PG & RESEARCH DEPARTMENT OF PHYSICS

NATIONAL COLLEGE
(AUTONOMOUS)

TIRUCHIRAPPALLI

M. Sc. - SYLLABUS

FROM JUNE 2019 ONWARDS

COURSE CONTENTS

Semester	Course	Code No.	Title of the course	Instrn. Hrs.	Credit	Exam Hrs.	Marks			Total Marks
							Int.	Ext.		
								Oral	W	
I	CC-I	P19PH1	Mathematical Physics	6	5	3	25		75	100
	CC-II	P19PH2	Classical Mechanics	6	5	3	25		75	100
	CC-III	P19PH3	Statistical Mechanics	6	5	3	25		75	100
	CC-IVP	P19PH4P	Physics Practicals - I (General & Electronics)	6	5	4	25	70	5	100
	EC-I	P19PH5E	Special Electronics - I	6	4	3	25		75	100
	Papers:5			**30**	**24**					**500**
II	CC-V	P19PH6	Atomic and Molecular Spectroscopy	6	5	3	25		75	100
	CC-VI	P19PH7	Quantum Mechanics	6	5	3	25		75	100
	CC-VII	P19PH8	Nuclear and Particle Physics	6	5	3	25		75	100
	CC-VIIIP	P19PH 9P	General and Electronics Practical - II	6	5	4	25	70	5	100
	EC-II	P19PH10E	Electronics - II	6	4	3	25		75	100
	Papers:5			**30**	**24**					**500**
III	CC-IX	P19PH11	Electromagnetic Theory	6	5	3	25		75	100
	CC-X	P19PH12	Crystal Growth and its Characterization Techniques	6	5	3	25		75	100
	CC-XIP	P19PH13P	Advanced Electronics - I - Microprocessor and Microcontroller	6	5	4	25	70	5	100
	EC III	P19PH14E	Numerical methods and C Programming	6	4	3	25		5	100
	EC IV	P19PH15E	Basics of Nanoscience and its Applications	6	4	3	25		75	100
	Papers:5			**30**	**23**					**500**
IV	CCXII	P19PH16	Condensed Matter Physics	6	5	3	25		75	100
	CCXIIP	P19PH17P	Advanced Electronics - II	6	5	3	25	70	5	100
	EC V	P19PH18E	Fiber Optics and Non-Linear Optics	6	4	3	25		75	100
	PROJECT	P19PHP19	Project Work	12	5	--			100	100
	Papers:5			**30**	**19**					**19**
			Total Credits		**90**					**1900**

Programme: M. Sc., PHYSICS

PO No.	Programme Outcomes *Upon completion of the M.Sc. Degree Programme, the post graduate will be*
PO-1	To practice analytical thinking and research skills in his career requirements.
PO-2	Strive for consistent academic excellence and to go for research related career.
PO-3	Appreciate and apply Basic Physics principles in everyday life.
PO-4	Realize and develop an understanding of the impact of physics and science on society.
PO- 5	Apply the knowledge of Mathematics and fundamentals of Physics to the solution of complex problems in Physics.
P**O-6**	Excel in the research fields related to Physics and Materials Science.

PSO No.	**Programme Specific Outcomes** **Upon completion of these courses the student**
PSO-1	Will have the capacity to develop analytical thinking and solving approaches.
PSO-2	Will be able to disseminate subject matter to upcoming student community.
PSO-3	Will have a perfect background for pursuing pedagogic education.
PSO-4	Will get familiarity with contemporary research within various fields of Physics.
PSO-5	M.Sc., project (the master thesis) enable to enter new problem areas that require an analytical and innovative approaches.
PSO-6	Will be able to apply Physics principles to manage projects in multidisciplinary environment.

FIRST YEAR - SEMESTER I

Course Title	MAJOR CORE 1: MATHEMATICAL PHYSICS
Total Hours	90
Hours/Week	6
Code	P19PH1
Course Type	Theory
Credits	5
Marks	100

Course Objectives:

To enable the learner to

CO No.	Course Objectives
COB-1	Apply, analyze and evaluate problems using Fourier series and Fourier transforms.
COB-2	Apply, analyze and evaluate problems through vector calculus.
COB-3	Understand the concept of complex numbers and to apply wherever needed.
COB-4	Understand group theory's basic concepts.
COB-5	Use matrices in solving difficult Physics problems in a relatively simple manner.

SYLLABUS

Core Course – I MATHEMATICAL PHYSICS

Semester – I **Course Code: P19PH1**

Instruction hrs. /week: 6 hrs. **Credit : 5**

UNIT - I: FOURIER SERIES AND TRANSFORMS

Review of Trigonometric series and Euler's formula - Fourier series – Dirichlet's theorem, condition – Problems on periods with simple functions Sinnx, Cosnx. – Fourier transform – Integral theorem – Fourier Sine, Cosine transform - Shifting theorem – Change of scale.

UNIT- II: VECTOR ANALYSIS AND VECTOR SPACE

Vector Analysis - Concept of vector and scalar fields – Gradient, divergence, curl and Laplace operator – Line integral, surface integral and volume integral – Gauss divergence theorem-Green's theorem-Stoke's theorem.

Vector Space: Definitions – Linear Dependence (LD) and Linear Independence (LI) of vectors – Gram-Schmidt's orthogonalisation process.

UNIT -III: COMPLEX ANALYSIS

Functions of complex variables – Differentiability – Cauchy-Riemann conditions – Cauchy's integral theorem and integral formula – Residues and singularities - Cauchy's residue theorem – Evaluation of definite integrals (Trignometric functions around the unit circles).

UNIT- IV: GROUP THEORY

Basic definition –Multiplication table – Subgroups, cosets and classes -Point groups and space groups-Homomorphism and Isomorphism –Representation of finite groups-Reducible and irreducible representations –The great Orthogonality theorem-Character table for C_{2v} and C_{3v} Point group.

UNIT- V: MATRICES

Transpose of a matrix-Inverse matrix-Adjoint matrix-Unitary matrix- Hermitian matrix-Skew Hermitian matrix - Rank of a matrix - Characteristic equation-Eigen values and Eigen vectors- Cayley-Hamilton theorem-Diagonalization of a matrix (reduction of a matrix to diagonal form).

BOOKS FOR STUDY

1. L. A. Pipes and L. R. Harvill, Applied Mathematics for Engineers and Physicists –Mc Graw-Hill (1987).
2. Satya Prakash, Mathematical Physics, Sulthan, Chand & Sons., New Delhi (2006).
3. Goyal and Gupta Laplace and Fourier Transforms,.Pragati Prakashan, Meerut (1995).

BOOKS FOR REFERENCE

1. B.D.Gupta, Mathematical Physics, Vikas Publishing House Pvt Ltd., New Delhi (2006).
2. A. K. Ghatak, I.C. Goyal and S. J. Chua, Mathematical Physics, Mac Millan India Ltd. (1995).

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSO's Addressed	Cognitive Level
CO-1	Solve problems using Fourier series and Fourier transforms, apply for X-ray diffraction studies	PSO-1	C
CO-2	Solve problems using Vector calculus	PSO-2	E
CO-3	Understand complex variables and their utility	PSO-2	R
CO-4	Evaluate problems using group theory	PSO-4	E
CO-5	Apply matrices basic to solve higher level problems in quantum mechanics	PSO-5	A

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand;

Ap – Apply; An – Analyse; E- Evaluate; C – Create: PSO –Programme specific out come

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FIRST YEAR - SEMSETER I

Course Title	**MAJOR CORE 2: CLASSICAL MECHANICS**
Total Hours	**90**
Hours/Week	**6**
Code	**P19PH2**
Course Type	**Theory**
Credits	**5**
Marks	**100**

Course Objectives (COB): To enable the learner to

CO **No.**	**Course Objectives**
COB-1	Understand the fundamental Principles of D'Alembert and derive Langrange's equation
COB-2	Analyse Hamiltonian formalism and solve related problems
COB-3	Apply both Lagrangian and Hamiltonian concepts to simple machines in physics
COB-4	Understand the concept of brackets and Jacobian formulation
COB-5	Apply classical formulation to simple oscillations

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Core Course – II -CLASSICAL MECHANICS

Semester – I **Course Code: P19PH2**

Instruction hours/week – 6 **Credit : 5**

UNIT-I: FUNDAMENTALS AND LAGRANGIAN FORMALISM

Principle of virtual work-Generalized co-ordinates – Generalized momentum – Generalized kinetic energy – D'Alembert's principle –Lagrangian's equation of motion from D'Alembert's principle – Cyclic co-ordinates – Conservation of angular momentum and total energy.

UNIT-II: HAMILTONIAN FORMALISM

Hamilton as total energy operator – Hamilton's variational principle – Deduction of Hamilton's principle from D'Alembert's principle – Deduction of Lagrangian equation of motion from Hamilton's principle – Hamilton's equation of motion – Hamilton's equation of motion from Hamilton's variational principle.

UNIT-III: APPLICATIONS AND CANONICAL TRANSFORMATIONS

Application of Lagrangian formalism a)Atwood's machine b)Simple pendulum – Transformations a)point or contact b)Canonical – Generating function of canonical transformation – Four types of canonical transformations - Δ Variation – Principle of least action.

UNIT-IV: BRACKETS AND HAMILTON – JACOBI THEORY

Lagrangian and Poisson's brackets – Symmetry, invariance of Poisson bracket under Canonical transformation – Hamilton's characteristic function – Hamilton-Jacobi equation – Physical significance of S – Action – angle formalism- Kepler's problem in action – angle variables.

UNIT-V: LINEAR OSCILLATIONS

Theory of small oscillations – Normal modes of oscillations and frequencies (frequencies) – Simple harmonic oscillator, Double pendulum and its normal modes – CO_2 as linear symmetrical molecule, its normal frequencies and its normal modes.

BOOKS FOR STUDY

1. Gupta-Kumar-Sharma, Classical Mechanics, S. Chand and Co. (1987).

BOOKS FOR REFERENCE

1 H. Goldstein, Classical Mechanics, McGraw Hill Pvt., New Delhi (1981).
2. G. Aruldhas – Classical Mechanics – PHI Learning Pvt., New Delhi (2009).

Course Outcomes:

The Learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	List the fundamental principles of D'Alembert and Hamiltonian and apply it to derive Langrange's equation from D'Alembert and Hamiltonian principle	PSO 3	R
CO-2	Describe Hamiltonian formalism	PSO 2	U
CO-3	Explain the concept of Hamiltonian Canonical equations of motion	PSO 6	U
CO-4	Compare Jacobian formulation with Lagrangian and Hamiltonian	PSO 6	U, An
CO-5	Understand linear oscillations using classical approach	PSO 4	Ap

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FIRST YEAR - SEMSETER I

Course Title	**MAJOR CORE 3: STATISTICAL MECHANICS**
Total Hours	**90**
Hours/Week	**6**
Code	**P19PH3**
Course Type	**Theory**
Credits	**5**
Marks	**100**

General Objective: To study the fundamental principles of thermodynamics and various statistical mechanics and to understand the basic ideas of particle behavior

Course Objectives (COB):

To enable the learner to

COB- No.	Course Objectives
COB-1	Understand the fundamental principles thermodynamics
COB-2	Analyse kinetic theory of gas particles
COB-3	Understand the nature of classical and semi classical particle and their statically different nature
COB-4	Understand the concept of quantum particle nature and their statistics
COB-5	Understand the application advanced statistical tools

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Core Course - III - STATISTICAL MECHANICS

Semester – I **Course Code: P19PH3**

Instruction hours/week – 6 **Credit: 5**

UNIT – I: REVIEW OF THERMODYNAMICS

First law –Entropy and second law - Principle of degradation of energy- Thermodynamic Potentials and its reciprocity relations-Gibb's-Helmholtz relation- Thermodynamic equilibria- Nernst heat theorem- Phase transitions-First order and Second order.

UNIT – II: KINETIC THEORY

Distribution function-Boltzmann transport equation for homogeneous and heterogeneous medium and its validity-Kinetic theory of gases-Maxwell Boltzmann distribution law of velocities-Mean free path-Expression and experimental determination-Viscosity.

UNIT – III: STATISTICAL MECHANICS

Macro and micro states – Stirling's approximation –Classical Maxwell- Boltzmann distribution law - Principle of equipartition of energy- Phase space and ensembles - Liouville's theorem-Statistical equilibrium- Partition function - Relation between partition function and thermodynamic quantities-Bose Einstein statistics, Fermi Dirac statistics.

UNIT – IV: QUANTUM STATISTICAL MECHANICS

Black body and Planck's radiation - Specific heat of solids-Dulong and Petit's Law-Einstein's theory- Debye's theory.

Ideal Bose gas - Energy, pressure of a gas-Gas degeneracy-Bose-Einstein condensation – properties of liquid Helium I and II.

UNIT – V: ADVANCED STATISTICAL MECHANICS

Electron gas - Free electron model and thermionic emission –White Dwarfs – Electrons in White Dwarfs - Wiener- Khinchine theorem and its correlation function - Bragg- Williams's approximation- One dimensional Ising model.

BOOK FOR STUDY

1.Gupta, Kumar, Sharma , Statistical Mechanics, Pragati Prakashan Publications(2005).

BOOKS FOR REFERENCE

1. Sathya Prakash, Statistical Mechanics, Pragati Prakasam Publications (2004).
2. K Huang, Statistical Mechanics, Wiley Eastern Ltd., New Delhi (1986).
3. F. Reif, Statistical and Thermal Physics, McGraw Hill, International Edition, Singapore (1975).
4. B.K Agarwal and N. Eisnor, Statistical Mechanics, Wiley Eastern Limited, New Delhi, 2nd Edn. (1989).
5. Mayer Joseph Edward, Statistical Mechanics, John Wiley and Son, New York (1949).

Course Outcomes:

The Leaner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	List the fundamental theorems that governs the thermodynamics of gas molecules	PSO 3	U
CO-2	Describe the basics of kinetic theory that governs the different natured particles	PSO 2	U
CO-3	Explain the concept of statistics of non-quantum particles	PSO 6	U
CO-4	Compare Maxwell Boltzmann, Bose-Einstein and Fermi Dirac statistics in quantum statistics	PSO 6	U, An
CO-5	Discuss the different models suggested on the basis of statistical approach	PSO 4	U, An

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FIRST YEAR - SEMESTER - I

Course Title	**MAJOR CORE 4: MAJOR PRACTICAL: I GENERAL AND ELECTRONICS EXPERIMENTS**
Total Hours	**90**
Hours/Week	**6**
Code	**P19PH4P**
Course Type	**Practical**
Credits	**5**
Marks	**100**

Course Objectives (CBO): To enable the learner to

CO No.	**Course Objectives**
COB-1	Understand principles of Op-amp and apply it to generate waves, do analog computation and explain its parameters
COB-2	Apply the concept of transistor to amplify the signals and study its characteristics
COB-3	Construct and analyse monostable, bistable and astable multivibrators using IC 555 timer
COB-4	Understand, analyze and apply the principles of different types of oscillators
COB-5	Understand and explain the characteristics of various semiconductor devices

Any FOURTEEN experiments only

1. Determination of q, n, σ by elliptical fringes method.
2. Determination of Stefan's constant.
3. Determination of Rydberg's constant.
4. Study of Hall's effect in a given semiconductor.
5. Determination of dielectric constant at high frequency by Lecher wire method.
6. Determination of wavelength of the monochromatic source using biprism.
7. Determination of charge of the electron using spectrometer experiments.
8. Determination of the wavelength of the predominant colors of a given Cu/Fe spectrum photo through Hartmann's formulas.
9. Full adder demonstration using both discrete ICs and NAND ICs only.
10. Design and study of Wein's bridge oscillator using OPAMP IC 741.
11. Study the Characteristics of FET and construct an amplifier using FET.
12. Study the thermal conductivity of the given probe using Forbe's method.
13. Determination of the compressibility of the given liquid using R.F oscillator output.
14. Full subtraction demonstration using both discrete ICs and NAND ICs only.
15. Instrumentation amplifier using IC 741.
16. V-I characteristics of the SOLAR cell.
17. G.M Counter
18. Michelson Interferometer
19. Iodine Spectral analysis
20. Bromine Spectral analysis

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FIRST YEAR - SEMESTER I

Course Title	ELECTIVE COURSE-I: SPECIAL ELECTRONICS– I : MICRO ELECTRONIC DEVICES
Total Hours	90
Hours/Week	6
Code	P19PH5E
Course Type	Elective - Theory
Credits	4
Marks	100

Course Objectives (COB):

To enable the learner to

CO No.	Course Objectives
COB-1	Understand the working of different Semiconductor devices
COB-2	Analyse the concept of certain special semiconductor devices
COB-3	Apply the characteristics of operational amplifier for different circuits
COB-4	Apply the op-amp to different oscillator circuits and digital applications
COB-5	Learn to fabricate ICs and then the concepts of IC 555 as a timer operations

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Elective Course – I SPECIAL ELECTRONICS - I: MICRO ELECTRONIC DEVICES

Semester - I **Course Code: P19PH5E**

Instruction hrs /week: 6 hrs. **Credit: 4**

UNIT- I: SEMI CONDUCTOR DIODES

Continuity Equation (PN Junction) -Tunnel diode - Backward diode -Varactor diode – PIN diode-Schottky diode - IMPATT Diode - Gunn diode -Optoelectronic diodes - LED and photo diode, Laser diode – Hall effect in semi conductors.

UNIT -II: SPECIAL SEMICONDUCTOR DEVICES

JFET- Structure and working - V-I Characteristics under different conditions - Biasing of JFET-DC load line-CS amplifier design-MOSFET: Depletion and enhancement type MOSFFT - Comparison of p with n-channel FETs - Digital MOSFET circuits- Complementary MOS, biasing the FET - FET as a Voltage Variable Resistor (VVR) — Common source and drain amplifier at high frequencies – SCR , DIAC , TRIAC -characteristics and applications

UNIT – III: OPERATIONAL AMPLIFIERS

Operational amplifier characteristics-Input offset current and voltage- Frequency response - Inverting and non-inverting amplifier -Voltage follower -Differential amplifier-Instrumentation amplifier- Voltage to current and current to voltage conversions- Log and antilog amplifiers -Integrating and differential circuits.

UNIT-IV: OP-AMP APPLICATIONS (OSCILLATORS AND CONVERTORS)

Oscillators: Schmitt's trigger -Square (Astable multivibrator)- Triangular-Sine wave generators-Phase shift and Wien bridge oscillator-Filter circuits - First order low pass filter-Band pass filter-High pass filter.

Convertors: Digital to Analog conversion: weighted resistor - Binary R-2R ladder - Analog to Digital conversion: counter type ADC - Successive approximation converter – Dual slope ADC.

UNIT – V: IC FABRICATIONS AND IC TIMER

Fabrications: Basic monolithic ICs - Epitaxial growth -Masking -Etching -Impurity diffusion-Fabricating monolithic resistors, diodes, transistors, inductors and capacitors - Circuit layout - Contacts and inter connections

555 Timer – Description of the functional diagram -Mono stable operation - Bistable multi vibrator - Applications-Missing pulse detector - Pulse width modulator - Schmitt's trigger – Voltage controlled oscillator.

BOOKS FOR STUDY

1. D Chattopadhyay, P C Rakshit, B Saha, N.Purkait, Foundations of Electronics- New Age International Publishers, New Delhi (2006).
2. Roy Choudry , Operational Amplifier and Integrated Electronics, New Age International Publishers, New Delhi (2006).
3. B.L. Theraja, Basic Electronics- S.Chand and Co., **New** Age (2006).
4. J. Milmann and C.C. Halkias, Integrated Electronics, Mc Graw Hill , New Delhi.

BOOKS FOR REFERENCE

1. V. K. Mehta, Rohit Mehta , Principles of Electronics- S.Chand and Co, **New** Delhi, (2008).
2. A.Mottershed, Semiconductor Devices and Applications - New Age Int. Pub, New Delhi.

Course Outcomes: The Learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recognize the working of different Semiconductor devices	PSO 6	R, U
CO-2	Describe the function of special semiconductor devices	PSO 6	U, Ap
CO-3	Apply the characteristics of operational amplifier for different circuits	PSO 6	U, Ap
CO-4	Op-amp as oscillators and digital convertors is learnt	PSO 6	U, Ap
CO-5	Understand IC fabrications and to know the fundamentals of 555 timer in Applications of op-amp and 555 Timer	PSO 6	U, Ap

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FIRST YEAR - SEMESTER II

Course Title	MAJOR CORE VI:Atomic and Molecular Spectroscopy
Total Hours	90
Hours/Week	6
Code	P19PH6
Course Type	Theory
Credits	5
Marks	100

Course Objectives (COB):

To enable the learner to

CO No.	Course Objectives
COB-1	Understand the fundamentals of spectroscopy
COB-2	Understanding the impact of atoms placed in the external fields
COB-3	Concept of microwave spectroscopy is well explained
COB-4	Analyse the Raman spectroscopic methods
COB-5	Understand the advanced mechanism like NMR, ESR methods of spectroscopy

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Core Course - VI - ATOMIC AND MOLECULAR SPECTROSCOPY

Semester - II **Course Code : P19PH6**

Instruction hrs. /week: 6 hrs. **Credit : 5**

UNIT- I: COUPLING SCHEMES AND SPIN INTERACTIONS

Concept of Vector atom model and its quantum numbers-Stern –Gerlach experiment – Fine structure of hydrogen lines – Spin orbit interaction –Lande "g" factor– LS-JJ coupling schemes –Pauli's exclusion principle and its physical significance-Periodic table-Alkali type spectra-Equivalent electrons-Hund's rule.

UNIT- II: ATOMS IN EXTERNAL FIELDS AND QUANTUM CHEMISTRY

Atoms in external fields: Zeeman effect-Paschen-Back effect-and its quantum mechanical treatment- Zeeman effect-Paschen-Back effect in two electron systems-selection rules-Stark effect.

Quantum chemistry of molecules: Born-Oppenheimer approximation-Heitler-London and molecular orbital theories of hydrogen molecule-Bonding and anti-bonding MOs-Huckel's molecular approximation-Application to butadine molecule.

UNIT- III: MICROWAVE AND IR SPECTROSCOPY

Classification of molecules-Rotational spectra of diatomic molecules-Effect of isotropic substitution-Non- Rigid rotator-Rotational spectra of polyatomic molecules-Linear, symmetric top and asymmetric top molecules-Experimental techniques-Vibrating diatomic molecule-Diatomic vibrating rotator-Linear and symmetric top molecules-Analysis of infra Red techniques-Characteristic and group frequencies-IRspectrophotometer:Instrumentation and sample handling.

UNIT- IV: RAMAN AND ELECTRONIC SPECTROSCOPY

Raman effect: Classical and quantum theory of Raman effect- Pure rotational and vibrational Raman spectra of diatomic molecules-Raman spectrometer.

Electronic spectroscopy of diatomic molecules: Vibrational coarse structure-Progressions and sequences-Franck-Condon principle-Dissociation energy and dissociation products-Rotational fine structure of electronic vibration transitions.

UNIT- V: RESONANCE SPECTROSCOPY

Nuclear magnetic resonance: Magnetic properties of nuclei-Resonance condition-NMR instrumentation-Additional techniques-Relaxation processes-Bloch equation-Dipolar interaction-Chemical shift.

Electron Spin Resonance: Principle-ESR spectrometer-Total Hamiltonian-Hyperfine Structure-Spectra of free radicals in solution.

Books for Study

1. C.N. Banwell, Elaine M. Mc Cash, Fundamental of Molecular Spectroscopy, Mc Graw Hill, New Delhi (2010).
2. G. Aruldhas, Molecular Structure and Spectroscopy, PHI Learning Private Limited, New Delhi (2009).
3. Gupta, S.L.Kumar, Sharma, Elements of Spectroscopy, Pragati Prakashan Publication, Meerut (2009).

Books for Reference

1. P.S.Sindhu, Elements of Molecular Spectroscopy, New Age International,(2007).
2. A.K.Chandra, Introductory Quantum Chemistry, Mc Graw Hill, New Delhi(2003).

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recognize the concept of spectroscopy	PSO 6	R, U
CO-2	Describe the application of external fields on an atom	PSO 6	U, Ap
CO-3	Analyse the vibration and rotational spectrum of atom	PSO 6	U, Ap
CO-4	Analyse the Raman spectrograph for different atoms	PSO 6	U, Ap
CO-5	Resonance spectrometric methods is understood	PSO 6	U, Ap

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FIRST YEAR - SEMESTER II

Course Title	MAJOR CORE 7:Quantum Mechanics
Total Hours	90
Hours/Week	6
Code	P19PH7
Course Type	Theory
Credits	4
Marks	100

Course Objectives (COB):

To enable the learner to

CO No.	Course Objectives
COB-1	Understand the fundamentals of quantum mechanics
COB-2	Apply the Schrodinger's equation to some problems
COB-3	Deal with approximations in quantum mechanics
COB-4	Represent the quantum theories
COB-5	Analyze the scattering mechanism through quantum treatment

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Core Course - VII - QUANTUM MECHANICS

Semester - II **Course Code : P19PH7**
Instruction hrs. /week: 6 hrs. **Credit : 5**

UNIT- I: INTRODUCTION TO QUANTUM MECHANICS

Wave – Particle - Dual nature of electron – De-Broglie wave length derivation – Wave (Eigen)function – Normalization technique – Orthonormal technique – Operator formalism – Total energy, momentum, kinetic and potential energy operators – Ehrenfest theorem - Derivation of Schrodinger's equation(time dependent and independent).

UNIT- II: EXACTLY SOLVABLE PROBLEMS

Hydrogen atom – Ground state of deuteron – Linear harmonic oscillator – Particle in a box – Rigid rotator – Zeeman effect semi-classical treatment.

UNIT- III: APPROXIMATIONS

Time dependant – Time independent perturbation theories - Stark effect - W.K.B approximation and its validity – Transition to continuum states "Fermi's Golden rule" – Adiabatic approximation.

UNIT -IV: REPRESENTATION THEORY AND IDENTICAL PARTICLES

Variation method - Ground state of Hydrogen atom using variation method - Bracket notation - Harmonic oscillator in matrix theory – Identical particles – Symmetry and anti-symmetric wave functions.

UNIT -V: THEORY OF SCATTERING AND RELATIVISTIC QUANTUM MECH.

Partial wave analysis – Scattering amplitude – Total scattering cross-section – Klein-Gordon equation – Dirac relativistic equation for free particle – Negative energy states.

BOOKS FOR STUDY

1. Gupta, Kumar and Sharma – Quantum Mechanics, S. Chand and Company publications.
2. G. Aruldhas - Quantum Mechanics – PHI Publications(2008).

BOOKS FOR REFERENCE

1. V.Devanathan, Quantum Mechanics, Narosa Publishing House (2005).
2. P.M. Mathews and K.Venkatesan, A Text Book of Quantum Mechanics, Tata McGraw Hill publications, New Delhi (1987).
3. V.K. Thankappan, Quantum Mechanics, Wiley –Eastern, New Delhi (1985).
4. P.G. Puranik, Quantum Particle Dynamics, S. Chand and Company Publications.
5. L. Schiff, Quantum Mechanics – Tata Mc Graw Hill Publications, New Delhi.

Course Outcomes:

The Leaner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Recognize the concept of quantum mechanical tool	PSO 6	R, U
CO-2	Describe the application of Schrodinger's equation to exactly solvable problems	PSO 6	U, Ap
CO-3	Analyzing the approximations of certain problems	PSO 6	U, Ap
CO-4	Quantum tool is represented in different format	PSO 6	U, Ap
CO-5	Scattering mechanism is well understood	PSO 6	U, Ap

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FIRST YEAR - SEMESTER II

Course Title	MAJOR CORE 8: NUCLEAR AND PARTICLE PHYSICS
Total Hours	90
Hours/Week	6
Code	P19PH8
Course Type	Theory
Credits	4
Marks	100

Course Objectives (COB):

To enable the learner to

CO No.	Course Objectives
COB-1	Understand the nuclear structure and nuclear forces through various models
COB-2	Analyze the theories involved in the α, β and γ radioactive decays
COB-3	Remember the basic knowledge about nuclear fission, fusion and astrophysics
COB-4	Understand the various types of nuclear reactions based on nuclear reaction cross sections
COB-5	Understand the elementary particles based on theoretical model and theory

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Core Course - VIII - NUCLEAR AND PARTICLE PHYSICS

Semester - II **Course Code: P19PH8**

Instruction hrs. /week: 6 hrs. **Credit : 5**

UNIT -I: PROPERTIES OF ATOMIC NUCLEI

Nuclear size and shape –Parity- Nuclear forces –Properties of deuteron-Simple theory of ground state of deuteron– Spin dependence of nuclear forces– Singlet and triplet states in deuteron ground state -Properties of nuclear forces - Meson theory of nuclear forces.

UNIT -II: RADIOACTIVE DECAYS

Range of alpha particles and Geiger-Nuttal law – Gamow's theory – Gamma decay and energy - Neutrino hypothesis – Fermi theory of beta decay – Selection rules – Parity violation – Selection rules of gamma radiation – Gas filled detectors – G.M counters -Scintillation counter.

UNIT -III: NUCLEAR REACTIONS AND NUCLEAR MODELS

Reaction Energetics-Q-Value-Threshold energy – Level width- Types of nuclear reactions- Compound nucleus theory – Breit - Wigner formula– Semi empirical mass formula -Liquid drop model-Shell model-Collective model.

UNIT -IV: ACCELERATORS REACTORS AND PLASMA PHYSICS

Linear accelerator-Cyclotron – Synchro cyclotron – Betatron–Nuclear fission – distribution of mass of fission products –Bohr-Wheeler's theory of nuclear fission – chain reaction-Four factor formula-Nuclear reactor- Nuclear fusion- - Stellar energy-Research and power reactors.

UNIT -V: ELEMENTARY PARTICLES

Classification of elementary particles–Fundamental interactions among particles-Quantum numbers specifying states of particles-Discovery of antiparticles-Conservation laws in production and decay processes– Symmetry and conservation laws–Quark model

BOOKS FOR STUDY

1. Sathya Prakash, Text Book of Nuclear and particle Physics, Sultan Chand and Sons, New Delhi (2005).
2. M.L.Pandya and R.P.S Yadav, Elements of Nuclear Physics, Kedar Nath Ramnath, Meerut (2015).

BOOKS FOR REFERENCE

1. V. Devanathan, Nuclear Physics, Narosa Publishing House (2006).
2. S. B. Patel, An Introduction to Nuclear Physics, (Wiley-Eastern) New Delhi (2008).
3. B. L. Cohen, Concepts of Nuclear Physics Tata Mc Graw Hill, New Delhi (1993).
4. D. Griffiths, Introduction to Elementary Particles, Wiley International, New York (1987).
5. Arora. C. L, Nuclear Physics, S.Chand and Co, New Delhi (1999).
6. Sharma.R. C, Nuclear Physics, K. Nath and Co, Meerut (1997).

Course Outcomes:

The Leaner will be able to:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Summarize the properties of atomic nuclei	PSO 3	U
CO-2	Discuss the theories involved in α, β and γ radioactive decays.	PSO 3	U, An
CO-3	Explain the nuclear reactions and its models	PSO 3	R, Ap
CO-4	Discuss about the accelerators	PSO 3	U
CO-5	Understand elementary particles and discuss its classification based on theoretical models	PSO 3	U

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FIRST YEAR - SEMESTER - I

Course Title	MAJOR CORE 9: MAJOR PRACTICALS: II GENERAL AND ELECTRONICS EXPERIMENTS
Total Hours	90
Hours/Week	6
Code	P19PH9P
Course Type	Practical
Credits	5
Marks	100

Course Objectives (COB): To enable the learner to

CO No.	Course Objectives
COB-1	Understand principles of Op-amp and apply it to generate waves, do analog computation and explain its parameters
COB-2	Apply the concept of transistor to amplify the signals and study its characteristics
COB-3	Apply and analyse monostable, bistable and astable multivibrators using IC 555 timer
COB-4	Understand, analyze and apply the principles of different types of oscillators
COB-5	Understand and explain the characteristics of various semiconductor devices

Any FOURTEEN experiments only

1. Determination of q, n, σ by hyperbolic fringes method.
2. Determination of bulk modulus of a liquid using ultrasonic interferometer.
3. Determination the band gap of a semiconductor using four probe method.
4. Determination of e/m ratio of an electron using Thomson's method.
5. Determination of the wavelength of a LASER source and thickness of wire using Plane diffraction grating method.
6. Determine the polarizability of the given liquid by finding the refractive indices at different wavelengths.
7. Determination of Numerical aperture and other parameters of a fiber cable,
8. Determine the specific rotator power of a given liquid using Polarimeter.
9. Reduce the given Boolean expression (both SOP & POS) by forming K-Map and study of it using logic gates.
10. Design and study of Phase shift oscillator using OPAMP IC 741.
11. Design and study of Bi-stable Multivibrator using Transistor.
12. Determine energy loss mechanism of a Schimitt' trigger using IC 741
13. Design and study the 0 -9 and 0 -99 mod counters. Design Mod 20, 40 and 60.
14. Using absorption spectrum analysis determines the dissociation energy of Iodine.
15. Using IC 555 time study the temperature coefficient.
16. V-I characteristics of the Solar cell.

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FIRST YEAR - SEMESTER I

Course Title	ELECTIVE-I: SPECIAL ELECTRONICS– II MICROCONTROLLER AND COMMUNICATION ELECTRONICS
Total Hours	90
Hours/Week	6
Code	P19PH10E
Course Type	Theory
Credits	4
Marks	100

Course Objectives (COB): To enable the learner to

CO No.	Course Objectives
COB-1	Understand the architecture of the microcontroller 8051
COB-2	Get introduced to the assembly language
COB-3	Know the concept of wave propagation through antennas
COB-4	Understand the modulation techniques used in communication
COB-5	Learn the fundamentals of cellular phones and its propagation methods

SYLLABUS

Elective Course – II - SPECIAL ELECTRONICS - II

MICROCONTROLLER AND COMMUNICATION ELECTRONICS

Semester - II **Course Code : P19PH10E**

Instruction hrs /week: 6 hrs. **Credit : 4**

UNIT -I: MICROCONTROLLER ARCHITECTURE - 8051

The 8051 architecture - 8051 oscillator and clock - Program counter data pointer - CPU registers-Flags and the program status word (PSW) -Internal memory- Internal RAM and ROM -The stack and the stack pointers. Special function registers-Signals of 8051-I/O ports -Timers and counters.

UNIT- II: ASSEMBLY LANGUAGE PROGRAMMING CONCEPTS

8051-Programming - 8051 instruction syntax - Moving data: addressing modes – External data moves- Code memory- Read only data moves -Push and pop opcodes-Data exchanges example programs - Logical operations: Byte-level logical operations –Bit level logical operations- Rotate and swap operations- Example programs .

UNIT -III: ANTENNAS AND MICROWAVES

Antennas-Power gain- radiation resistance and effective parameters an antenna-Hertzian dipole-Half wave dipole-Role of parabolic reflector in antennna design-VHF,UHF and microwave antennas: rhombus- log periodic -Discone- Yagi-Uda-helical-horn (design, significance and use only).

Microwave generation and application-Klystron and Magnetron -Wave guides-Rectangular wave guide-Mode of propagation-Circular wave guide-Ridged and flexible wave guides.

UNIT- IV: MODULATION TECHNIQUES

Amplitude Modulation: Theory of AM- Double sideband supressed carrier-Single Side Band principle (SSB)-Balanced modulator-SSB generation of AM and SSB signals.

Frequency Modulation: Theory of Angle modulation (FM and Phase modulation)- FM Methods-direct and indirect- FET reactance modulator

Digital Modulation: Pulse code modulation-Delta modulation-Differential PCM-Demodulation of pulse digital modulated signals

UNIT- V: CELLULAR TELEPHONE AND SATELLITE COMMUNICATIONS

Evolution of cellular telephone -Analog cellular telephone - personal communication system, Digital cellular telephone, Global system for mobile communication.

Kepler's laws – Orbits - Geostationary orbit-Altitude and attitude control-Satellite station keeping-Transponders uplink-Power budget calculation-Down link power budget calculations - Multiple access methods.

BOOKS FOR STUDY

1. Kenneth J.Ayala, the 8051 Microcontroller, Architecture, Programming and Applications.
2. Krishnakanth, Microprocessors and microcontroller, Prentice Hall of India (2013).
3. G.Kennedy, Electronic communication systems, TATA Mc Graw Hill publications, New Delhi (2003).
4. Dennis Roddy,John Coolen, Electronic Communications-IV Edition, Prentice Hall of India (2004).
5. Wayne Tomasi, Electronic Communication systems, Pearson Education.

BOOKS FOR REFERENCE

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram International Publishing (India) Private Limited, Fifth Edition.
2. Gupta S.L and Kumar - Hand book of Electronics, Pragati Prakasan Publications.
3. B.Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai publication (P)Ltd, New Delhi, Fifth Reprint (1998).
4. P.S. Manoharan, Microprocessors and Microcontroller – Charulatha Publications (2013).

Course Outcomes: The learner will be able to

CO No.	Course Objectives
CO-1	Understand the architect of the microcontroller 8051.
CO-2	Program in the assembly language.
CO-3	Understand the concept of wave propagation through antennas.
CO-4	Explain the modulation techniques used in em wave assisted communication.
CO-5	Explain the fundamentals of cellular phones and its signal propagation methods.

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SECOND YEAR - SEMESTER – III

Course Title	MAJOR CORE - 11: ELECTROMAGNETIC THEORY
Total Hours	90
Hours/Week	6
Code	P19PH11
Course Type	Theory
Credits	5
Marks	100

Course Objectives (COB):

To enable the learner to

CO No.	Course Objectives
COB-1	Understand Green's function and apply it to find the boundary value problems in electrostatics.
COB-2	Understand the basic laws in magneto statics and apply it to find its boundary condition.
COB-3	Understand the concepts of displacement current and apply it to derive Maxwell's equation.
COB-4	Analyze and compare the propagation of plane electromagnetic waves in different medium.
COB-5	Apply and analyze the concepts of interaction of electromagnetic waves with macroscopic matter.

SYLLABUS
Core Course – XI- ELECTROMAGNETIC THEORY

Semester - III **Course Code: P19PH11**
Instruction hrs. /week: 6 hrs. **Credit : 5**

UNIT - I: INTRODUCTION TO ELECTROSTATICS

Coulomb's law – Electric field –Electrostatic potential- Electric field and potential of a Dipole- Gauss law – Applied to 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

Ampere'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 Newmann 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 and Φ) – Maxwell's equations in terms of Electromagnetic potential- Gauge transformations – Lorentz gauge.

UNIT - IV: PLANE ELECTRO MAGNETIC WAVES AND WAVE PROPAGATION

Plane wave equation – Propagation of e.m. waves in free space - in a nonconducting 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 — Radiation patterns of antennas – Gain of an antenna – Linear array of antennas (N-arrays) – Qualitative analysis of a dipole antenna.

BOOKS FOR STUDY

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

BOOKS FOR REFERENCE

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

Course Outcomes: The learner will be able to:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Solve electrostatic boundary value problems using Green's function.	PSO 1	U, Ap
CO-2	Describe the boundary condition in magneto statics.	PSO 3	U
CO-3	Connect electrostatics and magneto statics.	PSO 3	U, Ap
CO-4	Derive Maxwell's equation in differential and integral form.	PSO 3	U
CO-5	Discuss the propagation of electromagnetic waves in different medium and its interaction with matter	PSO 2	U, Ap

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SECOND YEAR - SEMESTER – III

Course Title	MAJOR CORE - 12: CRYSTAL GROWTH AND ITS CHARACATERISATION TECHNIQUES
Total Hours	90
Hours/Week	6
Code	P19PH12
Course Type	Theory
Credits	5
Marks	100

Course Objectives (COB):

To enable the learner to

CO No.	Course Objectives
COB-1	Understand the fundamentals of crystal growth and nucleation
COB-2	Analyse the low temperature method of crystal growth
COB-3	Understand the melt growth technique of crystal growing
COB-4	Be aware of Thin film formation through vapour deposition
COB-5	Introduce Characterization techniques

SYLLABUS

Core Course – XII CRYSTAL GROWTH AND ITS CHARACTERISATION TECHNIQUES

Semester - III **Course Code: P19PH12**

Instruction hrs. /week: 6 hrs. **Credit : 5**

UNIT -I: NUCLEATION AND GROWTH

Nucleation –Classical theory of nucleation - Spherical and cylindrical nucleus - Growth Kinetics - Singular and rough faces- Models on surface roughness- Kossel, Stranski, Volmer (KSV) theory- Burton, Cabrera, Frank (BCF) theory.

UNIT -II: LOW TEMPERATURE GROWTH TECHNIQUES

Solution Growth Technique: Solution - Solubility and super solubility – Expression of super saturation – Mier's T-C diagram - Constant temperature bath and crystallizer – Seed preparation and mounting - Slow cooling and solvent evaporation methods.

Gel Growth Technique: Principle – Various types – Structure of gel – Importance of gel – Experimental procedure–Chemical reaction method – Single and double diffusion method – Chemical reduction method –Complex and decomplexion method – Advantages of gel method.

UNIT- III: MELT AND VAPOUR GROWTH TECHNIQUES

Melt Growth: Bridgman technique - Basic process – Various crucibles design - Thermal consideration – Vertical Bridgman technique - Czochralski technique – Experimental arrangement – Growth process.

Vapour Growth: Physical vapour deposition – Chemical vapour deposition (CVD) – Chemical Vapour Transport.

UNIT- IV: THIN FILM DEPOSITION TECHNIQUES

Introduction- Thin film growth stages- Application of thin films- Properties of thin films – Deposition techniques - Physical methods– Chemical methods- Resistive heating, Electron beam gun, Laser gun evaporation and flash evaporations, sputtering - Reactive Sputtering, Radio-Frequency sputtering - Chemical methods – Spray pyrolysis – Preparation of TCO tin oxide thin films .

UNIT- V: CHARACTERIZATION TECHNIQUES

X – Ray Diffraction (XRD) – Powder and single crystal - Fourier Transform Infra Red Analysis(FT-IR) – Elemental analysis – Elemental Dispersive X-ray Analysis (EDAX) - Scanning Electron Microscopy (SEM) – UV-Vis-NIR Spectrometer – Etching (Chemical) – Vicker's micro hardness.

BOOKS FOR STUDY

1. J.C. Brice, Crystal Growth Processes, John Wiley and Sons, New York (1986).
2. P. Santhana Ragavan and P. Ramasamy, Crystal Growth Processes and Methods, KRU Publications, Kumbakonam (2006).
3. A. Goswami, Thin Film Fundamentals, New Age International (P) Limited, New Delhi (1996).
4. Kasturi L. Chopra, Thin film Phenomena, McGraw Hill Book Company (1969).

BOOK FOR REFERENCE

1. Smith Donald. L, Thin Film Deposition, McGraw Hill, London (1995).

Course Outcomes:

The learner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Grow crystal using a simple technique	PSO 1	U, Ap
CO-2	Understand laboratory technique of growing crystal	PSO 3	U
CO-3	Understand the High level technique of melt growth	PSO 3	U, Ap
CO-4	Understand the formation of thin film mechanism	PSO 3	U
CO-5	Analyze and characterize the grown crystals	PSO 2	U, Ap

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SECOND YEAR - SEMESTER - III

Course Title	**MAJOR CORE 18: MAJOR PRACTICAL: III ADVANCED ELECTRONICS – I DIGITAL AND MICROPROCESSOR**
Total Hours	**90**
Hours/Week	**6**
Code	**P19PH13P**
Course Type	**Practical**
Credits	**5**
Marks	**100**

ADVANCED ELECTRONICS –I

Any FOURTEEN experiments only

1. Scalar or Modulus counter
2. Study the function of Decoder and Encoder
3. Digital comparator
4. Study of DAC interfacing (DAC 0900).
5. Study of ADC interfacing (ADC 0809).
6. Digital to Analog Converter - R-2R and weighted methods.
7. Study the function of Multiplexer and Demultiplexer.
8. Traffic control system using microprocessor.
9. Control of stepper motor using microprocessor.
10. Digital Clock using microprocessor.
11. Construction of all Flip-Flops using gates
12. Solving linear equations by Operational Amplifier.
13. Construction of RAM cells.
14. Study of ALU
15. Voltage control oscillators
16. Up-Down counter using J-K Flip-Flops
17. Shift registers – all modes of operations
18. Regenerative waveform using 555 timer

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SECOND YEAR - SEMESTER – III

Course Title	ELECTIVE COURSE-III: NUMERICAL METHODS AND C PROGRAMMING
Total Hours	90
Hours/Week	6
Code	P19PH14E
Course Type	Theory
Credits	4
Marks	100

Course Objectives (COB):

To enable the learner to

CO No.	Course Objectives
COB-1	Understand the fundamentals of error and measurements
COB-2	Analyzing the transcended equations and algebraic methods
COB-3	Learn the concept of interpolation methods
COB-4	Apply numerical techniques to differentiation and integration
COB-5	Use C program to apply for numerical techniques

SYLLABUS

Elective Course – III NUMERICAL METHODS AND C PROGRAMMING

Semester-III **Course Code: P19PH14E**

Instruction hrs /week: 6 **Credit : 4**

UNIT- I: ERRORS AND MEASUREMENTS

General formula for Errors-Errors and its Types-Graphical Method - Empirical formula -Principle of Least Squares- Fitting a straight line-Fitting a Parabola-Fitting an Exponential Curve-Fitting the curve ($y=ax^b$)

UNIT -II: ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

The Iteration Method –Method of false position-Newton-Raphson method – Convergence of Newton-Raphson Method – Bisection method – Order of Convergence for N-R Method.

Linear Algebraic Equations

Gauss Elimination method-Jordan's modification-Gauss-Seidel method of Iteration.

UNIT- III: INTERPOLATION

Linear Interpolation-Gregory-Newton forward and Backward Interpolation formula-Central difference formula-Gauss forward and backward interpolation formula-Lagrange's interpolation formula-Newton's formula for unequal Intervals.

UNIT- IV: NUMERICAL DIFFERENTIATION AND INTEGRATION

Numerical Differentiation for solving first order differential equations:-Euler's method-Improved Euler's method -Runge-Kutta second and fourth order method for solving first order differential equations-

Numerical Integration: Trapezoidal rule-Simpson's $1/3^{rd}$ rule-formula and derivation.

UNIT- V: C PROGRAMS

Structure of a C program-Primary data types-Constants-Integers-Various types of operators and expressions-Control structure-if-if-els**e**– go to – while – do, while – for statements-declaration and initialization of arrays(1-d,2-d)-Functions-Calling a function-Return values and their types.

Development of C program for

1)Fitting a straight line, 2)Newton-Raphson method, 3)Lagrange's Interpolation

4)Euler's method, 5)R.K Second order, 6)Trapzoidal rule

BOOKS FOR STUDY

1. B.P.Flannery, S.A.Teukolsky, W.T.Vetterling, Numerical Recipes in C, W.H. Press, Cambridge University (1996).
2. M.K.Venkataraman, Numerical methods in Science and Engineering, National Publishing Company, Chennai (2004).
3. E.Balagurusamy, Programming in ANSI – C, Tata McGraw Hill publications (2004).

BOOKS FOR REFERENCE

1. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, New Delhi (2003).
2. Numerical Methods in Science and Engineering – The National Publishing Co. Madras (2001).
3. Veerarajan, Numerical Methods in C and C++, S. Chand, New Delhi (2006).

Course Outcomes:

The leaner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Define the error and measurements	PSO 1	R, U
CO-2	Explain the Transcendental techniques	PSO 2	U, Ap
CO-3	Apply the interpolation formula	PSO 4	U, An
CO-4	Apply numerical methods for differential and integral equations	PSO 3	U, Ap
CO-5	Apply C program for numerical techniques	PSO 4	U, Ap

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SECOND YEAR - SEMESTER – III

Course Title	ELECTIVE COURSE-IV: BASICS OF NANOSCIENCE AND ITS APPLICATION
Total Hours	90
Hours/Week	6
Code	P19PH15E
Course Type	Theory
Credits	4
Marks	100

Course Objectives (COB):

To enable the learner to

CO No.	Course Objectives
COB-1	Know the types of nano materials
COB-2	Understand the properties and synthesis of CNTs
COB-3	Understand the synthesis of nano systems
COB-4	Learn the characterizing techniques of nano systems
COB-5	Be aware of the application of nano systems

SYLLABUS

Elective Course – III BASICS OF NANOSCIENCE AND ITS APPLICATIONS

Semester - III **Course Code: P19PH15E**

Instruction hrs /week: 6 **Credit: 4**

UNIT -I: INTRODUCTION TO NANO AND TYPES OF NANOMATERIALS

Nanoscience and nanotechnology – Need for nano - Origins of concepts of nano-Nano and energetics – Top down and Bottom up approaches – Types of nanomaterials (introductory ideas only):One dimensional(1D)– Two dimensional(2D)- Three dimensional(3D) nanostructured materials – Quantum dots – Quantum wire-Quantum well – Quantum Dot – Excitation confinement in Quantum Dots.

UNIT-II: NANO STRUCTURES EFFECTS

Fullerenes - Properties of fullerenes-Carbon Nano Tubes (CNTs)- Types, properties, synthesis and applications of CNTs. -Polymers – Biomimetics – Self assembled monolayers – Nano structured metals and alloys – Semiconductors – Band gap engineering and optical response.

UNIT-III: UNDERSTANDING AND SYNTHESIS OF NANO SYSTEMS

Nano materials variety – Micro emulsion based methods for Nano materials - Salvo-thermal synthesis – Magnetic Nano materials – Anisotropic Nano materials – Exciton confinement in Quantum dots – Quantum mechanics of confined Nano clusters – Band gap engineering and optical response.

UNIT- IV: NANOMATERIAL CHARACTERIZATION

Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Scanning Probe Microscopy (SPM) techniques-(Principle, experimental set up, procedure and utility for the all the techniques)

UNIT- V: APPLICATIONS

Molecular electronics and Nano electronics – Nano dots- Biological applications of Nanoparticles- Catalysis by gold Nanoparticles - band gap engineered quantum devices-Nano mechanics - CNT emitters- Photo electro chemical cells- Photonic crystals - Plasmon Waveguides.

BOOKS FOR STUDY

1. T. Pradeep et al., A text book of Nano science and Nanotechnology, TMGH, New Delhi(2012).
2. Guozhong Cao, Nanostructures and Nano materials, Imperial College Press, London(2004).
3. C.P. Poole and F.J. Owens, Introduction to Nanotechnology, Wiley-India (2009).

BOOKS FOR REFERENCE

1. Lusia Filipponian Duncan Sutherland, Nanotechnologies: Principles, Applications, Implications and Hands-on Activities (ISBN 978 -92 -79 -21437 -0) European Commission, B-1049 Brussels (2013).
2. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, (2002).
3. M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Overseas Press India Pvt. Ltd, New Delhi, First Edition (2005).
4. S. Shanmugam, Nanotechnology, MJP Publishers, Chennai (2010).
5. Lynn E. Foster, Nano Technology, Science, Innovations and Opportunity,Pearson Educations(2010).
6. Suhas Bhattacharya, A Text book of Nano Science and Technology,Wisdom Press.
7. Subbiah Balaji, Nano Biotechnology, MJP Publishers.

Course Outcomes:

The Leaner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the types of nano materials	PSO 1	R, U
CO-2	Analyse the properties and synthesis of CNT	PSO 2	U, Ap
CO-3	Analyse the synthesis of nano systems	PSO 4	U, An
CO-4	Characterize the nano system techniques	PSO 3	U, Ap
CO-5	Explain the application of nano systems	PSO 4	U, Ap

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SECOND YEAR - SEMESTER – III

Course Title	MAJOR CORE -XVI: CONDENSED MATTER PHYSICS
Total Hours	90
Hours/Week	6
Code	P19PH16
Course Type	Theory
Credits	5
Marks	100

Course Objectives:

To enable the learner to

CO No.	Course Objectives
COB-1	Understand the basic idea about crystal physics and to determine the Crystal Structure by different methods
COB-2	Identify the Lattice Vibrations in solids and to measure the electrical and thermal conductivity of metals by studying Band Theory of Solids
COB-3	Know electric conductivity and band theory of the materials
COB-4	Understand all the magnetic properties of materials
COB-5	Familiarize with the basic concepts of the occurrence of Super Conductivity and to study the characteristic properties, types and applications of superconductors

SYLLABUS

Core Course - XVI - CONDENSED MATTER PHYSICS

Semester - IV **Course Code: P19PH16**

Instruction hrs. /week: 6 hrs. **Credit : 5**

UNIT- I: CRYSTAL STRUCTURE

Crystals- Lattice representation - Simple symmetry operations - Bravais Lattices- Unit cell- Wigner -Seitz cell - Miller planes and spacing - Characteristics of cubic cells - Structural features of NaCl, CsCl, Diamond, ZnS – Close packing –X-ray diffraction – The Laue equations – Equivalence of Bragg and Laue equations – Interpretation of Bragg equation –- Powder and single crystal diffraction methods - Diffractometers.

UNIT- II: LATTICE VIBRATIONS AND THERMAL PROPERTIES

Vibration of monoatomic lattices – Lattices with two atoms per primitive cell – Phonon momentum – Inelastic scattering of neutrons by phonons –Dulong and Petit's Law– Einstein model – Density of modes in one-dimension and three-dimension – Debye model of the lattice heat capacity – Thermal conductivity – Umklapp process.

UNIT- III: ELECTRICAL PROPERTIES OF METALS AND SEMICONDUCTORS

Free electron gas- Ohm's law- Electrical conductivity and thermal conductivity- Wiedemann and Franz ratio- Quantum theory free electrons - Free electron gas in one dimension and three-dimension-Band theory of solids – The Kronig Penny model – Brillouin zone (Basic idea only) – Semiconductors –Intrinsic semiconductor-Carrier concentration in intrinsic Semiconductor-Hall effect-Experimental determination of Hall coefficient.

UNIT- IV: MAGNETIC PROPERTIES OF MATERIALS

Terms and definitions used in magnetism – Classification of magnetic materials – Atomic theory of magnetism– Langevin's classical theory of diamagnetism — Langevin's classical theory of paramagnetism – Quantum theory of paramagnetism –- Ferromagnetism – Weiss molecular field – Temperature dependence of spontaneous magnetization – The physical origin of Weiss molecular field - Ferromagnetic domains - Domain theory – Antiferromagnetism – Ferrimagnetism – Structure of ferrite.

UNIT-V: SUPERCONDUCTIVITY

Occurence of superconductivity - Meissner effect – Type I and Type II superconductors - Heat capacity - Energy gap - Microwave and infrared properties - Isotope effect - Thermodynamics of the superconducting transition - London equation - Coherence length - BCS theory of superconductivity- BCS ground state - Flux quantisation in a superconducting ring - Duration of persistence currents - Single particle tunneling - DC Josephson effect - AC Josephson effect - Macroscopic quantum interference – High temperature superconductors – Applications.

BOOKS FOR STUDY

1. Yu. L.S Irotin, M.P. Shaskolskaya, Fundamental of Crystal Physics, Mir Publics Moscow (1983).
2. C. Kittel, Introduction to Solid State Physics, Wiley Eastern, New Delhi (2008).
3. M. M. Woolfson, An Introduction to X-ray Crystallography, Cambridge University Press, Cambridge (1970).
4. S. O. Pillai, Solid State Physics, New Age International, New Delhi (2007).

BOOKS FOR REFERENCE

1. N. W. Ashcrof and N. D. Mermin, Solid State Physics, Holt, Rinehart and Winston, Philadelphia (1976).
2. J. S. Blakemore, Solid State Physics, Cambridge University Press, Cambridge (1974).
3. A. J. Dekker, Solid State Physics, McMillan, Madras(1998).
4. HP Myers A Compendium based on Introductory Solid State Physics, C & C Press (1997).

Course Outcomes:

The Leaner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Define the crystal lattice, to differentiate the 2D and 3D crystal systems and determine the crystal structure by different methods.	PSO 1	R, U
CO-2	Explain the Lattice Vibrations in solids to measure the electrical and thermal conductivity of metals	PSO 2	U, Ap
CO-3	Distinguish the Dielectric and Magnetic Properties of the materials.	PSO 4	U, An
CO-4	Understand the fundamentals of magnetic properties	PSO 3	U, Ap
CO-5	Explain the occurrence of Super Conductivity, properties, types and applications of superconductors.	PSO 4	U, Ap

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SECOND YEAR - SEMESTER - IV

Course Title	MAJOR CORE –XVII: MAJOR PRACTICAL III: ADVANCED ELECTRONICS – MICROCONTROLLER AND COMPUTER PROGRAMS
Total Hours	**90**
Hours/Week	**6**
Code	**P19PH17P**
Course Type	**Practical**
Credits	**5**
Marks	**100**

Course Objectives (COB):

To enable the learner to

CO No.	Course Objectives
COB-1	Learn to work on all microcontroller fundamentals
COB-2	apply the concept for certain mathematical operations
COB-3	i/o interfacing techniques are learnt
COB-4	Fundamentals of C program are analyzed
COB-5	C program are learnt for certain numerical methods

Core Course – XVII : ADVANCED ELECTRONICS -II - MAJOR PRACTICAL: IV ADVANCED ELECTRONICS–MICROCONTROLLER AND COMPUTER PROGRAMS – P19PH17P

Any FOURTEEN experiments only

Programs using Micro-Controller

1. Microcontroller- 8-Bit addition and subtraction.
2. Microcontroller- 8 Bit multiplication and division.
3. Microcontroller- 16Bit division and multiplication.
4. Microcontroller- Ascending and Descending order.
5. Microcontroller- Largest and Smallest number in a given array of numbers.
6. Sum of the given array.
7. Micro-Controller I/O interfacing-Application-I
8. I/O interfacing-Application-II
9. I/O interfacing-Application-III

COMPUTER PROGRAMS

1. Roots of algebraic equations - Newton-Raphson method.
2. Least-squares curve fitting – straight-line fit
3. Least-squares curve fitting – exponential fit.
4. Solution of simultaneous linear algebraic equations – Gauss elimination method.
5. Solution of simultaneous linear algebraic equations – Gauss-Seidal method.
6. Interpolation – Lagrange method.
7. Numerical differentiation – Euler method.
8. Solution of ordinary differential equations – Runge-Kutta 2^{nd}order method.
9. Evaluation of definite integrals – Monte Carlo method.
10. Numerical integration –Trapezoidal rule
11. Numerical integration –Simpson's 1/3rd rule.
12. Solution of ordinary differential equations – Runge-Kutta 4^{th} order method.
13. Calculation of mean, standard deviation and probability distribution of a set of random numbers.

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SECOND YEAR - SEMESTER IV

Course Title	MAJOR CORE XVIII: FIBER OPTICS AND NON-LINEAR OPTICS
Total Hours	90
Hours/Week	6
Code	P19PH18E
Course Type	Theory
Credits	4
Marks	100

Course Objectives (COB):

To enable the learner to

CO No.	Course Objectives
COB-1	Understand the basic idea fiber optical sources
COB-2	Analyse the communication components that suits optical communication
COB-3	Learn about the transmission characteristics of optical fibers
COB-4	Understand the fundamentals of non-linear optical techniques
COB-5	Understand the materials required for NLO communication systems

SYLLABUS

Elective Course –XVIII: FIBER OPTICS AND NON-LINEAR OPTICS

Semester - IV **Course Code: P19PH18E**

Instruction Hrs /week: 6 hrs. **Credits : 4**

UNIT- I: FIBER OPTICAL SOURCES

Operational principle in LED and Laser- External quantum efficiency of LED - LED modulation bandwidth- Coupling of LEDs with fiber- Edge emitting LEDs- Preparation of materials for LEDs- Fiber lasers- Super fluorescent fiber laser- Super luminescent diode.

UNIT- II: FIBER OPTIC COMMUNICATION COMPONENTS AND SYSTEM

Coupling components- Modulation methods and modulators-Switches-Transmitters-Receivers- Repeaters- Solitons-Wavelength Division Multiplexing (WDM)-Optical Time Division Multiplexing (TDM) - Data buses- LAN systems- SONET, SDH, ISDN, BISDN networks- Microwave technical applications of light wave systems

UNIT- III: TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS

Attenuation-Losses: Material absorption-Linear scattering-Non-linear scattering-Fiber bending- Dispersion-Intermodal – Intra modal and overall fiber dispersion- Dispersion shifted fibers- Dispersion flattened fibers- Modal birefringence.

UNIT- IV: NON-LINEAR OPTICS

Harmonic generation-Second Harmonic Generation- Phase matching -Third Harmonic Generation-Optical mixing: sum and difference frequencies-Parametric Generation of light-Self-focusing of intense light beams-Phase matching-Optical Matching-Advantages -Applications.

UNIT- V: NON LINEAR OPTICAL MATERIALS

Basic requirements-In-Organics-Borates-Organics-Urea- Nitro aniline-Semi organics-Thio Urea complex-Laser induced surface damage threshold-Kurtz and Perry powder technique.

BOOKS FOR STUDY

1. D.C. Agarwal, Fiber Optic Communication, Sultan Chand, New Delhi (2009).
2. John M. Senior, Optical Fiber Communications, Prentice Hall India, 2nd Edition (2005).
3. B. B. Laud, Lasers and Non-Linear Optics, New Age International Publishers, New Delhi (2008).
4. Lecture notes and course material: NLO Materials, Department of Physics, NCT.

BOOKS FOR REFERENCE

1. Govind .P. Agrawal, Nonlinear Fiber Optics, Third Edition, Academic Press (2001).
2. Govind. P. Agarwal, Fiber-Optics Communication Systems, 3rd Edn. John Wiley and Sons, Singapore (2003).

Course Outcomes:

The leaner will be able to

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand the basic idea fiber optical sources	PSO 1	R, U
CO-2	Analyse the communication components that suits optical communication	PSO 2	U, Ap
CO-3	Learn about the transmission characteristics of optical communication	PSO 4	U, An
CO-4	Understand the fundamentals of non-linear optical techniques	PSO 3	U, Ap
CO-5	Understand the materials require for NLO communication systems	PSO 4	U, Ap

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Course XIX: PROJECT WORK

Course Title	Project Work
Total Hours	180
Hours/Week	12
Code	P19PH19P
Course Type	Project
Credits	5
Marks	100

Course objective and outcome:

- To facilitate independent learning and research skills in the student in a chosen topic.
- To monitor the progress of the student with a teacher exclusively assigned to supervise him/her.
- To evaluate the performance of the student by assessing the dissertation of the work submitted by the student and with a viva-voce.

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