
Exam Hours	**: 3**	**Marks**	**:CIA ESE**
			25 75

OBJECTIVES:

- To study the atomic spectra and quantum chemistry of molecules.
- To educate students about the fundamental aspects of Infrared, Raman and Electronic spectroscopy.
- To acquire a thorough knowledge on the basic principles of Resonance Spectroscopy.

UNIT - I: ATOMIC SPECTRA AND QUANTUM CHEMISTRY

Spectrum of alkali atom - Doublet fine structure of alkali metals - Selection rule of doublets - Intensity rule for doublets - Spectrum of He- Atom.

Born Oppenheimer approximation - The LCAO Approximation - Molecular orbital theory for Hydrogen molecule -Harteefock equation self consistent field.

UNIT - II: ELECTRON SPECTROSCOPY:

Electronic spectra of Diatomic molecules - The Franck Condon principle - The Fortrat parabola - Dissociation and predissociation - Rotational fine structure of electronic vibrational transitions - Photoelectron Spectroscopy-principle-Instrumentation.

UNIT - III: IR SPECTROSCOPY

Vibrational Energy of a Diatomic Molecule - Harmonic Oscillator - Unharmonic Oscillator- Vibrating diatomic molecules - Diatomic vibrating rotator - Linear and symmetric top molecules - Qualitative and Quantitative analysis - Experimental techniques.

UNIT -IV: RAMAN SPECTROSCOPY

Raman spectroscopy: Raman Effect - Quantum theory of Raman Effect - Rotational and vibration Raman spectra of Diatomic Molecules - Selection rules - Experimental techniques - Applications.

UNIT - V: RESONANCE SPECTROSCOPY

NMR: Classical and Quantum mechanical description - Bloch equations - Spin - spin and spin lattice relaxation times - Chemical shift and coupling constant - Experimental methods.

ESR: ESR spectrometer - Nuclear interaction and hyper fine structure - Relaxation effects - g factor - Characteristics - Free radical and Biological applications - Moss Bauer Spectroscopy-Principle-Instrumentation.

BOOK FOR STUDY:

1. Spectroscopy (Atomic and Molecular),Gurdeep Chatwal and Sham Anand, Himalaya Publication House,(5th edition), reprint (2016).
2. Fundamentals of molecular spectroscopy, Colin N. Banwell and Elaine M.Mc cash, Mc Graw, Hill education (India) pvt.ltd, New Delhi, 5th edition 2016
3. Molecular structure and spectroscopy , G. Aruldhas, PHI Learning (P) Ltd., New Delhi, 2nd edition (2007).
4. Introductory Quantum Chemistry , A.K. Chandra , Tata McGraw Hill, New Delhi, 1989.

BOOK FOR REFERENCES:

1. Spectroscopy and Molecular structure, G.W. King, Holt, Rinehart and Wonton, New York, (1964).
2. Spectroscopy (Vol. II),B.P. Straughen and S. Walker, Chapman and Hall, London, (1976).
3. Michael Hollas, Modern Spectroscopy, John Wiley, New York, (4th edition), Reprint(2015).
4. Quantum chemistry and Spectroscopy, Thomas Engel, Dorling Kindersley (India) Pvt. Ltd., (2009).

COURSE OUTCOMES (COs):

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

CO1: Understand the concepts of atomic spectra and other features of alkali spectra.
CO2: Apply the knowledge of Quantum chemistry of molecules in computational research.
CO3: Analyze FTIR spectra and apply the instrumentation techniques in recording Infrared (IR) spectrum.
CO4: Comprehend the basics and importance of Raman spectroscopy and also able to extend the concepts of electronic spectroscopy to UV – visible analysis.
CO5: Identify the appropriate spectral technique as an analytical tool to investigate the characteristics of materials.

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓
	CO 2	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	CO 3	✓	✓		✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		
	CO4	✓		✓	✓	✓		✓	✓	✓	✓		✓		✓	✓				✓	✓	✓
	CO 5	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)

Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

CORE COURSE (CC) -X- ELECTROMAGNETIC THEORY

Theory Hours	**: 6**	**Course Code**	**: P21PHC310**
Practical Hours	**: -**	**Credits**	**: 5**
Exam Hours	**: 3**	**Marks**	**:CIA ESE 25 75**

OBJECTIVES:

- To study electro and magneto statics.
- To study the laws associated with electromagnetism and its applications.
- To study the nature of electromagnetic wave propagation in different medium.

UNIT - I: ELECTROSTATICS

Coulomb's law - Electric field - Electrostatic Potential- Electric field and potential of a Dipole-Gauss Law -Determination of electric field intensity due to infinite line charge distribution - Poisson and Laplace Equations in differential form - Method of Images - Illustration: Point charge in the presence of a grounded conducting Sphere - Boundary condition for D vector and E vector.

UNIT - II: MAGNETOSTATICS

Amphere's Force Law-Biot and Savart law and its Applications-Long straight wire- Ampere's Circuital Law -Amperian loop - application to Magnetic flux density due to infinite current carrying sheet - Magnetic scalar potential-Magnetic Vector potential - Boundary conditions on B and H - Dirichlet and Neumann conditions.

UNIT- III: ELECTRODYNAMICS

Equation of Continuity- Maxwell's displacement current - Maxwell's equations -differential and integral forms - Poynting's theorem-diffrential form of Poynting's theorem -Electromagnetic Potential (A&Φ) - Maxwell's equations in terms of Electromagnetic Potential- Gauge transformations - Lorentz gauge – Columb Gauge.

UNIT- IV: PLANE ELECTRO MAGNETIC WAVES AND WAVE PROPAGATION

Plane wave equation - Propagation of e.m. waves in free space - in a non-conducting isotropic medium - in a conducting medium- Reflection and refraction of electromagnetic waves (Snell's Law) - Propagation of electromagnetic waves in a rectangular wave guide -TM and TE modes.

UNIT - V:INTRODUCTION TO ANTENNAS

Radiation by an oscillating dipole - Skip distance - Radiation patterns of antennas - Directional characteristics - Gain of an antenna - Linear Array of Antennas (N-arrays) - Qualitative analysis of a dipole antenna.

BOOKS FOR STUDY:

1. Electrodynamics -S.L.Gupta and V.Kumar, PragatiPrakashan Publications(2004).
2. ElectromagnteicTheory -K.K.Chopra and G.C.Agarwal, K.Nath& Co(1993).
3. Electromagnetic Theory -Sathya Prakash, Sulthan Chand and Sons, New Delhi (2005).
4. Fundamentals of Electromagnetic Theory -S.K. Dash and S.R.Khunita –, PHI publications - New Delhi -(2011).

BOOKS FOR REFERENCE:

1. Classical Electrodynamics ,J. D. Jackson, (Wiley Eastern Ltd., New Delhi, (1993).
2. Introduction to Electrodynamics, D. Griffiths, (Prentice-Hall, New Delhi, (1995).

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration : 3 hours
Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)

Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

COURSE OUTCOMES (COs):

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

CO 1: Understand the basics of electronics.

CO2: Understand the basics of magnetostatics.

CO3: Understand the ramifications of time varying electric and magnetic fields.

CO4: Importance of Maxwell's equations and its consequence inoptics,Electromagnetic theory and other relative areas.

CO5: Solving boundary value problems by solving poisson's and laplace's equations.

CO6: Electromagnetic wave propagation through different media.

CO7: Understand how electromagnetic energy in transferred from source to observer.

CO8: Examine the phenomena of wave propagation in different media and its interfaces.

CO9: Analyze the nature of electromagnetic wave propagation in guided medium.

CO10: Understand the concepts of antenna and to arrange and recapture electromagnetic signals.

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓				✓	✓		✓	✓	✓	✓			✓		
	CO 2	✓	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓				✓	
	CO 3	✓			✓	✓	✓				✓	✓	✓	✓	✓	✓	✓		✓	✓		
	CO 4	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		
	CO 5	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓			✓		
	CO 6	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓			✓	✓	
	CO7	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓				✓	
	CO8	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓				✓	
	CO9	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓				✓	
	CO10	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓					✓	

CORE COURSE (CC)-XI- NUCLEAR AND PARTICLE PHYSICS

Theory Hours	**: 6**	**Course Code**	**: P21PHC311**
Practical Hours	**: -**	**Credits**	**: 5**
Exam Hours	**: 3**	**Marks**	**:CIA ESE 25 75**

OBJECTIVE

- To introduce the fundamental characteristics of nucleus, nuclear reactions and radioactive decay.
- To impart knowledge about various classification of elementary particles.

UNIT - I: NUCLEAR PROPERTIES, TWO BODY PROBLEM AND NUCLEAR FORCES

Basic ideas of Nuclear size - mass - charge distribution - spin and parity - Binding energy - semi empirical mass formula - Nuclear stability - Mass parabola of the nucleus.

Ground state of Deutron -Meson theory of Exchange forces - Scattering cross section - Neutron - proton scattering at low energies.

UNIT - II: RADIOACTIVE DECAYS

Alpha emission - Giger - Nuttal law - Gamow's theory - Neutrino hypothesis - Fermi theory of beta decay - Curie point - Energies of beta spectrum selection rules - Non conversation of parity - Gamma emission selection rules - Transition probability - Internal conversion - Nuclear isomerism.

UNIT - III: NUCLEAR REACTIONS AND NUCLEAR MODELS

Conservation of energy - Q-values of nuclear reaction - Energetic of nuclear reaction - Reciprocity theorem - Breit Wigner Formula - Compound nucleus - Resonance theory - Collective model - Optical model.

UNIT - IV: NUCLEAR FISSION AND FUSION

Characteristics of fission - Mass distribution of fragments - Fission cross section - Energy in fission - Bohr Wheeler theory of nuclear Fission - Fission reactors - Generation of electric power - Fast Breeder reactor - Basic fusion process - Characteristics of Fusion - Laser fusion - Plasma confinement.

UNIT - V: ELEMENTARY PARTICLES

Building blocks of nucleus - Nucleons, leptons, mesons, baryons, hyperons, strange hadrons - Classification of fundamental forces and elementary particles - Basic conservation laws - Quantum numbers - Gell - Mann - Nishijima formula - invariance under time reveals(T) charge conjugation(C) and parity(P) - CPT theorem - Parity and conservation in weak interaction - SU(3) symmetry - Meson Octet - Basic Quarks.

BOOKS FOR STUDY:

1. Nuclear physics - D.C. Tayal, Himalaya Publishing House Pvt. Ltd., Edition:v,2018.
2. Nuclear physics - B.N. Srivatsava, Basic Nuclear Physics and Cosmic Rays, Pragatiprakasan Publications, Meerut, Edition: XVII, 2016
3. Nuclear Physics - L. Pandya and P.R.S Yadav , KedarNath Publications, Meetut, 2016.

BOOKS FOR REFERENCE:

1. Introductory Nuclear Physics - K.S. Krane, John - Wiley, New York, (1987).
2. Concepts of Nuclear Physics - B.L.Cohen,Tata McGraw Hill, New Delhi,(1998).
3. Elementary Particle Physics an introduction - D.C Cheng & G.K. O'Neill, Addition -Wesely, (1979).
4. Introduction to elementary Particles - David J.Griffiths Wiley -Vch,2008.

COURSE OUTCOMES (COs):

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

CO1: Understand the fundamentals of nuclear properties and deuterons.
CO2: Illustrate the radioactive processes and their corresponding decay.
CO3: Realize the importance of nuclear energy resources through various nuclear reactions.
CO4: Apply the knowledge of elementary particles in the field of research on particle accelerators.
CO5: Acquire a thorough knowledge on fission and fusion reactions for production of energy as well as weapons.
CO6: Demonstrate the basic principles and applications of nuclear physics in the field of atomic research.

QUESTION PAPER PATTERN

Maximum Marks **:** 75
Exam Duration **:** 3 hours
Part A **:** 20 × 1 = 20 Answer **ALL** Questions (Two Questions from each unit)
Part B **:** 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question From Each Unit)
Part C **:** 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓	✓	✓
	CO 2	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓			✓	✓	✓
	CO 3	✓		✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓
	CO 5	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓	✓	✓

CORE COURSE (CP)-XII - DIGITAL ELECTRONICS - I

Theory Hours	**: -**	**Course Code**	**: P21PHC312P**
Practical Hours	**: 6**	**Credits**	**: 3**
Exam Hours	**: 4**	**Marks**	**:CIA ESE** **40 60**

OBJECTIVES:

- To give an overview of digital instrumentation.
- To learn the basic methods for the design of digital circuits and provide the fundamental concepts used in the design of digital systems.
- To provide hands-on experience to the students to make them familiar with the working and handling of the electronic devices.

ANY 12 EXPERIMENTS

1. Schmitt trigger using IC 555.
2. Half and Full wave precision rectifier using IC 741.
3. Digital to Analog convertor-Binary Weighted and R-2R method.
4. Function of decoders and Encoders.
5. Function of multiplexer and demultiplexer.(1:8,1:4,8:1,4:1)
6. Flip flops-Clocked RS, Clocked D and RS flip flop.
7. Full adder and Full Subtractor (using NAND and NOR only)
8. BCD seven segment display
9. Study of counter using IC 7490 (0-9 &0-99)
10. Verification of Karnugh maps-Reduction & Logic circuit implementation.
11. Set IC 7490 as a Scalar.
12. Synchronous and Asynchronous Counter – IC 7473.
13. Shift left Register –IC 7474.
14. Shift right Register –IC 7474.
15. Ring Counter.
16. Digital Comparator (NAND and NOR only)

BOOKS FOR REFERENCE:

1. Practical Physics, R.P. Jain, (Mc Graw Hill.,) (1987)
2. Digital Electronics Practices using Integrated Circuits - R.R. Jain, Mc Graw Hill Publications, New Delhi (1991).

COURSE OUTCOMES (COs):

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

CO1: Learn the basics of universal gates.
CO2: Construct basic combinational logic circuits and verify their operations.
CO3: Design of sequential logic circuits to encode and decode information.
CO4: Design of logic circuits to count the clock pulses for suitable applications in timer, memory and other electronic devices.
CO5: Design of digital circuits to perform mathematical operations.
CO6:Explore new areas of research in digital electronics, instrumentation and allied fields of science and technology.
CO7: Handle and understand the utility of analog and digital devices

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MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓		✓		✓	✓	✓	✓
	CO 2	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓
	CO 3	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓			✓	✓	✓
	CO 5	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	CO7	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		✓		✓	✓	✓	✓

MAJOR BASED ELECTIVE COURSE (MBEC)-IIICOMMUNICATION ELECTRONICS

Theory Hours	**: 6**	**Course Code**	**: P21PH3MBE3:1**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA ESE 25 75**

OBJECTIVES:

- To understand the concepts of antennas in transmission systems.
- To study the microwave propagations and its applications.
- To introduce the basics of fiber structures and fabrications.
- To understand the transmitter and receiver system and also the network controlled system.
- To understand the basic ideas of cellular network.

UNIT I: TRANSMISSION SYSTEMS

Non resonant antenna – loop antenna – Radiation fields – Polarization – Isotropic radiator – Power gain – Effective parameters of an antenna – Dipole arrayed antenna – VHF, UHF and microwave antennas – Thin linear antenna.

UNIT – II: MICROWAVES AND COLOUR TELEVISION

Microwave Generation and Applications

Klystron – Magnetron – Microwave propagation through wave guides – Crystal detection – measurement of SWR – Transmitters and receivers.

Colour Television

Introduction – Perception – Three colour theory – Luminescence – TV camera – Image Orthicon – Vidicon – LCD Colour Television.

UNIT – III: FIBER OPTICS COMMUNICATIONS

Fiber structure – Fiber materials – Fiber fabrication – Mechanical properties of fibers – Attenuation – Single distortion in optical waveguides – mode coupling-Fiber optic communications system.

UNIT – IV: SATELLITE COMMUNICATIONS

Ground station – Antenna angle of elevation and transmission path – Height of Geostation orbits – Problems – Satellite works – Frequency allocation and polarization – Various blocks of equipment about the satellite – Transmitter and receive contour – Block diagram of network control station (NCS).

UNIT – V: CELLULAR COMMUNICATIONS

Basic ideas of Cellular network – Operational principles of WDM – the 2*2 fiber Coupler – Fiber grating filters – Erbium Doped fiber Amplifiers – Amplification mechanism – EDFA architecture – Performance of WDM+EDFA system – Link Bandwidth – Optical power requirements for a specific BER – Cross talk – Optical CDMA – Interconnecting telephone traffic between remote stations.

BOOKS FOR STUDY:

1. Optical fiber Communication – G. Keiser, McGraw Hill – New Delhi 1991.
2. Electronic devices and circuits – J. Millman& C. Halkias. McGraw Hill Singapore 1972.
3. Electronic communication system – G. Kennedy, Tata McGraw Hill – New Delhi 1995.

BOOKS FOR REFERENCE:

1. Optical fiber Communication – Principles and practice – J.M. Senior, Prentice Hall, New Delhi (1996).
2. Fiber Optics technology and applications – S.D. Personick, Khanna Publishers, New Delhi (1996).
3. Communication systems and techniques – M. Schwartz, W.R. BannetS.Stein (JIEE press ,Newyork). (1996)
4. Electronic Communication – D. Roddy and Coolen.(2008)

COURSE OUTCOMES (COs):

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

CO1: Explain the operation of VHF,UHF and microwave antenna.
` **CO2**: Explain the operation of VHF,UHF and microwave antenna.
CO3: Understand the principle of microwave propagation and its applications..
CO4: Demonstrate the working principle, design and applications of colour television.
CO5: To understand the basics of satellite communications.
CO6: Understand the concepts of fiber fabrications
CO7: Understand the role of transmitter and receiver in satellite Communication networks.
CO8: Study of basics of cellular communications.
CO9: Understand the role of Erbium doped fibers structure and its properties.
CO10: Understand the different modes(CDMA,WDM) of the mobile communications.

QUESTION PAPER PATTERN

Maximum Marks : 75
Exam Duration **:** 3 hours
Part A **:** 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit
Part B **:** 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)

Part C **:** 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
COURSE OUTCOMES	CO 1	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓			✓		✓	✓
	CO 2	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 3	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 4	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 5	✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 6	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 7	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 8	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 9	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 10	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓

MAJOR BASED ELECTIVE COURSE (MBEC)-III INTEGRATED ELECTRONICS

Theory Hours	**: 6**	**Course Code**	**: P21PH3MBE3:2**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA 25 ESE 75**

Objectives

This course enables the students:

- First module of the course contains information about various type of circuitry to achieve logic processing for digital devices.
- The second module of the course would introduce the learners to the processes currently being followed in foundry for fabrication of integrated devices.
- The learners should explain different nanoscale devices.
- The working and construction of nanoscale electronic devices is planned to be covered.

UNIT-1Logic Families

Diode Transistor Logic, High Threshold Logic, Transistor-transistor Logic, ResistortransistorLogic, Direct Coupled Transistor Logic, Comparison of Logic families

UNIT-2Integrated Chip Technology

Overview of semiconductor industry, Stages of Manufacturing, Process and product trends,Crystal growth, Basic wafer fabrication operations, process yields, semiconductor materialPreparation, yield measurement, contamination sources, clean room construction, substrates, diffusion, oxidation and photolithography, doping and depositions, implantation, rapid thermal processing, metallization. patterning process, Photoresists, physical properties of photoresists, Storage and control of photoresists, photo masking process, Hard bake, develop inspect,

UNIT-3Nanoelectronic devices

Effect of shrinking the p-n junction and bipolar transistor; field-effect transistors, MOSFETs,Introduction, CMOS scaling, the nanoscale MOSFET, vertical MOSFETs, electrical characteristics of sub-100 nm MOS transistors, limits to scaling, system integration limits(interconnect issues etc.

UNIT-4Nano-Optoelectronic devices

Direct and indirect band gap semiconductors, QWLED, QWLaser, Quantum Cascade LaserIntegrated Micromachining Technologies for Transducer Fabrication

UNIT-5Applications of Functional Thin Films and Nanostructures

Functional Thin Films and Nanostructures for Gas Sensing, Chemical Sensors, Applicationsof Functional Thin Films for Mechanical sensing, Sensing Infrared signals by Functional Films.

BOOK FOR STUDY

1 Herbert Taub, Donald L. Schilling, Digital Integrated Electronics, McGraw-Hill, 1977

2 S.M. Sze, Ed, Modern Semiconductor Device Physics, Wiley, New York

3 S.M. Sze and K.K. Ng, Physics of Semiconductor Devices, 3rd Ed, Wiley, Hoboken.

4 S. Wolf and R.N. Tauber, Silicon Processing, vol. 1, (Lattice Press).

Reference Books

1.S.Wolf and R. N. Tauber, Silicon Processing for the VLSI Era. (Lattice Press, 2000)

2. Streetman, B.G. Solid State Electronic Devices, Prentice Hall, Fifth Edition, 2000

3.R. D. Doering and Y. Nishi, Handbook of Semiconductor Manufacturing Technology, CRC Press, Boca Raton.

Course Outcomes (Cos)

After the completion of this course, students will be:

CO1. This course would introduce students about designing and making process of integrated devices.

CO2. The various fabrication process taught in module-II would enrich their knowledge to various foundry fabrication processes enabling them with skills of nanofabrication.

CO3. Knowledge of functioning and construction of nanoscale electronic devices would cater the need to keep them update with recent technologies in the field.

CO4. Knowledge of functioning and construction of nanoscale optoelectronic devices would cater the need to keep them update with recent technologies in the field.

QUESTION PAPER PATTERN

Maximum Marks : 75

Exam Duration : 3 hours

Part A : 20 × 1 = 20 Answer **ALL** Questions (Two Questions from each unit)

Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question From Each Unit)

Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓			✓		✓	✓
	CO 2	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 3	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 4	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 5	✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 6	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 7	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 8	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 9	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 10	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓

MAJOR BASED ELECTIVE COURSE (MBEC)-III ANTENNA THEORY AND RADIOWAVE PROPAGATION

Theory Hours	**: 6**	**Course Code**	**: P21PH3MBE3:3**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA 25 ESE 75**

Objectives

- To understand the basic terminology and concepts of Antennas.
- To attain knowledge on the basic parameters those are considered in the antenna design process and the analysis while designing that.
- Analyze the electric and magnetic field emission from various basic antennas and mathematical formulation of the analysis.

Unit I - Basic antenna concepts:

Definition and functions of an antenna, comparison between an antenna & transmission line, radio communication link with transmitting antenna and a receiving antenna, radiation patterns of antennas-field and power patterns, all antenna types.

Unit II - Radiation of Electric dipole:

Potential functions and the electromagnetic field, Oscillating electric dipolederivations for E and H field components in spherical coordinate systems, Power Radiated by a current element, Application to antennas, Radiation from quarter wave monopole and half wave dipoles, Derivation for radiation resistance, application of reciprocity theorem to antennas, equality of directional patterns and effective lengths of transmitting and receiving antennas, directional properties of dipole antennas, antenna feeding methods.

UNIT - III Antenna parameters and definitions:

Beam area, beam width- Half-Power Beam width (HPBW)and First Null Beam width(FNBW) ,Polarisation, Radiation Intensity ,Beaperture-physical and effective apertures, effective height, transmission formula, antenna field zones, Transmission loss as a function of frequency. Antenna temperature and signal to noise ratio.am Efficiency, Directivity and directive gain, radiation resistance, radiation efficiency, resolution.

UNIT IV - Arrays of point sources:

Expression for electric fields from two, three and N element arrays- linear arrays: Broad-side array and End-Fire array- Method of pattern multiplication Binomial array-Horizontal and Vertical Antennas above the ground plane, Effect of ground on ungrounded antenna, Schelkunoff theorems for linear arrays, Dolph-Tchebysheff distribution for linear arrays.

UNIT V - Loop Antenna:

Small loop short magnetic dipole, comparison of far field of small loop and short dipole loop antennas, field pattern of circular loop antenna & radiation resistance of loop antenna, directivity of circular loop antennas with uniform current.

BOOK FOR STUDY:

1. “Antennas for all applications”, J.D. Krauss 3 RD Edition (TMH)

2. “Electromagnetic wave & radiating systems”, Jordan & Balmain PHI Publication

3. “Antenna & Wave Propagation”, K.D. Prasad Satyaprakash Publications

4. “Antenna Theory: Analysis and design”, C. Balanis Wiley India

Course Outcome (Cos):

After learning the course the students should be able to:

1. Explain the radiation through antenna and identify different types of antennas.
2. Identify and measure the basic antenna parameters
3. Design and analyze wire and aperture antennas
4. Design and analyze matching and feeding networks for antennas
5. Design and analyze antenna arrays 6. Identify the characteristics of radio-wave propagation.

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓			✓		✓	✓
	CO 2	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 3	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 4	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 5	✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 6	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 7	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 8	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 9	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	CO 10	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓

SELF STUDY COURSE - II - MOOC / NPTEL

Theory Hours	**:**	**Course Code**	**: P21PH3SS2**
Practical Hours	**: -**	**Credits**	**: 2**
Exam Hours	**: 2**	**Marks**	**: 100**

CORE COURSE (CC)-XIII: CONDENSED MATTER PHYSICS

Theory Hours	**: 6**	**Course Code**	**: P21PHC413**
Practical Hours	**: -**	**Credits**	**: 6**
Exam Hours	**: 3**	**Marks**	**:CIA ESE**
			25 75

OBJECTIVES:

- To relate crystal structure to symmetry, recognize the correspondence between real and reciprocal space.
- Acquire knowledge of the behavior of electrons in solids based on classical and quantum theories.
- To become familiar with the different types of magnetism and magnetism based phenomenon.
- To develop an understanding of the dielectric properties and ordering of dipoles in ferroelectrics.
- To get familiarized with different types of modern engineering materials.

UNIT-I: CRYSTAL STRUCTURE AND DEFECTS

Crystal lattice-Primitive and unit cell-seven classes of crystals-Bravias lattice- Miller indices-Reciprocal lattice-Structure (SC, BCC, FCC and HCP) - Lattice defects-Point, Line and plane defects-Schottky and Frenkel defects-Vacancies- Colour centres- Edge and screw dislocation-Grain boundaries.

UNIT-II: FREE ELECTRON THEORY AND ENERGY BANDS

Energy levels and density of orbitals-Fermi Dirac Distribution-Free electron gas in three dimensions-Heat capacity of electron gas- Electrical conductivity and ohm's law-Motion in magnetic field- Hall effect –Thermal conductivity of metals-Nearly free electron model- Kroneig Penny model-Semiconductors-Band gap-Effective mass- Intrinsic carrier concentration.

UNIT-III: MAGNETISM

Wiess theory of Paramagnetism-Quantum theory of Paramagnetism-Diamagnetisation of a Paramagnetic salt-Paramagnetic susceptibility of conduction electron- Hund's rules-Ferromagnetic order-Curie point and the exchange integral- Temperature dependence of saturation magnetization-Magnons- Antiferromagnetic order- Ferromagnetic Domains-Origin of Domains and Hysteresis- Introduction to Ferrites.

UNIT-IV:DIELECTRICS AND FERROELECTRICS

Macroscopic electric field- Local electric field at an atom-Dielectric constant and polarizability-Types of polarisability- Temperature and frequency dependence- Determination of Dielectric constant-Claussius-Mossotti equation-Ferroelectric materials - ferroelectric Domains - - Polarization Catastrope.]

UNIT V:MODERN ENGINEEERING MATERIALS

Polymer, Ceramics, Super strong materials-Elactrets-Cermets-Nuclear Engineering materials-Thermoelectric materials- Metallic Glasses-Fibre reinforced Plastics-Metal matrix composities-High temperature materials –Soft and Hard Magnetic materials-Basic idea of Nanomaterials.

BOOKS FOR STUDY:

1. Solid State Physics - S. O. Pillai, New Age International, New Delhi, (1995).
2. Solid State Physics – Singhal.(Arihant publishers) (2011)
3. Solid State Physics – Gupta, Kumar and Sharma.(2013)

BOOKS FOR REFERENCE:

1. Introduction to Solid State Physics -C. Kittel Wiley Eastern, New Delhi. (2018)
2. Solid State Physics - N. W. Ashcrof and N. D. Mermin. Half, Rineharf and Winston Philadelphia.(1976)
3. Solid State Physics- J. S. Blakemore, Cambridge University Press.(1985)
4. Solid State Physics-A. J. Dekker, McMillion, Madras, (1971).
5. An Introduction to X-ray Crystallography- M. M. Woolfron, Cambridge University Press (1991).

COURSE OUTCOME (COs):

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

CO1: Able to correlate the X-ray diffraction pattern for a given crystal structure based on the corresponding reciprocal lattice and understand the typesof crystalline imperfections

CO2: To enhance the ability of students to understand electron and band theories.

CO3: Able to explain how the predicted electronic properties of solids differ in the classical free electron theory, quantum free electron theory and thenearly free electron theory.

CO4: To explain various magnetic phenomena and describe the different types of magnetic ordering based on the exchange interaction.

CO5: Acquisition of knowledge concerning the electrical behavior of dielectric materials (polar and non-polar)

CO6: Explain the structural dependence of electrical, optical and mechanical properties of modern engineering materials.

QUESTION PAPER PATTERN

Maximum Marks : 75

Exam Duration : 3 hours

Part A : 20 × 1 = 20 Answer **ALL** Questions (Two Questions from each unit)

Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question From Each Unit)

Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO								1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓											✓	✓		✓	✓	✓
	CO 2	✓	✓	✓	✓	✓										✓	✓	✓		✓		✓
	CO 3	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	CO 4	✓	✓	✓		✓		✓	✓	✓	✓			✓	✓	✓	✓		✓	✓		✓
	CO 5	✓		✓	✓	✓		✓		✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
	CO 6	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓

CORE PRACTICAL (CP) -XIV

PROGRAMS WITH MICROPROCESSOR, MICROCONTROLLER AND C++ PROGRAM

Theory Hours	**: -**	**Course Code**	**: P21PHC414P**
Practical Hours	**: 6**	**Credits**	**: 3**
Exam Hours	**: 4**	**Marks**	**:CIA 40 ESE 60**

OBJECTIVES:

- To develop programming skills of microprocessor and C++ programming in solving some mathematical problems and their applications.
- To understand numerical methods for employing such as C++ for simulation for different physical problems and graphic analysis of physical data.

(Any six of the following)

1. 8 Bit addition, subtraction, Multiplication and division using 8085.
2. 16 bit addition, 2's complement and 1's complement subtraction using 8085.
3. Conversion from decimal to octal and hexa systems.
4. Conversion from octal, hexa to decimal systems.
5. Largest and Smallest element of N numbers.
6. Ascending and Descending order of N numbers using 8085.
7. Square, square root and factorial of a given number using 8085.
8. Display, Flashing, Rolling of a Message - 8085.
9. Study of DAC interfacing.
10. Study of ADC interfacing.
11. Traffic control system using microprocessor.
12. Stepper motor control using microprocessor.
13. Square wave, Triangular wave generation using microprocessor.
14. Character words display using microprocessor.
15. Micro Controller 8051- Arithmetic operations.
16. Micro Controller 8051- Logical operations.
17. Micro Controller 8051- DAC interfacing.
18. Micro Controller 8051-Ascending and Descending order of numbers.

Computer Practical by C++ Programming

(Any six of the following)

1. Roots of algebraic equations – Newton Raphson method.
2. Least square curve fitting – Straight line.
3. Lagrangian interpolation method.
4. Numerical integration – Trapezoidal rule.
5. Numerical integration – Simpson's rule.
6. Numerical integration – Euler's rule.
7. Solution of differential equations- RungeKutta 2^{nd} order method.
8. Solution of differential equations – RungeKutta 4^{th} order method.
9. Calculation of Hartmann's constant.
10. Transpose of matrix.

COURSE OUTCOMES:

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

CO1:Understand and apply the basic knowledge of computational physics in solving various physical problems.

CO2: Write C++ Programmesfor different applications.

CO3: Demonstrate ability to handle arithmetic operations using assembly language.

CO4: Set up programming strategies and select proper mnemonics and run their program on the training boards.

CO5: Practice different types of programming keeping in mind technical issues and evaluate possible causes of discrepancy in practical's.

CO6: Develop testing and experimental procedures on Microprocessor and microcontroller to analyze their operation under different cases.

CO7: Demonstrate the ability to interact effectively on a social and interpersonal level with fellow students.

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓		✓	✓	✓	✓
	CO 3	✓	✓		✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
	CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓		✓	✓
	CO 5	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓	✓
	CO7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓

CORE COURSE (CC)-XV - PROJECT

Theory Hours	**: 12**	**Course Code**	**: P21PHPW415**
Practical Hours	**: -**	**Credits**	**: 6**
Exam Hours	**: -**	**Marks**	**: 100**

In this course, students are required to undertake a project work on a research problem and submit their results as a report followed by oral presentation in front ofaviva-voce committee.

MAJOR BASED ELECTIVE COURSE (MBEC)-IV-CRYSTAL GROWTH, THIN FILM AND NANO SCIENCE

Theory Hours	**: 6**	**Course Code**	**: P21PH4MBE4:1**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA ESE**
			25 75

OBJECTIVES:

- To get a prolonged exposure on the basics of growing crystals and thin films deposition.
- To understand the various aspects related to preparation, characterization and study of different properties of the nanomaterials, so that the students can pursue this emerging research field as a career.

UNIT I: CRYSTAL GROWTH TECHNIQUES

Low temperature solution growth: Solubility and super solubility-Expression for super saturation – Miers T-C diagram – Constant temperature bath and crystallizer – Seed preparation and mounting – Slow cooling and solvent evaporation.

Gel Growth Techniques

Principle – Various types – Structure of gel –Importance of gel – Experimental procedure – Chemical reaction method – Single and double diffusion method – Chemical reduction method.

UNIT II: THIN FILM PREPARATION TECHNIQUES

Thin films – Introduction to vacuum technology – Deposition techniques - Physical methods – Resistance heating – Electron beam method - Sputtering – Reactive sputtering - Chemical methods –Spray pyrolysis – Electro deposition – Sol-gel techniques.

UNIT III: BASICS OF NANOTECHNOLOGY

Atomic structures-Molecular and atomic size – Bohr radius – Emergence of Nanotechnology – Challenges in Nanotechnology – Carbon age – New forms of carbon (from Graphene sheet to CNT) – Definition of a Nano system – Types of nanocrystals – One Dimensional (1D) – Two Dimensional (2D) – Three Dimensional (3D) nanostructured materials – Quantum dots.

UNIT IV: SYNTHESIS OF NANOMATERIALS

Top down Approach, Bottom Up Approach, Wet Chemical Synthesis Methods, Micro emulsion Approach, Synthesis of metal and semiconductor nanoparticles by colloidal route, Sol Gel Methods, Sonochemical Approach, Chemical Vapour Depositions.

UNIT V: CHARACTERIZATION TECHNIQUES

Thin Film thickness measurement – Microbalance method – Optical interference method - Four probe method to determine film resistivity. Working principle and applications: Particle size analyzer -Atomic force microscopy (AFM) - Transmission electron microscopy (TEM) – Photoluminescence-Thermo luminescence.

BOOKS FOR STUDY:

1. P.SanthanaRaghavan&P.Ramasamy, Crystal Growth Processes and methods, KRV Publication, Kumbakonam, (2000).
2. A.Goswami, Thin film fundamentals, New age international (P) Ltd., New Delhi, (2006).
3. Poole & Owners, Introduction to Nanotechnology, Wiley India Pvt. Ltd, (2007).
4. Chattopadhyay & Banerjee, Introduction to Nano science and Nanotechnology, PHI Learning Pvt. Ltd., (2009).
5. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, Instrumental Methods of Analysis, 7th edition, CBS publishers and Distributors, New Delhi, (1986).
6. S. Zhange, L. Li and A. Kumar, Materials Characterization Techniques (CRC) press, Bota, Racon, 2009.

BOOKS FOR REFERENCE :

1. LI Maissel and R Clang, Hand book of Thin films Technology, McGraw Hill, New York, (1970).
2. K L Chopra, Thin film Phenomena, McGraw Hill, New York, (1990).
3. M. Ohring, Materials science of Thin films, 2nd Edition, Academic press, Elsevier, New Delhi (2002).
4. J.W.Mullin, - Crystallization, Elsevier Butterworth-Heinemann, London, (2004).
5. A.W.Vere - Crystal Growth: Principles and Progress- Plenum Press, New York, (1987).

COURSE OUTCOMES (COs):

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

CO1: Understand the concepts related to crystal growth, epitaxy and the necessary concepts in thermodynamics and kinetics.
CO2: Explain the connection between growth parameters and the quality and properties of the grown materials.
CO3: Awareness of recent trends in crystal growth, super lattices and heterostrucutres.
CO4: Knowledge of the preparation techniques of thin films using physical and chemical deposition method.
CO5: To impart the basic knowledge on nanoscience and nanotechnology and understand the exotic properties of nanostructured materials.
CO6: Study the various techniques available for the processing of nanostructured materials.
CO7: Acquire in-depth knowledge of at least one specialization area within the field of nano science and nanoscale.
CO8: Gain fundamental knowledge to undertake research.

QUESTION PAPER PATTERN

Maximum Marks **:** 75

Exam Duration **:** 3 hours
Part A **:** 20 × 1 = 20 Answer **ALL** Questions (Two Questions from each unit)
Part B **:** 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question From Each Unit)

Part C **:** 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓
	CO 3	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	CO 4	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓	✓
	CO7	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	CO8	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓

MAJOR BASED ELECTIVE COURSE (MBEC)-IV–THIN FILM SCIENCE AND TECHNOLOGY

Theory Hours	**: 6**	**Course Code**	**: P21PH4MBE4:2**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA ESE 25 75**

OBJECTIVES:

- To familiarize with preparation and properties of Thin films
- To understand the preparation and characterization of Thin films.
- To apply the knowledge of Thin film technology into applications.

UNIT I - REPARATION OF THIN FILMS

Kinetic aspects of gases in a vacuum chamber – classifications of vacuum ranges – production of vacuum - pressure measurement in vacuum systems – thin film (epitaxy) – definition – types of epitaxy. Different Growth Techniques: Liquid phase epitaxy – vapour phase epitaxy – molecular beam epitaxy – metal organic vapour phase epitaxy – sputtering (RF & DC) – pulsed laser deposition. Thickness Measurement: Microbalance technique – photometry- ellipsometry – interferometry.

UNIT **II - KINETICS OF THIN FILMS**

Nucleation Kinetics: types of nucleation – kinetic theory of nucleation – energy formation of a nucleus – critical nucleation parameters; spherical and non spherical (cap, disc and cubic shaped) Growth Kinetics: Kinetics of binary (GaAs, InP, etc.), ternary ($Al_{1-x}Ga_xAs$, $Ga_{1-x}In_xP$, $InAs_{1-x}Px$, etc.) and quaternary ($Ga_{1-x}In_xAs_{1-y}P_y$, etc.) semiconductors – derivation of growth rate and composition expressions.

UNIT III - CHARACTERIZATION 9

X-ray diffraction – photoluminescence – UV-Vis-IR spectrophotometer – Atomic Force Microscope – Scanning Electron Microscope – Hall effect – Vibrational Sample Magnetometer – Secondary Ion Mass Spectrometry – X-ray Photoemission Spectroscopy.

UNIT IV - PROPERTIES OF THIN FILMS 9

Dielectric properties – experimental technique for the determination of dielectric properties – optical properties – experimental technique for the determination of optical constants – mechanical properties – experimental technique for the determination of mechanical properties of thin films – magnetic and superconducting properties.

UNIT V - APPLICATIONS 9

Optoelectronic devices: LED, LASER and Solar cell – Micro ElectromechanicalSystems (MEMS) – Fabrication of thin film capacitor – application of ferromagnetic thin films; data storage, Giant Magnetoresistance (GMR) – sensors – fabrication and characterization of thin film transistor and FET – quantum dot.

BOOK FOR STUDY

1. Goswami. A, Thin Film Fundamentals, New Age International (P) Limited, New Delhi, 1996.
2. AichaEishabini-Riad, Fred D. Barlow and ISHN, Thin film Technology Handbook, McGraw-Hill Professional Publishers, 1997.
3. Krishna Seshan, Handbook of Thin Film Deposition, William Andrew Publishers, 2012.
4. Donald Smith, Thin-Film Deposition: Principles and Practice, McGraw-Hill Professional Publishers, 1995.

COURSE OUTCOME (COs)

At the end of the course, the students will be able to understand

CO1 : The basic concepts about the thin film technology

CO2 : The importance of use of thin films in application and research.

CO3: Gain fundamental knowledge to undertake research.

QUESTION PAPER PATTERN

Maximum Marks : 75

Exam Duration : 3 hours

Part A : 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit

Part B : 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)

Part C : 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓
	CO 3	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
	CO 4	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓		✓	✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓	✓
	CO7	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	CO8	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓

MAJOR BASED ELECTIVE COURSE (MBEC)-IV -
NANO PHOTONICS

Theory Hours	**: 6**	**Course Code**	**: P21PH4MBE4:3**
Practical Hours	**: -**	**Credits**	**: 4**
Exam Hours	**: 3**	**Marks**	**:CIA 25 ESE 75**

OBJECTIVES:

- To understand the concepts of Nano Photonics.
- To know the importance of photonics materials.
- To use the ideas of nano photonics and apply in research

UNIT I - QUANTUM CONFINED MATERIALS

Quantum dots – optical transitions – absorption-inter-band transitions-quantum confinement intraband transitions-fluorescence / luminescence– photoluminescence / fluorescence optically excited emission – electroluminescence emission.

UNIT II- PLASMONICS

Internal reflection and evanescent waves- plasmons and surface plasmon resonance (SPR)- Attenuated total reflection- Grating SPR coupling- Optical waveguide SPR coupling- SPR dependencies and materials- plasmonics and nanoparticles.

UNIT III- NEW APPROACHES IN NANOPHOTONICS

Near-Field Optics- Aperture near-field optics- Apertureless near-field optics- Near-field scanning optical microscopy (NSOM or SNOM)- SNOM based detection of plasmonic energy transport- SNOM based visualization of waveguide structures- SNOM in nanolithography- SNOM based optical data storage and recovery.

UNITIV -ELECTRONIC & PHOTONIC MOLECULAR MATERIALS

Preparation –Electroluminescent Organic materials - Laser Diodes – Quantum well lasers:- Quantum cascade lasers- Cascade surface-emitting photonic crystal laser- Quantum dot lasers- Quantum wire lasers:- White LEDs – LEDs based on nanowires - LEDs based on nanotubes- LEDs based on nanorods High Efficiency Materials for OLEDs- High Efficiency Materials for OLEDs - Quantum well infrared photo detectors.

UNIT V - PHOTONIC CRYSTALS

Important features of photonic crystals- Presence of photonic bandgap- Anomalous Group Velocity Dispersion - Microcavity-Effects in Photonic Crystals- Fabrication of photonic crystals- Dielectric mirrors and interference filters- Photonic Crystal Laser- PC based LEDs- Photonic crystal fibers (PCFs)- Photonic crystal sensing.

BOOK FOR STUDY:

1. Masuhara. H, Kawata. S and Tokunaga. F, Nano Biophotonics, Elsevier Science, 2007.
2. Saleh. B.E.A and Teich. A.C, Fundamentals of Photonics, John-Wiley & Sons, New York, 2007.
3. Ohtsu.M, Kobayashi.K, Kawazoe.T and Yatsui.T, Principles of Nanophotonics (Optics and Optoelectronics), University of Tokyo, Japan, 2003.
4. Joannopoulos.J.D, Meade. R.D and Winn. J.N, Photonic Crystals, Princeton University Press, Princeton, 1995.
5. Ranier. W, Nano Electronics and Information Technology, Wiley, 2003.

COURSE OUTCOMES (Cos):

At the end of the course, the students will be able to understand

CO1 - The concepts of nano photonics and its uses

CO2 - The importance of applications of Nano photonics in design of devices

CO3 **-** Gain fundamental knowledge to undertake research.

QUESTION PAPER PATTERN

Maximum Marks : 75

Exam Duration **:** 3 hours

Part A **:** 20 × 1 = 20 Answer **ALL** Questions (Multiple Choice Questions) Four questions from each unit

Part B **:** 5× 5 = 25 Answer **ALL** Questions (Either or Type – Two Question from Each Unit)

Part C **:** 3 × 10 = 30 Answer Any **Three** (One Question from each Unit)

MAPPING OF POs AND PSOs WITH COs

COURSE OUTCOMES		PROGRAMME OUTCOMES (POs)													PROGRAMME SPECIFIC OUTCOMES(PSOs)							
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
	CO 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓
	CO 3	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
	CO 4	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓
	CO 5	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓		✓	✓	✓
	CO 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓	✓
	CO7	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	CO8	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓

LIST OF ELECTIVE PAPERS

I Semester

1. Analog electronics, Microprocessor and Microcontroller
2. Microprocessor and Microcontroller
3. Digital electronics and Microprocessors.

II Semester

1. Experimental techniques and instrumentation
2. Instrumentation and control
3. Measurement and instrumentation

III Semester

1. Communication Electronics
2. Integrated Electronics
3. Antenna theory and Radio wave propagation

IV Semester

1. Crystal growth, Thin Film and Nano Science
2. Thin film science and technology
3. Nano Photonics